Chain-store Pricing and the Structure of Retail Markets

by

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Abstract: This paper investigates competition between chain-stores and independents in the UK opticians' industry, using the relationship between the number of outlets present in a local market and the market size. Chain-stores are shown to have a significant effect on local market competition. In addition, the empirical approach is extended to allow inferences on the nature and extent of product differentiation. The results are broadly consistent with a model of vertical product differentiation in which chain-stores adopt national pricing strategies. The evidence suggests that the nature of competition between independent retailers depends on whether a chain-store is present.

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1 Introduction

Chain-stores are becoming an increasingly significant form of retailing across UK high-streets. Many markets are now dominated by chain-store retailers including food supermarkets, clothes stores, restaurants and bars. In the UK retail sector multiple retailers increased their market share from around 23% in 1950 to 65% by 1995[1] and casual observation suggests that this figure has continued to rise. Various empirical studies suggest that this has a negative effect on smaller independent retailers. There is therefore widespread concern in particular due to the effects on product choice and the impact on local economies.[2]

Deregulation of the opticians' industry in the mid 1980s brought about many significant changes, particularly the removal of restrictions on advertising and the possibility of entry by unregistered suppliers.[3] Since deregulation, there has been rapid entry and growth of chain-store retailers, who have rapidly increased their market share from 46% to 75% from 1985 to 1991[4] and since then have continued to grow in importance. However, these chain-stores also compete with independent retailers at a local level, at least in terms of consumer search behaviour. Also, the infrequency of purchases means consumers typically choose between one of the chain-stores or the independent retailers located within the local market. This is in contrast to other retail markets such as the supermarket industry, where consumers typically visit smaller convenience stores as well as 'one-stop' shops. These features mean the opticians' industry is ideal for studying the effect chain-stores have on local market competition. For clarity, henceforth; outlet will be used to refer to an individual optician premise, chain-store to a chain of outlets under common ownership and chain-stores for several chains of outlets. In *Section 3*, a precise definition to distinguish between chain-stores and independents in the UK opticians' market will be given.

This paper investigates competition and the nature and extent of product differentiation between chain-stores and independent retailers within local retail markets, using evidence on the relationship between the number of outlets present in a local market and market size in the UK opticians' industry. The approach

[1] Burt and Sparks (2003).
[2] See for example; Daunfeldt et al (2005), New Economics Foundation (2005) and House of Commons, All-Party Small Shops Group (2006).
[3] See Davies et al (2004) Ch 2 for a discussion of the impact of deregulation on competition.
[4] Figures from Fulop and Warren (1993).

taken in this paper draws on two separate but related streams of literature. First, following the tradition of Bresnahan and Reiss (B&R) (1991) inferences are drawn about competitive conduct by examining the size of market needed to support a given number of outlets. Recent literature has examined the determinants of entry more explicitly. Toivanen and Waterson (2005) for example, study the entry patterns of McDonalds and Burger King in the UK hamburger market. The presence of a rival store is found to provide information on market size and thus make entry more likely. Also, some evidence of product differentiation between firms is found.

Based on the B&R approach Dinlersoz (2004) models competition in local markets between chain-stores and independent retailers using a model of vertical product differentiation, in which the independent retailers are assumed to provide a higher quality product. His model predicts how the number of independent and chain-store retailers in a local market changes as the market size increases. The predictions of the model are supported by evidence from the Californian retail alcoholic beverage industry. In this industry the assumption that independent retailers produce a higher quality product (and therefore charge a higher price) is made as it is argued that they are niche firms selling more specialised products.

Morton and Podolny (2002) suggest sellers' utility maximization behaviour as an alternative explanation for independent retailers producing a higher quality product. Utility maximization behaviour is shown to prevent profit maximizing firms from entering niche, high quality segments of the market, with empirical evidence from the Californian wine industry. However, in other industries it appears that chain-stores charge higher prices than competing independent retailers. Loertscher and Schneider (2005) provide evidence on prices for bus tickets and a cup of coffee as examples where a chain-store retailer charges a higher price for a seemingly homogeneous product. The explanation given is that chain-stores located in numerous local markets, can charge higher prices to exploit the search costs faced by consumers who visit an unfamiliar local market but know the chain-store's price from other markets. Importantly, the chain-store is assumed to set an identical price in all local markets, this strategic decision is the focus of the second, related stream of literature.

This literature focuses on the strategies chain-stores adopt when competing in local markets. In particular the question of whether chain-stores set prices according to local market conditions or set an identical national price for all retail outlets owned. In a series of recent theoretical papers Dobson & Waterson (2005a 2005b) model this strategic decision faced by chain-stores to show that under certain circumstances it can be profitable for a chain-store to set a national price. In contrast Montgomery (1997) suggests that a pricing strategy tailored to local market conditions can significantly increase a firm's profit; however, the danger of a strategy of this kind is that it can affect a chain-store's overall image. Evidence suggests that a significant number of important retail chain-stores adopt national pricing, for example, over half of the UK's leading supermarkets set prices nationally and the competition authorities have expressed concern over the use of local pricing strategies.[5] In the UK retail opticians' market national pricing strategies are adopted by the large retail chains. The Dinlersoz approach will therefore be modified to account for chain-store national pricing strategies. In addition, extending the national pricing model to allow for heterogeneity between chain-stores means that empirical evidence of vertical product differentiation can be examined. Another important difference from the Dinlersoz paper is that this dataset, in addition to markets where chain-stores are present, includes local markets where only independent retailers are present. This allows important comparisons between markets with and without chain-stores to be made.

Section 2 combines the vertical product differentiation model used by Dinlersoz with a national chain-store pricing strategy. Then *Section 3* describes the dataset collected on the UK retail opticians' market and *Section 4* presents the econometric results. In *Section 5* the analysis is extended to allow for heterogeneous chain-stores and examine the extent of product differentiation. *Section 6* further extends the analysis, firstly by considering the determinants of the number of chain-stores present in a market and then comparing markets with and without chain-stores, finally *Section 7* concludes.

2 A model of retail competition

A vertical product differentiation model is used based on that described in Dinlersoz (2004)[6]. The next section will outline the assumptions and then *Section 2.2* explains the predictions from the Dinlersoz model. Then, *Section 2.3* adapts the Dinlersoz model to allow for chain-store national pricing strategies. The differing predictions from the model will then be tested empirically.

[5] Competition Commission (2000).

[6] The assumptions of *Section 2.1* and the results of *Section 2.2* only differ from Dinlersoz (2004) in terms of the notation used.

2.1 Assumptions

There are two types of firms; chain-stores (*subscript* C) producing a low quality product, and a competitive fringe of independent retailers (*subscript* I) producing a higher quality product. Each local market contains S consumers, consumers have heterogeneous tastes for quality with a marginal utility from one unit of quality equal to α where α is uniformly distributed over an interval $[\underline{\alpha}, \overline{\alpha}]$ with $\underline{\alpha} > 0$ and $\overline{\alpha} - \underline{\alpha} = 1$. In addition the market is assumed to be fully covered; i.e. all consumers buy one unit of the product from one of the independent or chain-store retailers. For a consumer of type α the utility derived from a product of quality θ and price p is given by:

$$u(p, \theta; \alpha) = \begin{cases} \alpha\theta - p & if \quad \alpha\theta - p \geq 0 \\ 0 & otherwise \end{cases} \tag{1}$$

The independent retailers are assumed to produce a good of exogenously determined quality θ_I and all chain-stores produce a good of quality θ_C (the assumption of homogeneity between chain-stores well be relaxed in *Section 5*), again exogenously determined and with $\theta_I > \theta_C$. The utility level of the consumer (denoted by $\alpha *$) indifferent between the product offered by the chain-stores and the independent stores can then be defined:

$$\alpha^* = (p_I - p_C)/(\theta_I - \theta_C) \tag{2}$$

Without loss of generality, the quality differential is normalised so that $\theta_I - \theta_C = 1$. From (2) the local market demand functions for the independent retailers and the chain-stores can be derived:

$$D_I(p_I, p_C) = S(\overline{\alpha} - p_I + p_C) \tag{3}$$

$$D_C(p_C, p_I) = S(p_I - p_C - \underline{\alpha}) \tag{4}$$

Fixed costs are denoted as f and variable costs as c. The independent retailers have a total cost function (C_I) defined as:

$$C_I = f_I + c_I q_I^{\,2} \tag{5}$$

This implies a U-shaped average cost function for the independent retailers. The chain-stores are assumed to have a total cost function (C_C) with increasing returns to scale[7] given by:

$$C_C(q_C) = f_C + c_C q_C \tag{6}$$

Both the number of chain-store outlets and independent outlets are determined by the free entry equilibrium. The independent retailers in each local market, as price-takers in a perfectly competitive setting, compete the price down to the level where it is equal to marginal costs at the minimum efficient scale (MES):

$$q_I{*} = (f_I / c_I)^{1/2} \tag{7}$$

$$p_I{*} = 2(f_I c_I)^{1/2} \tag{8}$$

Because the independent retailers produce an output and set a price which is invariant to market size, the number of independent retailers in a local market depends only upon the total demand for the independents' product. This depends upon the proportion of the market served by chain-stores and crucially, as will now be shown in *Sections 2.2* and *2.3*, differs according to the pricing strategies adopted by chain-stores.

[7] The results, as explained in Dinlersoz (2004) pg216, do not require this specific cost function. However the minimum efficient scale for the chain-stores must be sufficiently greater than that for the independent retailers, as this enables the chain-stores to expand output as the market size increases.

2.2 Local pricing by chain-stores

Dinlersoz assumes that all chain-stores, producing a product of equal quality, compete *a la Cournot* taking the price set by the independent retailers as given. The output of each chain-store is found to be[8]:

$$q_C* = f_C^{1/2} S^{1/2} \qquad (9)$$

The total chain-store output (Q_C*) is therefore:

$$Q_C* = N_C * q_C * \qquad (10)$$

Where N_C* is the equilibrium number of chain-store outlets in a local market. As the market is assumed to be fully covered, the independent retailers total output (Q_I*) can be expressed as:

$$Q_I* = S - N_C * q_C * \qquad (11)$$

The equilibrium number of independent outlets (N_I*) is given by:

$$N_I* = Q_I * / q_I * \qquad (12)$$

Substituting if for q_I* from (7), Q_I* from (11) and q_C* from (9):

$$N_I* = \left(S - (N_C * f_C^{1/2} S^{1/2})\right) / (f_I / c_I)^{1/2} \qquad (13)$$

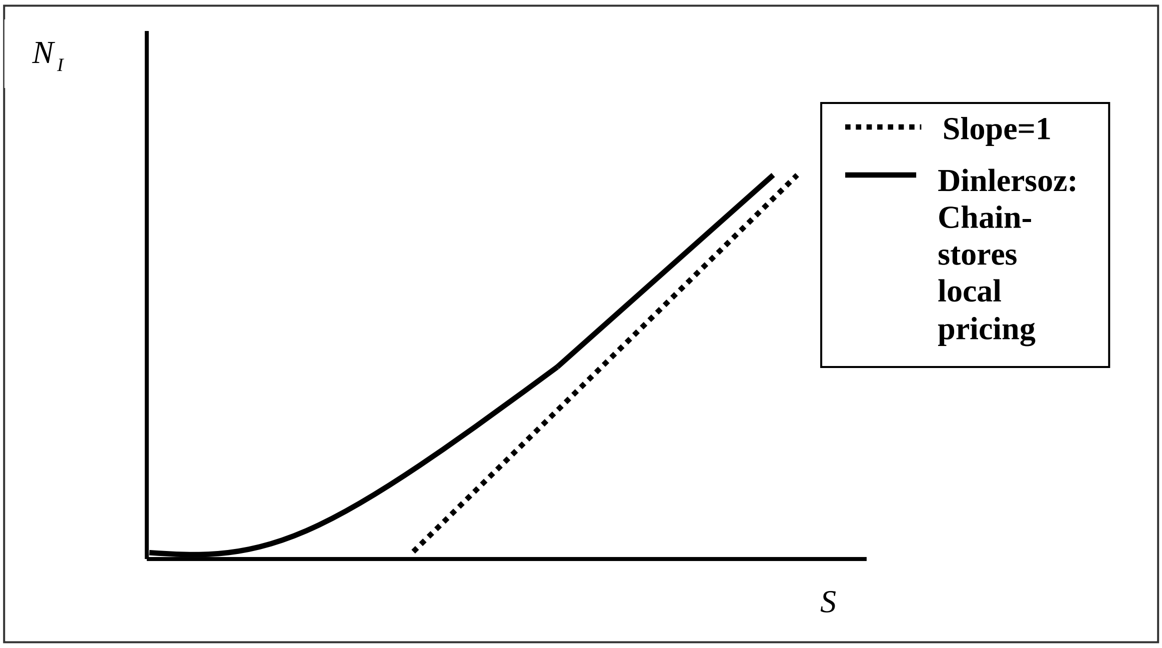
Dinlersoz solves for N_C^* given by the Cournot free entry equilibrium taking p_I* as given by (8), substituting for N_C^* into (13) and rearranging gives[9]:

$$N_I^* = (f_I / c_I)^{-1/2} \left(\left(\bar{\alpha} + c_C - 2(c_C f_C)^{1/2} \right) S + f_C^{1/2} S^{1/2} \right) \qquad (14)$$

[8] See Dinlersoz pg 217.
[9] See Dinlersoz (2004) pg 217.

Equation (14) shows that the number of independent outlets increases less than proportionately with an increase in the market size, this is because as the market size increases chain-store entry occurs, which leads to a fall in the chain-store price. Therefore, the number of chain-stores increases less than proportionately with an increase in market size, this is the B&R result described earlier. However, the fall in the chain-store price also affects the independent retailers' share of the market. Crucially, some consumers will switch from the independents' high quality product to the chain-stores' lower quality product. Consequently, the number of independent outlets increases less than proportionately with an increase in the market size. As the number of chain-stores entering the local market continues to increase, additional chain-store entry has less of an effect on price and therefore fewer additional consumers switch from independent retailers to chain-stores. Therefore, as shown in *Figure 1*, as the market size increases further the number of independent outlets can increase almost proportionately with an increase in the market size.

Figure 1: The number of independent retailers under chain-store local pricing



Dinlersoz finds evidence of this relationship between the number of independent outlets and market size in the Californian retail alcoholic beverage industry.

2.3 National pricing by chain-stores

Dinlersoz assumes chain-store costs exhibit increasing returns to scale, chain-stores produce a lower quality product than independents and chain-stores set prices locally. The first two of these assumptions appear to fit the UK opticians' market relatively well, but the final one does not. Casual observation suggests chain-stores tend to employ a larger number of opticians, providing evidence of a higher minimum efficient scale even at the individual store level. The assumption that independent retailers supply a higher quality service could be justified in terms of a more personal service, with consumers benefiting from repeated interaction with the same ophthalmic practitioner. In fact, one of the concerns of opponents of deregulation was a reduction in service quality[10]. However, a crucial assumption in the Dinlersoz model is that in each local market chain-stores compete *a la Cournot*. This implies the price will vary according to the number of chain-stores present in the market (determined by the market size). However, as discussed above, the main retail opticians' chain-stores in the UK adopt national pricing strategies. This section considers the effect of altering the Dinlersoz model for chain-store national pricing strategies[11].

Suppose now that the chain-stores all set an exogenously determined price p_{nat} which is invariant to the market size (S). The national price can be assumed to be exogenous as it will be determined by factors at a national level, where factors affecting an individual local market make up only a small part. The demand for the independent firm's product therefore becomes:

$$D_I(p_I, p_C) = S(\overline{\alpha} - p_I + p_{nat}) \qquad (15)$$

In addition, the output and price of an independent store remain unchanged as the number of independent outlets adjusts to ensure that the output of an individual outlet remains equal to MES as in (7). It is therefore possible to solve for the free entry equilibrium number of independent outlets (N_I^*):

$$D_I / N_I^*(p_I - c_I.q_I) - f_I = 0 \qquad (16)$$

[10] See for example Fulop and Warren (1993) pp. 262-64.
[11] Empirical evidence on the nature and extent of product differentiation will be considered in *Section 6*.

Substituting in for D_I from (15), p_I from (8) and q_I from (7):

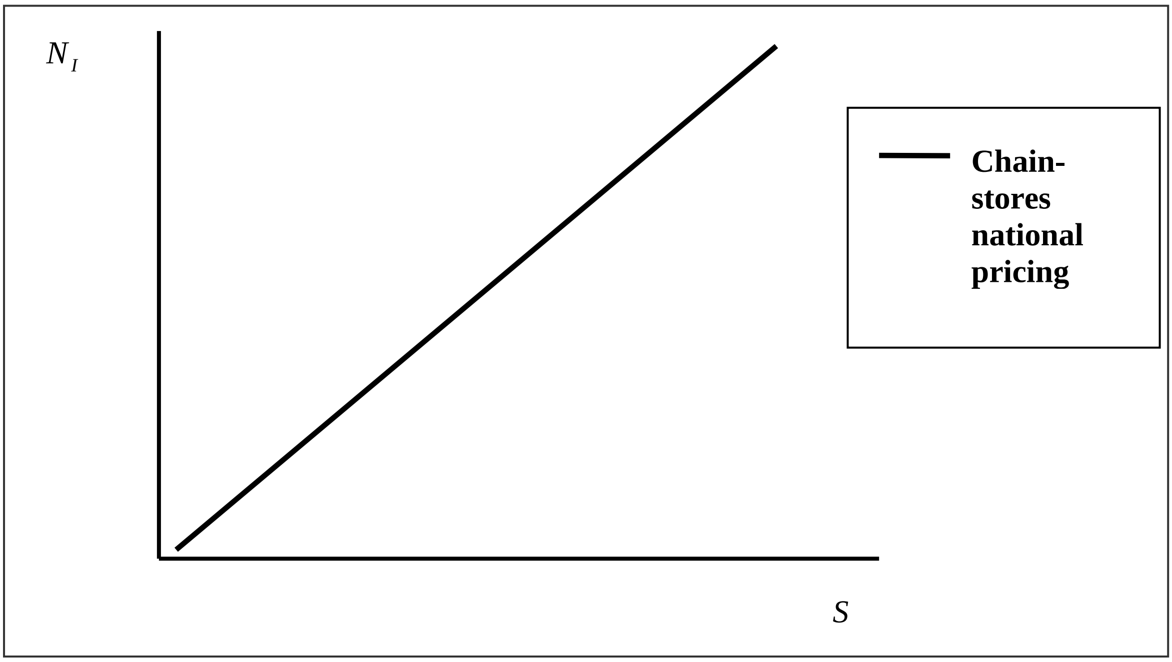
$$S(\overline{\alpha} - p_I + p_{nat}) / N_I^* \left(2(c_I f_I)^{1/2} - c_f (c_f f_I)^{1/2} / c_f\right) - f_I = 0 \tag{17}$$

Simplifying and rearranging:

$$N_I^* = S(\overline{\alpha} - p_I + p_{nat})(c_I f_I)^{1/2} / f_I \tag{18}$$

Equation 18 shows that number of independent outlets increases at a rate proportional to the increase in market size, as shown in *Figure 2*. Because both chain-stores and independent firms now set a price that is invariant in the market size, the proportion of consumers preferring chain-stores to independent outlets and vice versa is fixed for all market sizes.

Figure 2: The number of independent retailers under chain-store national pricing



Comparing the results under national and local pricing leads to two propositions, which will be tested below. Comparing (14) and (18):

PROPOSITION 1:

- If chain-stores use local pricing: the number of independent outlets will increase less than proportionately with an increase in market size but at an increasing rate.
- If chain-stores use national pricing: the number of independent outlets will increase proportionately with an increase in market size, for all sizes of market.

Comparing (13) and (18) implies:

PROPOSITION 2:

- With chain-store local pricing, the number of independent outlets is inversely related to the number of chain-stores present in the local market
- If chain-stores use national pricing: the number of independent outlets is unaffected by the number of chain-stores present in the local market.

Propositions 1 and *2* will now be tested on the dataset, described in *Section 3*, collected on the UK retail opticians market.

3 Data and descriptive statistics

The dataset was obtained by downloading the names and postcodes of all opticians' outlets in England and Wales from the online Yellow Pages directory.[12] *Table 1* shows the number of outlets owned by the largest multi-store firms.

Table 1: The largest multi-store opticians in England and Wales

Chain	**Number of outlets**
Specsavers	412
Dolland and Aitchison	338
Boots	271
Vision Express	169
Scrivens	105
Optical Express	104
Rayner	97
Batemans	54
Leightons	41
Others	4633
	6224

As can be seen, there is a clear natural break in the size distribution, with the top four owning more than 150 stores. Here after, these four will be referred to as chain-stores and all remaining outlets as independents:

Definition: Chain-store – an opticians' store owned by Specsavers (SS), Dolland and Aitchison (DA), Boots (BO) or Vision Express (VE).

Of course, this definition of a 'chain-store' is somewhat arbitrary, but there are a number of reasons for differentiating these four from smaller, multi-store firms.[13] First, as shown in *Table 2.1* all four have a national presence, with stores in all regions, with similar rankings in all regions.

[12] www.yell.com
[13] The main econometric results were also re-estimated with the definition of a chain-store widened, see *footnote 19*.

Table 2.1: The proportion of the total number of chain-store outlets in a region owned by each chain-store

Region	Number LAD markets	Number chain-stores	% Specsavers	% Dolland and Aitchison	% Boots	% Vision Express
North-East	23	49	41	24	18	16
North-West	43	140	36	28	21	15
South-East	67	215	31	28	27	14
South-West	44	129	41	24	21	14
East	46	129	33	19	33	14
East Mid	40	88	34	30	22	15
West Mid	33	131	28	36	19	17
London	33	166	28	40	19	13
Yorks & Hum	21	95	39	24	22	15
Wales	22	48	60	17	17	6

On the other hand, as can be seen from *Table 2.2*, with the possible exception of Optical Express the other, main multi-store firms do not have a national presence.

Table 2.2: The distribution of selected firm's total number of outlets by region

	North-East	North-West	South-East	South-West	East	East Mid	West Mid	London	Yorks & Hum	Wales
Scrivens	0	3	16	19	9	16	25	0	12	0
Optical Express	4	16	13	9	5	11	10	20	12	1
Rayner	3	10	7	1	2	16	15	0	20	25
Batemans	0	0	59	41	0	0	0	0	0	0
Leightons	0	0	76	12	2	0	0	10	0	0

The Optical Express chain, established in 1991, has grown rapidly, and if it continues to expand as rapidly will soon join the group of main chain-store retailers. Interestingly, Optical Express adopts a local pricing strategy.

Second, the four chain-stores, in addition to being the largest chains are also the firms in the market with a significant brand name and prominence as a high street retailer. Advertising figures suggest the dominance of these four chain-stores, as in 2001 they together accounted for 75% of the UK main media advertising expenditure on opticians and eye clinics.[14] In addition, all prices set by both Specsavers and Boots are national prices. Dolland and Aitchison and Vision Express also set the prices for frames and sight tests nationally.[15] Based on this definition, chain-stores therefore make up 19% of the total, of just over 6200 outlets in the dataset.

Table 3 describes the number of opticians for all 372 Local Authority Districts (LAD) in England and Wales, with *N inds.* used to refer to the number of independent outlets. [1] LADs tend to be centred on town/cities and therefore represent a reasonable approximation of the area in which consumer search behaviour takes place, as well as a unit of observation for which data is readily available.

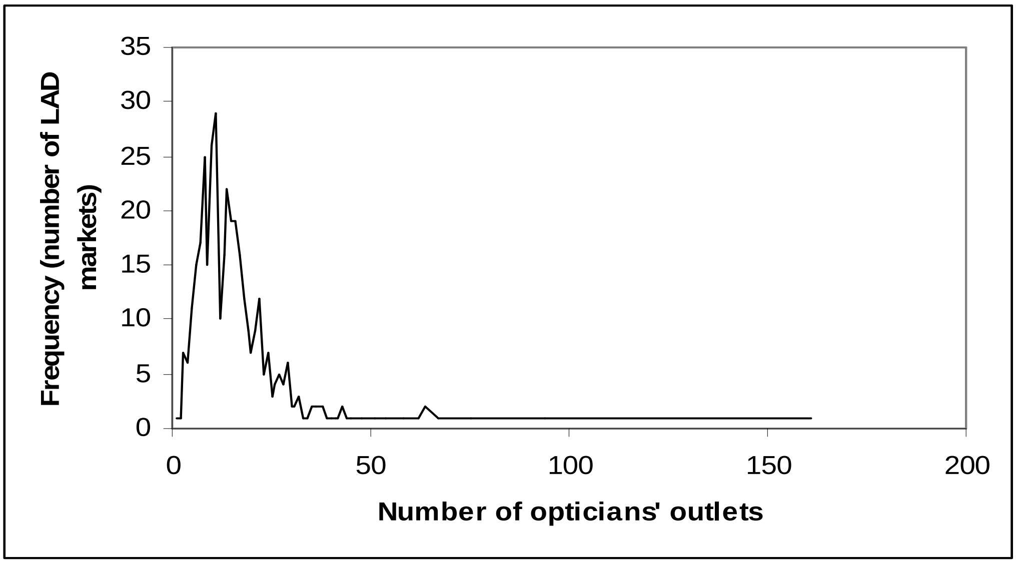
[14] Keynote (2002).
[15] There are some small differences in the prices of lenses between markets, and franchisee stores have some autonomy over prices. However, the prices set can still be considered to be predominantly nationally determined.

Table 3: The number of opticians' outlets by LAD market

	Mean	Std Dev	Min	Max
Total	16.73	13.82	1	161
Chain-stores	1.90	1.31	0	4
Chain-store outlets	3.20	2.40	0	21
N inds.	13.53	12.17	1	140
SS	1.11	0.81	0	5
DA	0.91	1.04	0	9
BO	0.73	0.71	0	4
VE	0.45	0.55	0	3

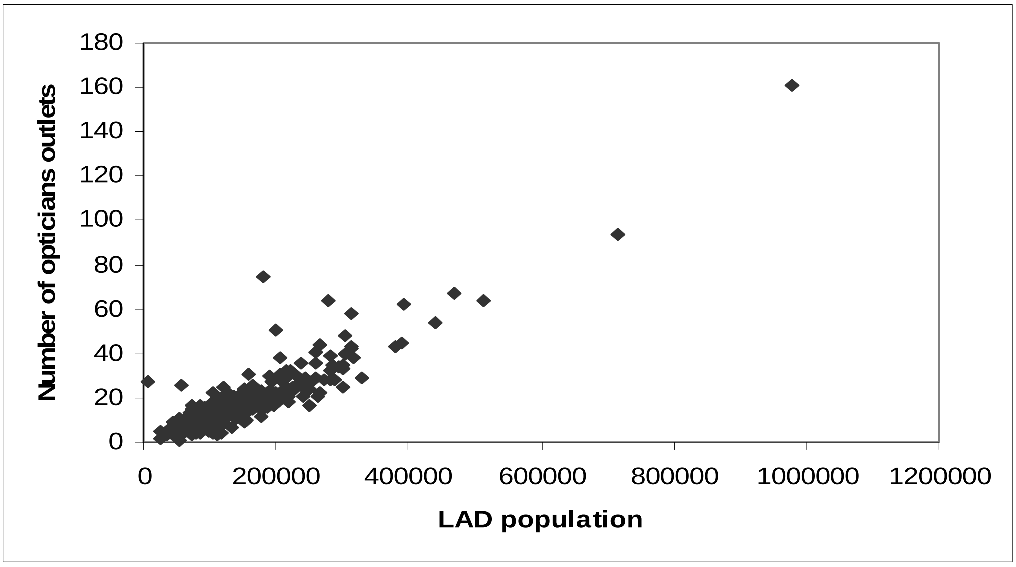
A 'typical' LAD market contains 17 opticians' outlets; 3 chain-store outlets and 14 independent outlets. However, clearly many markets contain more and there are 42 markets in which there are no chain-stores. In addition, all chain-stores have multiple outlets in one or more LAD. *Figure 3* shows the frequency distribution for the total number of opticians in a market. Clearly the distribution is skewed to the right, with 74% of markets containing less than 20 outlets.

Figure 3: The number of opticians' outlets in an LAD market



Finally, *Figure 4* shows the relationship between the total number of opticians' outlets present and the population of the market. As we would expect, there is clearly a positive relationship between this definition of market size and the number of opticians located in the market.

Figure 4: The number of opticians' outlets by LAD population



4 Econometric results

In this section *Propositions 1* and *2* will be tested against the data. *Section 4.1* outlines the econometric specification used and then *Section 4.2* presents the results.

4.1 Econometric specification and explanatory variables

The general econometric specification used is:

$$\log N_i = \alpha + \beta \log(Population_i) + \delta C_i + \phi C_i * \log(Population_i) + \gamma(X_i) + \varepsilon_i \quad (19)$$

Where the subscript *i* refers to an LAD market, N_i is the number of independent outlets, C_i is a continuous variable for the number of chain-stores. $L\log(Population_i)$ is the natural logarithm of the LAD population and X_i is a vector of demand and cost control variables as described in *Table 4.1* below. The error term ε_i is assumed to be independent across LAD markets. The model will be estimated using

OLS and the log-linear specification means that the estimated coefficients can be interpreted as the proportional change in N_i given a change in the explanatory variable.

The use of LAD districts to define the market allows the data on the number of outlets to be matched with census demographic data, including importantly population as a measure of market size and other variables that can then be used to control for cost and other possible demand differentials between markets. *Table 4.1* provides definitions for the demographic variables that will be used and *Table 4.2* provides descriptive statistics for these variables.

Table 4.1: Description of Demographic variables

Variable	**Description**
Population	LAD population (number of people)
Density	Number of people per hectare
Age	Mean age of LAD population (years)
Wage	Mean weekly wage of LAD population excluding overtime (£)
Inc support	% of LAD population claiming income support

All variables are for 2001, Source: Census 2001 [16] except wage data for 2005, Source: Annual Survey of Hours and Earnings 2005[17].

Table 4.2: Descriptive Statistics for Demographic variables

	Mean	**Std Dev**	**Min**	**Max**
Population	13906.23	91781.6	7185	977087
Density	13.47	19.73	0.23	131.02
Age	39.29	2.30	31.75	46.85
Wage	412.45	103.04	237.4	1251.8
Inc support	0.061	0.024	0.019	0.150

Density allows for the possibility that more densely populated areas may attract additional opticians' outlets, perhaps as they act as centre for retail activity and thus

[16] www.statistics.gov.uk/census2001/

[17] http://www.statistics.gov.uk/downloads/theme_labour/ASHE_2005/2005_res_la.pdf

attract customers from outside the LAD. The inclusion of age, controls for the likelihood that the demand for opticians' services is higher, and typically more complex sight problems exist amongst older people. The wage variable has two possible interpretations; firstly it could reflect firms' cost differences between markets or it could reflect higher demand due to a more affluent population. Income support claimants are entitled to an NHS voucher, which provides the recipient with a free sight test and discounted spectacles or contact lenses. It is therefore plausible that demand could be higher in LADs with more income support claimants and for this reason is included as an additional explanatory variable. The inclusion of these explanatory variables will also provide important evidence in support of the assumptions made in the vertical differentiation model.

4.2 Testing the relationship between the number of independent retailers and market size

In order to test *Propositions 1 and 2*; the relationship between the number of independents and market size and the effect of the number of chain-stores, the sample will be restricted to those markets where one or more chain-store is present[18].

[18] The dataset used for the regressions reported in *Table 5* are all 330 markets in which one or more chain-store is present, with the exception of the City of London LAD. This was omitted from all the econometric results as it is principally a business area with a very low population but a comparatively large number of opticians' outlets.

Table 5: The relationship between the number of independent outlets and market size and the effect of the number of chain-stores

Dep var: Exp vars:	(1) OLS Log (N inds.)	(2) OLS Log (N inds.)
Constant	-19.520 *** (2.009)	-17.263 *** (2.344)
Log (Population)	1.079 *** (0.048)	0.949 *** (0.116)
Log (Age)	1.938 *** (0.408)	1.761 *** (0.413)
Log (Wage)	0.495 *** (0.126)	0.483 *** (0.127)
Log (Inc support)	0.283 *** (0.068)	0.262 *** (0.069)
N Chain-stores		-0.710 * (0.420)
N Chain-stores * Log (Population)		0.058 (0.036)
N Adj Rsq	329 0.705	329 0.709

*** Significantly different from 0 at 1% level ** Significantly different from 0 at 5% level
* Significantly different from 0 at 10% level Standard errors in parenthesis

The equation is tested in two forms; with and without the inclusion of the number of chain-stores present and the interaction with *Log*(*Population)* as explanatory variables. In both cases, it is not possible to reject the null hypothesis that the coefficient on *log (Population)* is equal to one:

RESULT 1

- In markets where one or more chain-store is present the number of independent outlets increases proportionately with an increase in market size.

This is consistent with chain-store national pricing strategies (see *Proposition 1)*[19].

In addition markets with an older population also have more independent outlets, suggesting demand is higher in these markets. The number of independent outlets is also increasing in both the average wage of the LAD population and the proportion of income support claimants; this will be discussed in more detail at the end of this section[20].

Finally in relation to *Proposition 2,* with the inclusion of the number of chain-stores present and the interaction with *Log* (*Population)* as explanatory variables, the number of chain-stores has a negative effect and is weakly significant. In addition, the results from F-tests of joint significance show that these extra explanatory variables, included in regression (2) are jointly significant at the 5% level. Additional results, not reported here, instead include the number of chain-store outlets as the explanatory variable, however neither variable was individually or jointly significant. Overall, the results therefore provide some evidence that the number of chain-stores rather than the number of chain-store outlets affects the number of independent outlets and this will be examined further in *Section 5.*

5 Heterogeneous chain-stores

The theory described in *Section 2* assumes that all chain-stores supply identical quality. This assumption is now relaxed.

5.1 A model of retail competition with national pricing but heterogeneous chain-stores

The following analysis can easily be generalised to the case where there are any number of chain-stores; however, as an illustration consider the following

[19] This result is robust to various sensitivity tests: excluding Scrivens, Optical Express and Rayner outlets from the definition of independent retailers, excluding the largest 10% or 25% of markets, or excluding all London LADs.

[20] *Log (Density)* was also included but was insignificant.

example where there are only two chain-stores, denoted *1* and *2*. Assume *Chain-store 1* produces a higher quality product than *Chain-store 2* i.e.[21];

$$\theta_{C1} > \theta_{C2} \tag{20}$$

In order for *Chain-store 2* to be active it must therefore be the case that:

$$p_{C1nat} > p_{C2nat} \tag{21}$$

There are potentially three different types of local market:

Type i): Markets with *Chain-store 1 and 2* present.

Type ii): Markets with only *Chain-store 1* present.

Type iii): Markets with only *Chain-store 2* present.

Consider first of all *Type i)* markets with both *Chain-store 1* and *2* present. As before, we can consider the consumer with a marginal willingness to pay for quality such that he is indifferent between two different types of quality of retailer. However, as there are now three different product quality levels being offered in the market there are now two types of indifferent consumers. First define the consumer indifferent between the products offered by the two chain-stores as having a marginal willingness to pay for quality of level α_{12}, where:

$$\alpha_{12}\theta_{C1} - p_{C1nat} = \alpha_{12}\theta_{C2} - p_{C2nat} \tag{22}$$

and therefore;

$$\alpha_{12} = (p_{C1nat} - p_{C2nat})/(\theta_{C1} - \theta_{C2}) \tag{23}$$

Therefore, assuming as before that the market is always covered, consumers with a marginal willingness to pay for quality in the range $\underline{\alpha} \leq \alpha < \alpha_{12}$ buy from the low quality chain-store; *Chain-store 2*. Proceeding in a similar fashion we can then denote

[21] Allowing for these different, exogenously determined quality levels relaxes the earlier assumption that $\theta_I - \theta_C = 1$ however, under the assumption of national pricing this is unimportant.

marginal willingness to pay for quality of the consumer indifferent between the high quality chain-store; *Chain-store 1* and the independent outlet(s) producing an even higher quality product as α_{1I}, where:

$$\alpha_{1I} = (p_I - p_{C1nat})/(\theta_I - \theta_{C1}) \quad (24)$$

Clearly for markets of *Type i)* to exist[22]:

$$\alpha_{1I} > \alpha_{12} \quad (25)$$

Therefore, consumers with $\alpha_{1I} < \alpha \leq \bar{\alpha}$ buy from one of the independent outlets and consumers with $\alpha_{12} < \alpha < \alpha_{1I}$ buy from *Chain-store 1*.

We can now consider markets where only one of the two chain-stores is located, first of all consider markets of *Type ii)* where only *Chain-store 1* competes with the independent retailers. This means that only one indifferent consumer needs to be considered; the consumer indifferent between *Chain-store 1* and the independent retailers however, this consumer has already been defined for *Type i)* markets and therefore for this consumer;

$$\alpha = \alpha_{1I} \quad (26)$$

Because the market is assumed to be fully covered, consumers who would prefer to buy from *Chain-store 2* (as shown in *Type i)* markets) instead buy from *Chain-store 1* in *Type ii)* markets as *Chain-store 2* is not present.

The final type of markets to consider are those in which only the low quality chain-store (*Chain-store 2*) and independent retailers are present i.e. *Type iii)* markets. Denote the marginal willingness to pay for quality for a consumer indifferent between Chain-store 2 and an independent retailer as α_{2I}, where:

$$\alpha_{2I} = (p_I - p_{C2nat})/(\theta_I - \theta_{C2}) \quad (27)$$

---

[22] If $\alpha_{1I} = \alpha_{12}$ then consumers in the market either buy from the low quality chain-store (*Chain-store 2*) or from an independent retailer, *Chain-store 1* has no demand.

The *Appendix* proves that:

$$\alpha_{12} < \alpha_{2I} < \alpha_{1I} \tag{28}$$

The intuition is that when *Chain-store 1* is not present in a local market, assuming that the market remains fully covered, the consumers that would have preferred *Chain-store 1* have a choice between *Chain-store 2* and the independent retailers. A proportion of those consumers will prefer the higher quality product of the independent retailers whilst others with a lower willingness to pay for quality will prefer to buy from *Chain-store 2*.

The implication of this result is that the number of independent firms present in the market will depend on whether or not *Chain-store 1* (the high quality chain-store) is a competitor in the local market. If *Chain-store 1* is present the number of independent firms is lower than if only *Chain-store 2* is present. Formally; the independent retailers demand can be expressed as:

$$D_I = S(\overline{\alpha} - \tilde{\alpha}) \tag{29}$$

where:

$$\tilde{\alpha} = \begin{cases} \alpha_{1I} \text{ in Type } i) \text{ and type } ii) \text{ markets} \\ \\ \alpha_{2I} \text{ in Type } iii) \text{ markets} \end{cases} \tag{30}$$

Therefore as before the number of independent retailers is given by:

$$D_I / N_I^{*}\left(p_I - c_I . q_I\right) - f_I = 0 \tag{31}$$

Substituting in for D_I, simplifying and rearranging gives:

$$N_I^{*} / S = (\overline{\alpha} - \tilde{\alpha})(c_I f_I)^{1/2} / f_I \tag{32}$$

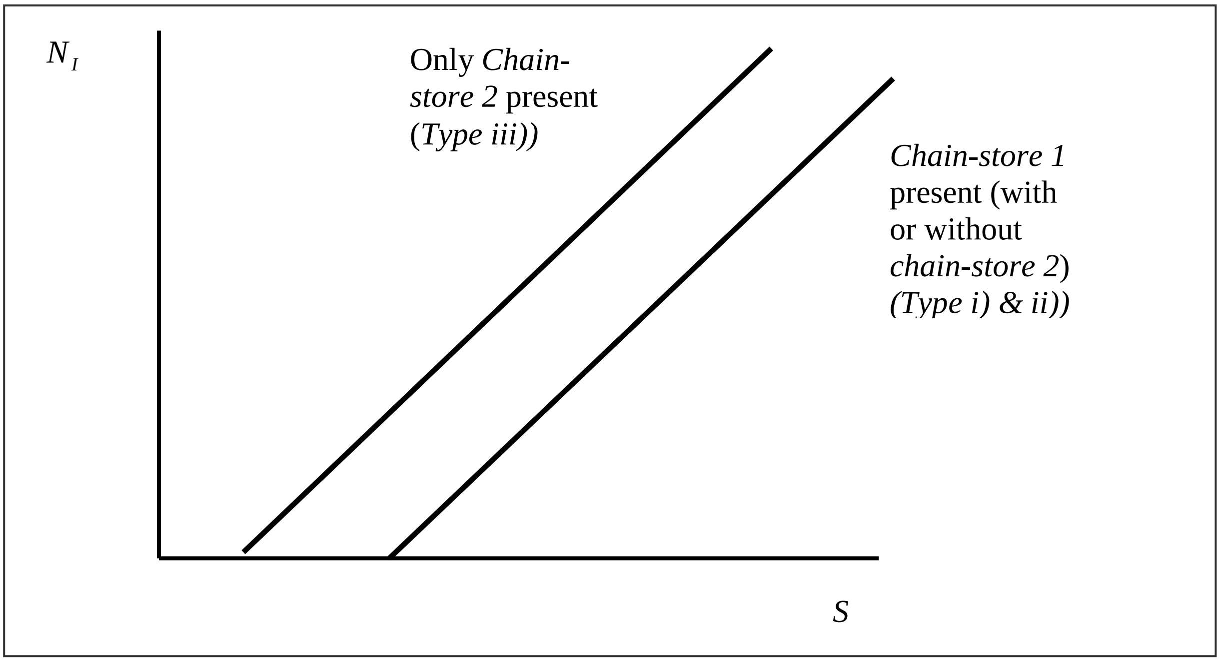
Proposition 3 follows from the result shown in (32):

PROPOSITION 3:

For a given market size; N_I * is higher in *Type iii)* markets i.e. those where *Chain-store 2* (the lower quality chain-store) is the only chain-store present compared to *Type i)* and *ii)* markets i.e. markets where *Chain-store 1* (the higher quality chain-store) is present.

More generally the number of independent retailers is determined by the highest quality chain-store present in the local market. The simple case with only two chain-stores can be illustrated diagrammatically:

Figure 5: The number of independent retailers under chain-store national pricing with heterogeneous quality chain-stores



5.2 Econometric results

Potentially, the evidence from the previous section, that the number of chain-stores affects the number of independents' outlets, can be explained by chain-store heterogeneity. As the number of chain-stores increases, this increases the probability that a higher quality chain-store is present in the market. In order to allow for heterogeneous chain-stores and test *Proposition 3*, a series of new dummy variables will be added to the basic specification used in *Section 4; Table 4 (1)*. These dummy variables capture the presence of each chain-store individually and therefore the effect of this chain-store can be compared to the alternative; the presence of one or more of the other chain-stores.[23] Separate regressions were then estimated including the presence of each chain-store in turn. The results reported in *Table 6 (1)* are for the only one of these four regressions in which the added dummy variables were individually significant; the inclusion of dummy variables for a Boots outlet. In addition, *Table 6 (2)* reports the results from including separate dummy variables capturing the presence of each of the four chain-stores.

[23] A more detailed approach could be used; including in a single regression the additional effect of each chain-store in turn and redefining the dummy variables to consider all the possible rankings according to quality. However, the dataset does not include enough variability in different chain-store presence between markets.

Table 6: The effect of the number and identity of chain-stores on the number of independent opticians' outlets in a local market

Dep var: Exp vars:	(1) OLS Log (N inds.)	(2) OLS Log (N inds.)
Constant	-18.088 *** (2.156)	-16.400 *** (2.642)
Log (Population)	0.968 *** (0.081)	0.901 *** (0.159)
Log (Age)	1.863 *** (0.409)	1.723 *** (0.417)
Log (Wage)	0.517 *** (0.127)	0.492 *** (0.129)
Log (Inc support)	0.284 *** (0.069)	0.291 *** (0.069)
Boots [222]	-1.957 * (1.036)	
Boots * Log (Population)	0.166 * (0.089)	
Dum SS [302]		-0.701 (1.606)
Dum DA [227]		-1.407 (1.274)
Dum BO [222]		-2.397 * (1.255)
Dum VE [159]		1.502 (1.326)
Dum SS * Log (Population)		0.045 (0.138)
Dum DA * Log (Population)		0.109 (0.109)
Dum BO* Log (Population)		0.205 * (0.108)
Dum VE * Log (Population)		-0.124 (0.113)
N	329	329
Adj Rsq	0.707	0.713

*** Significantly different from 0 at 1% level ** Significantly different from 0 at 5% level
* Significantly different from 0 at 10% level Standard errors in parenthesis
[…] frequency dummy variable =1

The results from *Table 6 (1),* suggest that the presence of a Boots outlet has an additional effect on the number of independent outlets compared to one of the other chain-stores. However, an F-test suggests that the Boots dummy variable and the interaction with *log (Population)* are not jointly significant. A similar Boots effect is observed in *Table 6 (2),* however, now an F-test suggests that all four chain-store dummy variables and the interaction terms are jointly significant at the 5% level.

RESULT 2:

- There is weak evidence to suggest that the presence of a Boots' outlet reduces the number of independent outlets in the market, compared to markets with no Boots' outlet, but where one or more of the other chain-stores are present.[24]

In the context of the vertical differentiation model, the implication of *Result 2* is that Boots produces a higher quality product than the other chain-stores. Additional evidence of this quality difference is suggested in the earlier table; *Table 2.1,* where Boots is particularly prominent in the South-East and the East. If the regions are ranked according to average regional wage, these with the exception of London are the two highest. In addition, Boots arguably benefits from a long established brand name in other related retail segments including other health-care products and this may distinguish Boots from the other opticians' chain-stores.

This potential quality differential between chain-stores provides one explanation for the earlier result, suggesting that the number of chain-stores outlets affects the number of independent outlets. However, alternative explanations for this result are firstly, the possibility that despite the use of national pricing strategies local competition could remain important. It is highly plausible that some form of non-price competition, such as service quality, increases the more chain-stores are present in the local market. This could for example take the form of hiring extra staff or making a higher sales effort. This would therefore imply that a given chain-store differs in quality between markets. Alternatively, local promotions or advertising could be more intense in markets where more chain-stores are present. Secondly, some form of horizontal product differentiation such as location decisions within markets may also

[24] Calculations (not reported), using the results from *Table 6 (1),* show that the estimated number of independent outlets is lower in the presence of a Boots chain-store compared to markets with only other chain-stores up to a relatively large market size.

be important. It could be that an increase in the number of chain-store outlets in a market affects the location decisions of independent outlets, for example forces them to locate further from a city centre and therefore reduces their share of the market.

6 Extensions

The empirical analysis is now extended it two ways; *Section 6.1* considers the determinants of the number of chain-stores in a local market and *Section 6.2* compares the number of independents in markets with and without chain-stores.

6.1 The number of chain-stores in a local market

So far all of the analysis has focused on the determinants of the number of independent opticians' outlets in a market. In contrast to the Dinlersoz model, where both the number of chain-stores and the number of independents in a local market are determined by the free entry equilibrium, the model in *Section 2.2* with national pricing makes no predictions on the number of chain-stores present in a local market. As the chain-store price is set at a national level, each chain-store's decision on entry into a local market has to be considered in the context of its effect on the national price. Thus whilst the national price can be considered as exogenous within a local market, it is clearly endogenous as far as entry decisions are concerned. However, further evidence on the nature and extent of product differentiation can be obtained by examining the determinants of the number of chain-stores and chain-store outlets in a local market. Due to the nature of the dependent variable this is done by using ordered probit analysis. *Table 7 (1)* reports the results with the number of chain-stores as the dependant variable (ranging from 0 to 4 and bounded at 4) and *Table 7 (2)* with the number of chain-store outlets as the dependant variable (ranging from 0 to 21 and unbounded).

Table 7: The determinants of the number of chain-stores and chain-store outlets present in a local market

Exp vars: / Dep var:	(1) Ordered Probit N chain-stores	(2) Ordered Probit N chain-store outlets
Log (Population)	1.216 *** (0.155)	1.628 *** (0.147)
Log (Age)	-1.491 (1.319)	-1.424 (1.251)
Log (Density)	0.227 *** (0.067)	0.158 ** (0.062)
Log (Wage)	-1.172 *** (0.392)	-0.449 (0.367)
Log (Inc support)	-0.706 *** (0.218)	-0.441 ** (0.206)
N	371	371
Log L	-495.975	-670.045

*** Significantly different from 0 at 1% level ** Significantly different from 0 at 5% level
* Significantly different from 0 at 10% level Standard errors in parenthesis

As we would expect, both the number of chain-stores and the number of chain-store outlets are increasing in LAD population. In addition the effect of age is negative but insignificant; therefore comparisons with the earlier results suggest that independent opticians appeal to an older customer than chain-store opticians. In addition the results suggest that both the number of chain-store outlets and chain-stores are higher in more densely populated markets and the number of chain-stores is higher in markets with a lower average wage. If the effect of a lower average wage is compared to the results in *Table 5*:

<u>RESULT 3:</u>

- The number of independent outlets in a market is higher in markets where the average wage is higher.
- The number of chain-stores in a market is higher in markets where the average wage is lower.

Thus, supporting the assumption in the vertical product differentiation model, that independent opticians produce a higher quality product than chain-stores[25].

As shown in *Tables 5* the number of independent outlets increases in the proportion of income support claimants. In contrast, the results in *Table 7* suggest that the number of chain-stores and chain-store outlets declines as the proportion of income support claimants rises, importantly having controlled for the average wage. This suggests that the increased demand created by the NHS voucher scheme in markets with a large proportion of income support claimants, benefits independent rather than chain-stores retailers.

6.2 A comparison of markets with and without chain-stores

The preceding analysis has shown that the number of independent outlets increases proportionately with an increase in market size, for markets in which one or more chain-store is present. However, as the dataset also contains markets where no chain-stores are present, this provides a useful comparator to compare the impact of chain-store presence. *Table 8* shows the effect one or more chain-stores have on the number of independent opticians' outlets in a local market. *Table 8(2)* includes a dummy variable; *dum chain*, which is equal to one for the markets where one or more chain-stores are present, and in addition is interacted with *log (Population).*

[25] Importantly, this assumes that wage differences between markets capture demand rather than cost differences.

Table 8: The effect of chain-stores on the number of independent opticians' outlets in a local market

Dep var: Exp vars:	(1) OLS Log (N inds.)	(2) OLS Log (N inds.)
Constant	-18.927 *** (2.068)	-15.443 *** (2.672)
Log (Population)	1.067 *** (0.048)	0.751 *** (0.161)
Log (Age)	1.773 *** (0.456)	1.805 *** (0.455)
Log (Density)	-0.010 (0.022)	-0.007 (0.022)
Log (Wage)	0.521 *** (0.134)	0.495 *** (0.134)
Log (Inc support)	0.282 *** (0.074)	0.257 *** (0.075)
Dum chain [329]		-3.792 ** (1.862)
Dum chain* Log (Population)		0.340 ** (0.166)
N	371	371
Adj Rsq	0.694	0.696

*** Significantly different from 0 at 1% level ** Significantly different from 0 at 5% level
* Significantly different from 0 at 10% level Standard errors in parenthesis
[…] frequency dummy variable =1

For regression (1) in *Table (8)*, a one tailed-test at the 5% level is unable to reject the null hypothesis that the coefficient on *log (Population)* is equal to one as opposed to the alternative hypothesis that it is less than one. For regression (2), in markets where chain-stores are present the proportionate increase in the number of independent outlets as market size increases, is given by the sum of the coefficients on *log (Population)* and *dum chain * log (Population)*. A one tailed t-test at the 5% level does not reject the hypothesis that these two coefficients are jointly equal to one. These results therefore, provide additional evidence supporting *Result 1*. In contrast, a one tailed t-test at the 5% level can now reject the hypothesis that the coefficient on *log (Population)* is equal to one. In addition, an F-test shows that *dum chain* and *dum chain * log (population)* are jointly significant at the 10% level.

RESULT 4:

- In markets with no chain-stores; the number of independent outlets increases less than proportionately with an increase in market size[26].

In contrast to *Result 1* therefore, in markets where no chain-stores are present competition takes place between the independent retailers in the manner outlined by B&R. Interestingly, this result suggests that the nature of competition between the independent opticians depends on whether a chain-store is present.

7 Conclusion

This paper has presented a theoretical model illustrating that the relationship between the number of independent outlets and market size will differ depending on whether chain-stores adopt local or national pricing strategies. Testing the theoretical predictions on a dataset from the UK retail opticians' market the results are, in most respects, consistent with a model of vertical product differentiation in which chain-stores adopt national pricing strategies. From a policy perspective the results suggest that chain-store national pricing strategies can protect independent retailers from the intense competition that could arise under local pricing between chain-stores in large markets where several chain-stores interact. This therefore provides evidence to justify policymakers concern over chain-store local pricing strategies, see for example Competition Commission (2000).

Independent retailers were found to be more frequent in markets with higher average wages and in contrast more chain-stores are located in markets with lower average wages. This supports the assumption, made in the vertical model, that independent retailers produce a higher quality product than chain-stores. In addition the dataset allows comparisons between markets with and without chain-stores to be

[26] This result continues to hold if Scrivens, Optical Express and Rayner outlets are excluded from the definition of independent retailers.

made. Chain-store presence in a local market has been shown to have a significant effect on the relationship between the number of independent outlets and market size. In addition there is some weak evidence of heterogeneity amongst chain-stores, more specifically there is some evidence that Boots' product is of a higher quality than the other chain-stores. One explanation for this is the potential importance of Boots' long established brand name from other product markets. The results provide some evidence, inconsistently with the theory, that the number of chain-stores present also affects the number of independent retailers. Some possible explanations have already been discussed and these merit further investigation.

Possible extensions to the paper would therefore include; first of all allowing chain-stores to make endogenous quality choices. An interesting implication is that this would allow for the endogenous escalation of sunk costs as described by Sutton (1991) and thus provides an addition constraint on the increase in outlets present in a market as the market size increases. An important question then becomes whether a chain-store's quality is nationally determined or varies to reflect local market competition. It would be interesting to conduct an empirical investigation into the significance of non-price competition across local markets in particular looking for the possibility of differences between a given chain-store's outlets. In addition, the fact that the most recent of the main chain-stores to enter the market; Optical Express, is the only one of the five chain-stores to use a local pricing strategy could also be an interesting area for further study. More generally, it would be interesting to consider the determinants of chain-store entry under national as compared to local pricing strategies. Finally, the empirical analysis in this paper has been restricted to cross-sectional analysis, however the availability of time-series data would allow entry and location decisions to be examined and for example the long-term impact of chain-store entry on independent retailers could be investigated. Information on the timing of entry would allow the use of empirical methods similar to those used in Toivanen and Waterson (2005). Chain-store entry could then be investigated in an industry where there are a significant number of both independent and chain-store retailers.

Appendix

In *Type i)* markets, consumers with a marginal willingness to pay for quality such that:

$$\underline{\alpha} \leq \alpha \leq \alpha_{1I} \quad (33)$$

Weakly prefer *Chain-store 1* to an independent retailer (i.e. either prefers *Chain-store 1* or is indifferent between the two).

Consumers with a marginal willingness to pay for quality such that:

$$\underline{\alpha} \leq \alpha \leq \alpha_{12} \quad (34)$$

Weakly prefer *Chain-store 2* to *Chain-store 1*.

Combining (33) and (34) and given that $\alpha_{12} < \alpha_{1I}$ (see *Footnote 22*) therefore means that consumers with:

$$\underline{\alpha} \leq \alpha \leq \alpha_{12} \quad (35)$$

Prefer *Chain-store 2* to an independent retailer.

Therefore a consumer with $\underline{\alpha} \leq \alpha \leq \alpha_{12}$ in *Type ii)* markets where only *Chain-store 2* and independent retailers are present must prefer *Chain-store 2* to the independent retailers. i.e;

$$\alpha_{12} < \alpha_{2I} \quad (36)$$

Similarly in *Type i)* markets, consumers with a marginal willingness to pay for quality such that:

$$\alpha_{1I} \leq \alpha \leq \bar{\alpha} \quad (37)$$

Weakly prefer an independent retailer to *Chain-store 1*.

Consumers with a marginal willingness to pay for quality such that:

$$\alpha_{12} \leq \alpha \leq \bar{\alpha} \quad (38)$$

Weakly prefer *Chain-store 1* to *Chain-store 2*.

(37) and (38) together, and given that $\alpha_{12} < \alpha_{1I}$, means that consumers with:

$$\alpha_{1I} \leq \alpha \leq \bar{\alpha} \quad (39)$$

Prefer chain-store an independent retailer to *Chain-store 2*.

Therefore a consumer with $\alpha_{1I} < \alpha \leq \bar{\alpha}$ in *Type ii)* markets where only *Chain-store 2* and independent retailers are present must prefer an independent retailer to *Chain-store 2* i.e.;

$$\alpha_{2I} < \alpha_{1I} \tag{40}$$

Combining (36) and (40) gives:

$$\alpha_{12} < \alpha_{2I} < \alpha_{1I} \tag{41}$$

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