Clustering and Joint Marketing in Retail Trade*

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December 4, 2001

Abstract

This paper presents the idea that retail trade stores might cluster with their competitors to pool marketing expenses and thereby increase their individual visibility among consumers. In a model which presumes such a marketing technology we derive some new comparative statics results. In a mall/mega center we expect more competing stores in retail trade markets where products are heterogenous and consumers like to compare products before they buy, i.e. where people like to shop around. The size of the demand (number of consumers) is expected to have a greater impact on the number of stores in heterogenous markets compared to homogenous. We also show in this model that there will be too little clustering compared to what a social planner would have preferred. The usual result in the literature is that clustering is excessive. Using data on the store composition of Swedish malls/mega centers we establish evidence in accordance with the model’s empirical predictions.

JEL: C52, D21, L81, R12

Keywords: Clustering, Retail Trade, Joint Marketing, Malls

1 Introduction

For quite some time there has been a clear tendency for retail trade stores to cluster in large retail trade areas and mega centers outside the city centers. Inside city centers a similar development has taken place and malls have become very common1. This trend can be seen

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*I am grateful for the financial support of HUR (Foundation for Research in Trade and Commerce). I also express my gratitude to the consultancy Centrum Development for giving me access to data on stores in Swedish malls and mega centers. Last but not least, I would like to thank my supervisor Erik Forslid, seminar participants at the Department of Economics as well as my PhD student colleagues for valuable comments and insights.

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1We will use the terms mall and mega center as synonyms.
in many big cities and it is expected to continue (HUI [2000]; HUI [1999]). The fundamental
economic driving force behind this clustering phenomenon is generally thought to be economies
of scale in shopping for the consumers (Eaton and Lipsey [1982]; Stahl [1987]). Consumers,
shopping in a mall, can pursue multi-purpose shopping and earn time and travel costs by
being able to shop "everything" at the same time and at the same place.

In addition to the multi-purpose shopping explanation an explanation is needed for casual
observations showing an increasing tendency for strong competition in retail trade markets in
malls and mega centers\(^2\). That is, in malls one often observes many stores in the same retail
trade market (more than one café, sport store and so on in the same mall) and it seems to be
big differences between the retail trade markets in terms of how many stores that compete in
them\(^3\).

In this paper we will present a model which offers an information based explanation,
abstracting from other explanations, to clustering. That is, while the fundamental and general
explanation for clustering of stores may be economies of scale in shopping, this model explains
why clustering is more important for some retail trade markets than for others. One can
therefore say that this paper contributes to and sharpen our knowledge of clustering and why
it occurs. In the model, stores cluster in an effort to increase their individual visibility among
consumers. The underlying presumption is that stores, individually, reach more consumers,
for the same level of marketing expenditures, if they cluster. Put another way, we presume
that stores pool their marketing expenditures to achieve a greater visibility among consumers.
We do not model explicitly how clustering and pooling of marketing expenditures create a
visibility effect but in principle there are strong arguments for its existence.

First, if stores locate on one common address and market that address it is arguably easier
for consumers to know/remember where the stores are located geographically compared to
if every store would market their own address. Second, the choice of a common address
gives consumers greater chances to compare the stores’ competing products and increase the

\(^2\) In Stockholm new inaugurated malls tend to be more narrow in the sense that they contain stores from
just a few retail trade markets, while in those markets there are more competing stores. Examples are food
courts, clothing malls and so on. (Source: Interview, Nislund, T. January the 17th 2001.)

\(^3\) One suspicion that might pop up is that the differing number of stores just reflect the fact that there are
more stores in total in some retail trade markets than in others. But as we show in the empirical section (6.3),
the correlation between a ranking of the retail trade markets in terms of how many stores there are in total
and a ranking of the markets in terms of how many stores there are in malls is quite low (0.372). That is,
there are definitively other factors which explain how many stores there are in a retail trade market in a given
mall.
knowledge of product characteristics. This may increase consumer interest in the stores and also in the market as such. Third, by realizing that there will be many products at the same place, consumers may consider the risk for mistakes in their choices to be smaller and hence their interest in the products and in the market may increase. Fourth, the marketing costs of achieving the same visibility on its own would be higher for a single store if it tried to compete with clusters of stores.

In addition to the principle arguments there are plenty of real world observations that point to the relevance of this type of marketing cooperation. First, one can notice that it is nothing new with stores that cluster in the same geographical area even though they are selling close substitutes. Antique store-, pub-, restaurant- and fashion districts have been around for a long time. It is not unusual that restaurant districts make their own magazines, like guides, with information on the restaurants in the area. The reason is obviously to make the restaurants in the area more visible but also to educate consumers so that they become more picky and interested in the restaurant market in general. In the same manner car sales often take place in specific areas which are heavily marketed as "the car area". Similarly, certain famous shopping streets sometimes have their own associations in order to create the right atmosphere and to get the right configurations of stores.

The analysis, cast in a circular city model with product differentiation in characteristic space, will be performed in an oligopolistic framework where the number of stores in the market are exogenously given\(^4\). Each store sells one differentiated product which we will call a brand. In addition to the characteristic space there is a second (spatial) dimension in which clustering decisions take place. Travel costs in the spatial dimension are not distance related which means that the geographic distance is not relevant for consumers when they are deciding on where to shop and for stores when they are deciding on where to cluster. The geographical aspect of clusters is for these reasons not meant to be taken literally\(^5\). We assume that there are no coordination problems and no costs connected to the clustering of stores, i.e. the choice of clustering partners is random and there are therefore no strategic choice concerning with which stores to cluster. The choice only concerns the number of stores to cluster with.

\(^4\)Below we will interpret some fixed amount of marketing spending as a barrier to entry, which will give the market its oligopolistic character with possibilities to make positive profits by increasing the efficiency of the marketing spending.

\(^5\)The model in this paper explains sizes of clusters in terms of the number of stores. It does not have anything to say concerning where a cluster is located geographically.
Distance in the characteristic space is relevant since it measures how well a brand suits the taste of a particular consumer.

The term cluster will be needed in the analysis and it is defined as a collection of stores in the same retail trade market at the same spatial location. In the empirical section that definition will be useful for tests of the model predictions. That is, for each retail trade market, a mall is the empirical counterpart to a cluster. Since a mall contains many retail trade markets it will contain many clusters.

A consumer evaluates the stores he knows about (those stores who have reached that particular consumer with their marketing) and chooses his best alternative in terms of price and brand characteristics. The stores therefore have individual incentives to increase their visibility among consumers. That is, the clustering is driven by an agglomerating force which comes from the visibility effect of clustering, i.e. consumers know about more individual stores the more the stores cluster. A countervailing force comes from increasing price competition and increasing costs of land rents as the number of stores in a cluster increases. When stores cluster their visibility increases but at the same time price elasticity increases and the land rents increase according to some general cost function. If and when those forces balance we have an equilibrium.

Stores make their clustering- and price decisions simultaneously in a non-cooperative fashion. The game is an one-shot game which means that the stores make one price choice and one clustering choice and that consumers shop once at the best store they know about in terms of price and brand characteristics.

We derive some comparative statics results to study how the level of clustering (how many stores there are in a cluster) as well as the price margins are effected by shifts in exogenous parameters. We also determine whether the equilibrium level of clustering will be equivalent with the socially optimal level. We find that the equilibrium level of clustering in this model will be too low, i.e. there will be too few stores in a cluster. The common result in the literature on clustering for marketing/information reasons is that clustering will be excessive, implying that society should try to dampen clustering via regulations and/or taxes and subsidies. The excessiveness result in most models is due to increased geographic travelling costs which more

\footnote{It may seem a bit strange that the game is modelled to be non-cooperative while the reason for the clustering of stores is the efficiency effect of joint marketing. Since we do not model the marketing technology explicitly we abstract from strategic interactions between stores and just assume that the stores know ex-ante how much visibility they will get when clustering with a certain number of stores.}
than offset the social gains induced by better informed consumers.

Since the model in this paper has no geographical travelling costs its welfare result may seem trivial. However, it reminds us that the excessiveness results of the literature may be questioned because of the typical over simplified modelling of the societal costs and gains connected to clustering. Consumers are assumed to have geographic travel costs but other types of consumer costs, like the use of time or environment costs, are typically not included in the societal cost function. Therefore, it is important to remember that higher travel costs due to clustering (costs are more or less assumed to increase as stores cluster in a few market places) may be offset by time savings or environmental gains\(^7\). In terms of policy implications our welfare result simply reminds us that the question of whether we should welcome or oppose an increasing number of malls and mega centers is far from resolved.

Using data on the store composition of Swedish malls and mega centers we establish evidence, in accordance with the model’s empirical predictions, that in retail trade markets where products arguably are more heterogenous there are more competing stores located in a cluster. In malls with a larger proportion of the total demand the heterogeneity of products seems to be more important for the number of competing stores. That is, in markets where people like to shop around there are more competing stores in a cluster, especially when the cluster lies in a mall which has a high proportion of the demand.

In section two we survey relevant literature and discuss the contribution of my theoretical results and how they differ from related studies. Section three presents the model and derives the demand and profit, while section four derives market equilibria as well as comparative statics results. Section five analyzes welfare aspects of the model and determines whether the clustering level will be optimal from a societal point of view. Section six discusses empirical predictions of the model and compares them with predictions of other papers. An empirical investigation of shopping malls in Sweden is also presented. Section seven concludes.

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\(^7\)Intuitively, one may think that travelling must increase as stores cluster at a few geographical locations. But if such locations are chosen so that they are close to densely populated areas and if, for example, it is straightforward to find a parking lot then the intuition may be reversed in reality. Moreover, it is fairly clear that, concerning public and private transport, the harmful environmental effects are greater in traffic jams, car line ups and parking lot search compared to the environmental effects from steady speed cruising vehicles outside city centers which find parking lots on the spot.
2 Related literature

Location theory originally focused on land use in agriculture, problems of location concentration in heavy industries, shifts of location of industrial production due to new forms of transport like railroads as well as the impact of trade and internationalization.\(^8\)

Location theory research was later extended to services and retailing activities by the introduction of one of the most important research tools of location theory, central place theory (CPT). (Christaller, W [1933]; Lösch, A [1940]). The main idea of CPT is that services and retailing activities are located in central places whose specific locations depend on trade flows and transportation networks.

However, the original CPT is not derived from microeconomic fundamentals, i.e. the configurations of central places are not derived from the behavior of buyers and sellers. The first to provide CPT with such fundamentals was Eaton and Lipsey [1982]. In their paper the explanation for the clustering of stores lies in the cost minimizing behavior of consumers and the profit maximizing behavior of stores. That is, if consumers are able to shop more than one type of good at the same location then they save transport costs, i.e. they can pursue multipurpose shopping. At the same time these cost savings create a social gain from which stores hope to take a big slice. One problem with this first attempt to give an economic explanation for CPT was that it was abstracted from price competition. It was hence somewhat problematic to argue that the clustering decisions was thoroughly understood and explained.

In another paper by Eaton and Lipsey [1979], where stores sell homogenous goods, clustering is explained by comparison shopping. That is, consumers visit more than one store before deciding where to shop. If one assumes (which the authors do) that consumers pursue comparison shopping then consumers can save transport costs if stores cluster. Their paper assumes an exogenous price which makes it problematic to derive optimal equilibria.

The papers by Eaton and Lipsey offer two explanations for the clustering decisions of stores: consumers engage in multipurpose shopping and/or they pursue comparison shopping. Another influential scholar in this field, Stahl [1987], summarizes that the fundamental factors behind the formation of market places like clusters are connected to economies of scale and scope in shopping.

A natural question is whether the degree of clustering will be socially optimal or if stores

\(^{8}\)Palgrave Dictionary of Economics, "location theory", p 223
will cluster too little or too much. In the tradition going back to Hotelling [1929] stores will cluster in the middle of the metaphorical main street, making clustering excessive and wasteful, instead of adopting the transport cost minimizing location. Whether the Hotelling model in fact predicts that the firms will cluster in the middle is open to debate. D’Aspremont, C et al [1979] derives the famous maximum differentiation principle where there is no equilibrium in which firms cluster in the middle. Instead firms try to locate as far as possible from each other. Bester [1998] shows on the other hand that the firms may cluster in the middle if there is uncertainty concerning the quality level of products (vertical product differentiation) since the uncertainty decreases the elasticity of demand and consequently the severeness of price competition. In any case, the stores will not choose the transport cost minimizing location and hence the location will not be socially optimal. As regards multiple firms, it is clear by now that the Hotelling model is unable to explain clustering of firms in a market with more than two firms (D’Aspremont, C et al [1979]; Smithies [1941]; Lerner and Singer [1937]; Eaton and Lipsey [1979]).

It is shown in a paper by Quinzi and Thisse [1990] that CPT can offer configurations of central places which are socially optimal. For the optimal location configuration to be sustained also in a market solution when prices can influence consumer choices, and consequently firm location decisions, a social planner is needed. Otherwise, some firms will have bigger market shares and earn positive profits which will lead to entry of new firms and consequently to excess capacity. A social planner may impose land rents on firms with positive profits and thereby avoiding a socially inefficient excess capacity outcome.

One can conclude from the discussion so far that some clustering is socially positive but often the socially optimal level of clustering is exceeded.

The literature surveyed above explains clustering from a geographic starting point. There are costs connected to travelling and hence there might be gains for consumers, firms and society if trade is somewhat centralized. Firms and consumers cluster which diminish travelling and thereafter they try to grasp as much as possible from the resulting surplus. The market solution is in general not a socially optimal configuration.

Another literature, to which this paper belongs, tries to explain clustering from an information perspective. Here clustering takes place because it helps consumers and firms to find each other. The fundamental research question is how the different channels through which consumers inform themselves or become informed effect the way stores cluster?
Stahl [1982] shows in a paper, with some similarities to my approach, that the spatial concentration of sellers often will be excessive. A model is used where consumers search once for optimal product characteristics (prices are given) and where sellers influence consumers’ search costs by the sellers’ choice of locations. The agglomerating force which induces sellers to cluster is a market size externality which increases in the size (number of sellers) of the clusters. The intuition is that a larger cluster will have a proportionally bigger part of the demand since consumers expect larger chances of finding their preferred product in a larger cluster. This will induce stores to move to the cluster. It is shown that noncooperative equilibria tend to lead to only a few (or just one) cluster/s. But there will always be coalitions among firms under which it would be profitable to decentralize, i.e. decrease the sizes and increase the numbers of clusters. There is therefore room for some business coordinator which could help sellers to decentralize since that would enable them to increase profits (or increase the rents of the land owners).

Wolinsky [1983] uses a circular city model with imperfectly informed consumers to explain clustering of stores. Consumers search for their best brands and it is shown that if there are sufficiently many consumers all stores may end up in the same cluster. The contribution of Wolinsky is to show the existence of such a cluster for quite general conditions. The cluster may or may not lie on a location which minimizes consumer transport costs. Even though it is not clear how big the social cost of an inefficiently located cluster might be, the size of the social loss is bounded by the possibility that a single store deviates from the cluster if the cluster is located too far away from the cost minimizing location.

Another approach is chosen by Dudey [1990] who uses a location-search game to model a situation where consumers are attracted to clusters with many firms since they expect harsh competition there. Firms are simultaneously interested to locate in such clusters since they expect big demand there. Firms realize at the same time that many firms will mean harsh competition. The tension between these incentives is then studied in the game. The finding in the paper is that under reasonable conditions there is a Nash Equilibrium in which all firms locate in the same cluster. This result is interesting since the products do not have to be heterogenous, which is an usual condition in these models, to induce firms to cluster. Two empirical predictions follow:

First, the model may explain why firms/stores which sell homogenous products choose to cluster. Examples are gas stations, fast food restaurants and so on. Second, we should expect
more clustering in markets where consumers search by visiting stores compared to markets where consumers search by telephone or go by advertising. This is so since in the game stores expect more consumers in the cluster if those have to visit clusters. Consumers expect stores to realize the importance of being in the cluster and hence consumers expect harsher competition in the cluster.

The second prediction is confirmed by other theoretical and empirical studies. Nelson [1970] shows that search goods, compared to experience goods, will be associated with a larger search sample which means that search costs are more important for that type of goods. Empirical work by Van Handel [1969] shows that there was indeed more clustering of firms which sell search goods compared to those selling experience goods. Also Fischer and Harrington [1996] find, both theoretically and empirically, that firms which sell goods that induce more search cluster more.

The first prediction has not, to my knowledge, been derived earlier and it may be contrasted with Fischer and Harrington [1996] who shows theoretically that more heterogenous goods should induce more search by consumers since information has a greater value for such goods. This should lead stores to cluster to decrease consumer search costs. The predictions of Fischer and Harrington are confirmed by their empirical study of the relative spatial concentration of nine different consumer markets in Baltimore. The most concentrated markets were shoes and antiques while supermarkets and theaters were the least concentrated.

In a paper by Dudey [1993], that considers welfare effects of clustering, it is shown that market solutions may lead to both too much and too little clustering. There is hence improvements to make by land use controls or other methods to regulate firm clustering. In our model as well as in that of Dudey [1990] and Bester [1998] geographic travelling costs are not needed to derive the clustering results. Both our model and that of Dudey have endogenous prices, but both of them (predicting equal sized clusters) suffer from inconsistency with the empirical observations that clusters are different in size. Technically our model is quite similar to Grossman and Shapiro [1984] but their model have no spatial interpretation.

This paper differs from the literature in several respects. The idea that clustering of retail trade stores may arise as a result of the need to attract the attention of consumers is not new (see Stahl [1982]; Dudey [1990]); Eaton and Lipsey [1979]), but this model introduces a new

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9Experience Goods are goods for which product knowledge is more efficiently developed by buying and consuming the good. Examples are groceries.
idea since stores cluster to increase the impact and efficiency of their marketing spending. The model delivers optimized results on prices and the level of clustering. We also derive somewhat surprising welfare results. Moreover, in contrast to Dubeck and Eaton and Lipsey we deal with heterogenous products. This model also delivers some new empirical predictions which can be tested on data. Finally the empirical data, which allows us to test empirical predictions of the model, delivers insights from real-world clustering and contributes to the understanding of why and when stores cluster.

3 Model

The base model in this section was first formulated by Grossman and Shapiro [1984] but it is modified somewhat to suit this paper.

3.1 Consumers and Stores

Product differentiation is modelled by using the well known circular city (Salop [1979]) which symbolizes a characteristic space where products are differentiated horizontally. The utility of a consumer is given by the simple utility function $U(y, d) = y - db$, where $y$ is a parameter giving every consumer the same utility from their best brand (defined below), respectively. A consumer gets disutility from the distance $d$ in characteristic space to its best brand, which means that a consumer’s utility of any given brand is decreasing in the distance from this particular consumer’s best brand. The parameter $b$ gives the sensitivity in utility terms from a higher distance in characteristic space\textsuperscript{10}.

**Definition 1** The best brand for any consumer $i$ is a brand $x$ located in characteristic space such that the utility of $x$ is given by $U(d = 0, y) = y$. The best available brand $z \in n$ for a consumer $i$ is a brand located in characteristic space such that there is no other brand $w \in n$ available in the set of brands $n$ (the product range) on the market such that the utility $U(d^w, y) \geq U(d^z, y)$.

The circular city has a circumference of one. There is a continuum of consumers with density $N$ per unit length and every consumer has a best brand, defined by a particular

\textsuperscript{10}We assume that $y - \frac{b}{d} \geq 0$. This assumption ensures that even if a consumer would find only his worst possible brand (at the distance $1/2$ in characteristic space) he gets a non-negative utility from the brand. Without this assumption we would have some consumers dropping out from the market.
consumer’s location in characteristic space. Tastes (consumers) are uniformly distributed in characteristic space. That is, no taste is more common than another.

There is a large number of stores \( n \) so that integer constraints can be ignored. A brand is sold by one and only one store and a store can offer only one brand\(^\text{11}\). The stores in the market are spread out symmetrically in characteristic space and their locations in characteristic space are exogenously given. There are hence no possibilities of endogenous differentiation.

Since there are no geographical travelling costs, no spatial location is more attractive than another location for a consumer or a store.

### 3.2 Clustering and Marketing

Consumers will be unaware of the existence of a store and also about that particular store’s location in characteristic space unless they are reached by marketing from that store. Consumers and stores have no other means to find each other. We will assume that stores, individually, spend a given and fixed amount \( M \) on marketing. This fixed amount may be seen as an entry ticket to the market which means that the market gets oligopolistic features so that there will be some possibilities of positive profits also in equilibrium. According to the technology specified below, clustering increases the proportion of the consumers which know about an individual store, given its marketing spending. By keeping marketing expenses fixed we consequently focus on the clustering effect on the visibility of stores.

**Definition 2** A cluster is a collection of stores in the same retail trade market at the same spatial location, where the number of stores \( B \in [1, n] \).

Stores cluster with other stores to pool their marketing spending in an effort to increase the impact of those spending, i.e. to get a stronger promotion effect. The marketing technology is assumed to be an additively separable function where the proportion of consumers which know about an individual store is increasing in \( B \) and \( M \):\(^\text{(1)}\)

\[
\theta(B, M) = \theta(B) + \theta(M)
\]

\(^{11}\)The definition of a brand will be broad. For example a restaurant or a fashion store often offers a concept, style, atmosphere which could be interpreted as a brand.
Since the monetary spending $M$ on marketing is treated as fixed we only consider one decision variable; the number of stores, $B$. In the rest of the analysis we normalize so that only $B$ matters for the visibility of a store, i.e. we use $\theta(B)$ and set $\theta(M) = 0$. Hence, the proportion of the $N$ consumers which know about a particular store is given by the marketing technology $\theta(B) \in (0, 1)$, and we assume that $\theta_B(B) \geq 0$ and also that $\theta_{BB}(B) \leq 0$. Concerning the curvature of the marketing technology it is intuitively reasonable that $\theta_{BB} \leq 0$. When the visibility of the store increases it is plausible that the marginal consumer gets harder and harder to find. Alternatively, consumers mix up stores to a larger extent as the number of cooperating stores increase.

The presumed marketing technology $\theta(B)$ is admittedly ad hoc but, as discussed in the introduction, there are arguments which support the idea that clustering and joint marketing may enhance the visibility of stores, i.e. increase the efficiency of their individual marketing spending. Real world observations also indicate that stores do cluster to conduct joint marketing.

To repeat; if stores are located on the same geographic address (the cluster) consumers will remember better where to find the stores; consumers are able to compare the competing brands (compare their location in characteristic space) and increase their knowledge of brand characteristics; consumers consider the risk for mistakes in the choice of brand to be smaller; the marketing costs of achieving the same visibility on its own would be prohibitively high for a single store which tries to compete with clusters of stores. Empirically we observe that, restaurant districts often make their own magazines like guides with information on the restaurants in the area; car sales often take place in specific areas which are highly marketed as the car area; shopping streets sometimes have associations to create the right atmosphere and to have the right configurations of stores.

Of course it would be a great improvement with a more detailed idea of the specifics of this marketing technology and how clustering leads to enhanced visibility among consumers. In this first attempt to model clustering and joint marketing we take the idea as a starting point and support our hypothesis on the principle arguments as well as on real world observations.

### 3.3 Information and Competition

For later purposes, we will now define the exact meaning of perfect and imperfect information in this model.
Definition 3 Under perfect information every consumer knows about every store in the market.

Under perfect information each particular store reaches each particular consumer with its marketing. That is, in the perfect information case every consumer knows about every store in the market and a consumer is able to examine all available brands in the market and choose the brand which gives that consumer the highest surplus, i.e. that consumer’s best available brand-price pair.

We will choose parameter values so that we never have perfect information in equilibrium. Intuitively, this is because we want to study a situation when it gets increasingly expensive to reach the marginal consumer. That is, \( \theta(B^*) < 1 \), which means that a particular consumer will never know about all stores in the market.

Definition 4 Under imperfect information no consumer knows about every store in the market.

Under imperfect information a particular store does not reach each particular consumer and therefore none of the consumers knows about every brand in the market. These two alternative information situations determine which type of competition the stores face in the market. Imperfect information makes the competitive situation much more complicated for the stores since the competition will be non-localized.

To explain the concept of non-localized competition we start, as a benchmark, with the perfect information case in which competition is localized (just like in the seminal Salop [1979] case). That is, store A in figure 1 knows that all consumers which consider its brand to be their best available brand know about A’s existence\(^{12}\). The same is valid for store B and C. This means that a store, for example A, only has to watch out for competition from its neighbors on the circle, in this example B and C, and not from the other \( n - 3 \) stores in the market. To understand this reasoning consider a small price increase by A. On the marginal it only loses customers to B and C since the other stores are far away on the circle. That is, competition is localized.

When consumers are imperfectly informed competition is non-localized. This means that some of the consumers which are located in characteristic space so that they should consider

\(^{12}\) For simplicity, in figure 1 just the three stores A, B, and C are marked but there are of course \( n - 3 \) other stores in the market. That is, the reasoning applies for all stores.
A's brand to be their best available brand do not know about the existence of A. Instead they might know about some other stores far away on the circle. Analogous reasoning obviously goes for B and C. Moreover, some of the consumers which choose A's brand should have, if they knew about the store selling their best available brand, bought that brand instead. Hence, a store will end up selling its brand to some consumers which would have chosen that store's brand also in the perfect information case, but the store will also sell its brand to consumers who would have preferred other brands in the perfect information case.

The consequences of imperfect information is that a store ex-ante does not know which consumers it will reach and therefore the store does not know which stores that it will compete with, i.e. which stores that also reach the same particular consumer. As we will see below imperfect information will decrease price elasticity which will effect the decisions on price and clustering. In next section we derive the consumer demand and profits under imperfect information.

3.4 Demand and profits

Since all stores are identical, except for the difference between their differentiated brands, we can treat one of the stores as the representative store. We start by deriving the demand facing the representative store, \( x(p, \theta(B)) \), given the prices \( \overline{p} \) and clustering decisions \( \overline{B} \) of the other stores. Consider a consumer who knows about the representative store. If that consumer is located at the distance \( d \) from the representative store which charges the price \( p \) the consumer
gets a surplus according to \( y - db - p \).\(^{13}\)

Because of imperfect information consumers will not know about all brands in the market. A consumer will therefore rank the brands which he does know about and choose the one offering the highest surplus. This means that some of the consumers buying from the representative store do get their best available brand since this store is located closer to them on the circle than any other store in the market. Other consumers buy from the representative store not because it is particularly close to them on the circle but because they do not know about any better brand than the representative store. Therefore, consumers buying from the representative store are more or less mismatched to the brand sold by the representative store.

To derive consumer demand we partition all consumers buying from the representative store in \( n \) different groups. Consumers belong to a particular group depending on how that consumer ranks the representative store in comparison to the other stores in the market. That is, if a consumer belongs to the first group the brand of the representative store is that consumer’s best available brand. If the consumer belongs to the second group the representative store sells its second best available brand and so on. Hence, the higher group number a consumer belongs to the more mismatched he is to the representative store’s brand and vice versa. That is, to be a well informed consumer means knowing about many stores which means belonging to a low group number since knowing about many stores means that a consumer will find brands relatively close to its best available brand.

So, given the price of the representative store \( p \) and the price \( \bar{p} \) of its \((n - 1)\) rivals, we partition all consumers into \( n \) groups of consumers, \( k = 1, \ldots, n \), where the \( k \)th group is that set of consumers to whom the representative store offers the \( k \)th highest surplus of the \( n \) stores. To clarify things we draw a figure which symbolizes a segment of the characteristic space.

In figure 2, store A symbolizes the representative store and the distance between any two stores is \( \frac{1}{n} \).

For consumers located at \( 0 \leq d \leq \frac{1}{n} \) from the representative store, the best alternative to the representative store is the closest neighbor store (think of B) on the circle. This store sells a brand that gives the surplus \( y - b|\frac{1}{n} - d| - \bar{p} \). If we consider one of those consumers with \( d_1 \) from the representative store he will be indifferent between the two neighbors if \( y - d_1 b - p = y - b|\frac{1}{n} - d_1| - \bar{p} \). This can be written as \( d_1 = \frac{\bar{p} - p}{2b} + \frac{1}{2n} \) and all consumers

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\(^{13}\)Note that the best brand ( \( d = 0 \) ) is not available for every consumer, since there is a large but not infinite number of stores.
Segment of Characteristic Space

\[ \text{Figure 2:} \]

with \( d \leq d_1 \) would, provided they know about the representative store, buy the brand sold by the representative store. That is, not all consumers with \( d \leq d_1 \) will end up buying from the representative store since some of them do not know about that store. Below we will derive the proportions \( \theta_i, i = 1, \ldots, n \) of the consumer population which belong to each of the \( n \) groups.

Since stores are spread out symmetrically around the circle the distances between stores are equal and the representative store will sell to consumers "on both sides", i.e. to consumers on both the left and the right side (see figure 2). We can now derive the group \( N_1 \) of consumers which consider the brand sold by the representative store to be their best available brand;

\[
N_1 = 2Nd_1 = \frac{N(\bar{p} - p)}{b} + \frac{N}{n}
\]

We can also consider under which conditions the consumer referred to above will be indifferent between the brand sold by the representative store and the brand sold by the second closest neighbor store on the circle (in figure 2 think of D); \( y - bD_2 - p = y - b(\frac{2}{n} - d_2) - \bar{p} \). This can be written \( d_2 = \frac{E-p}{2b} + \frac{1}{n} \) and;

\[
N_2 = 2N(d_2 - d_1) = \frac{N}{n},
\]

where the last equality follows since we know that \( d_2 - d_1 = \frac{1}{2n} \). This expression therefore defines the consumer group which has the representative store as their second choice. If we go on this way the general expression is
\[ d_k = \frac{p - p}{2b} + \frac{k}{2n}, \quad k = 1, 2, \ldots n - 1 \]  

(2)

and

\[ N_k = \frac{N}{n}, \quad k = 2, \ldots n - 1 \]

Finally the \( n \)th group contains all consumers not belonging to the other \( n - 1 \) groups, i.e.

\[ N_n = N - \sum_{k=1}^{n-1} N_k, \text{ or } N_n = \frac{N}{n} - \frac{N(p - p)}{b} \]

We can now write the demand facing the brand of the representative store,

\[ x(p, \theta(B)) = N_1 \theta_1 + N_2 \theta_2 + \ldots N_n \theta_n \]  

(3)

where \( \theta_i, \quad i = 1, \ldots n \) are the proportions of the consumers which belong to each of the \( n \) groups.\(^{14}\)

As was explained above, the demand faced by the representative store will consist of consumers from different groups which rank the brand of the representative store differently. That is, the brand of the representative store is to different degrees matched to a particular demand group’s tastes. This imperfect matching among the consumers which demand the brand of the representative store makes the demand less elastic the more imperfect the matching is.

Recapitulating from above a consumer knows about a particular store with probability \( \theta(B) \). That is, with probability \( \theta(B) \) a consumer knows about a store, and with probability \( 1 - \theta(B) \) he does not know about that store. Another way of expressing this is that a store reaches a proportion \( \theta(B) \) of the consumer population with its marketing while it does not

\(^{14}\)In a perfect information case \( \theta_1 = 1 \) and \( \theta_2, \ldots, \theta_n = 0 \), which means that all consumers know about the representative store and competition is consequently localized.
reach the proportion $1 - \theta(B)$.

Consider now the demand faced by the representative store. A consumer in the first group $N_1$ considers the brand of the representative store to be his best available brand. In a symmetric equilibrium all stores take the clustering decision $B = B^*$ which means that consumers in $N_1$ will find the representative store with probability $\theta(B^*)$ and the probability to sell to consumers in $N_1$ is consequently $\theta_1 = \theta(B^*)$.

Consumers in the second group $N_2$ are those consumers which consider the brand sold by the representative to be their second best available brand. The representative store will therefore sell to consumers in this group if they do not know about the store selling their best available brand and if they do know about the representative store. That is, the representative store will sell to consumers in the second group $N_2$ with probability $\theta_2 = \theta^*(1 - \overline{\theta})$, where $\overline{\theta} = \theta^*$ is the probability for all other stores to reach the consumers with their marketing (equal in a symmetric equilibrium).

With this reasoning we can write the probability for the representative store to sell to any of the $n$ groups as,

$$\theta_k = \theta(1 - \overline{\theta})^{k-1}, \ k = 1, 2, \ldots, n$$ (4)

We can now substitute the expressions for the number of consumers in all groups as well as the corresponding probabilities into the demand function facing the representative store:15

$$x(p, \theta(B)) = \left[ \frac{N(p - \overline{p})}{b} + \frac{N}{n} \right] \theta + \frac{N}{n} \theta \left( 1 - \overline{\theta} \right) +$$ (5)

$$\frac{N}{n} \theta \left( 1 - \overline{\theta} \right)^2 + \ldots \left[ \frac{N}{n} - \frac{N(p - \overline{p})}{b} \right] \theta \left( 1 - \overline{\theta} \right)^{n-1}$$

This can be written as:16

---

15The steps below when deriving the demand follows the method of Grossman and Shapiro[1984].

16To get this we use the formula for a finite geometric series. $a + ak + ak^2 + \ldots ak^{n-1} = a \frac{1-k^n}{1-k}$, $k \neq 1$. Source:
\[ x(p, \theta(B)) = \frac{N\theta(\theta - p)}{b} \left[ 1 - (1 - \theta)^{n-1} \right] + \frac{N\theta}{n\theta} \left[ 1 - (1 - \theta)^n \right], \]

and approximated to: \(^17\)

\[ x(p, \theta(B)) = \frac{N\theta(\theta - p)}{b} + \frac{N\theta}{n\theta} \]  \hspace{1cm} (6)

We have now derived the demand faced by the representative store in terms of prices and the proportion of consumers which knows about the representative store.

We have assumed a fixed marketing spending \(M\) and we will use a land rent function \(R(B)\) which is increasing in the number of stores in a cluster. For convenience we assume that \(R_B(B); R_{BB}(B) \geq 0\). The profits of the representative store can now be written as, \(^18\)

\[ \pi(p, \theta(B, M)) = (p - c)x(p, \theta(B, M)) - M - R(B) \]  \hspace{1cm} (7)

where \(c\) is the constant marginal cost of selling/producing the brand. Substituting for the demand we get;

\[ \pi(p, \theta(B, M)) = (p - c) \left[ \frac{N\theta(\theta - p)}{b} + \frac{N\theta}{n\theta} \right] - M - R(B) \]  \hspace{1cm} (8)

4 Clustering and Pricing Equilibria

The decisions on clustering and prices take place simultaneously in a non-cooperative one-shot Nash game. That is, stores make identical decisions on the optimal number of stores in a cluster and on which price to charge. As pointed out above the actual clustering is assumed to take place without costs. A consumer who is reached by marketing from a set of stores

---

\(^{17}\) This approximation which says that \((1 - \theta)^n\) and \((1 - \theta)^{n-1}\) is \(\approx 0\), means that every consumer finds at least its second worst brand. For \(n\) large enough this approximation is unproblematic.

\(^{18}\) We present the profit with \(\theta(B, M)\) since we want to be explicit on which costs are involved.

---

Sydsæter, K; Hammond, P.J. [1995], page 198
choose its best brand-price pair and shop there\textsuperscript{19}. The first order conditions below give the optimal decision on clustering $B$ as well as the optimal decision on price $p$:

$$B : \frac{(p - c)N\theta_B(\bar{p} - p)}{b} + \frac{(p - c)\theta_BN}{\bar{\theta}_n} - R_B(B) = 0$$

$$p : p = \bar{p} + c + \frac{b}{2n\bar{\theta}}$$

In a symmetric equilibrium we have $p = \bar{p}$ and $\theta = \bar{\theta}$ so that,

$$p : p^* = c + \frac{b}{n\theta(B^*)} \quad (9)$$

$$B : \frac{(p^* - c)N\theta_B(B^*)}{\theta(B^*)n} = R_B(B^*) \quad (10)$$

These first order conditions give the choices of $B^*$ and $p^*$ and they form an equilibrium where $n$ is exogenously given\textsuperscript{20}.

4.1 Comparative Statics

We will now study the effects of shifts in exogenous parameters on the equilibrium clustering levels and price levels. The possibility to test the empirical predictions on data is discussed in section six. For formal proofs of the comparative statics results see appendix 2.

To prove the comparative statics result we combine (9) and (10) to get:

\textsuperscript{19}The choice of a brand-price pair which the consumer makes means that he travels to the cluster in which his choice is located to buy his chosen brand. It may happen that, as he arrives to the cluster, some of the other stores which are also located there turn out to be a better brand-price pair for him. In equilibrium this "leakage" will have an equal impact on all stores which means that it does not effect the price and clustering choices.

\textsuperscript{20}The first order conditions show that locally we have an equilibrium, but since we do not know the explicit functional forms we can not exclude the possibility of multiple equilibria. Moreover we choose to focus on symmetric equilibria even though asymmetric equilibria with different market shares and price dispersion are theoretically possible.
\[
\frac{bN}{n^2} = \left| \frac{\theta(B^*)}{\theta_B(B^*)} \right|^2 \cdot R_B(B^*)
\]

(11)

By total differentiation of (11) and by using (9) we get the comparative statics results in the table below. The endogenous variables are on the rows while the exogenous are on top of the columns:

\[
\begin{array}{ccc}
dn & db & dN \\
dp & ? & ? \\
 dB & - & + + \\
\end{array}
\]

An exogenous increase in the number of brands \( n \) in the market may be due to abolished regulations,\(^{21}\) new technologies that allow more differentiation of a product (more brands), or better marketing technologies that make marketing cheaper which allow more stores to enter the market. The result \( \frac{dn}{dn} < 0 \) is somewhat surprising since one would perhaps expect that more brands on the market would induce stores to cluster more in competition for consumer attention. The first explanation to the result is that more brands \( n \) on the market directly decrease the marginal revenue of clustering since there are more stores which share the demand, i.e. there is less to compete for. Second, the marginal revenue decrease indirectly via lower margins since more stores mean harder price competition and therefore the marginal consumer gives less profit.

The effect on the mark-up from an increase in \( n \) is ambiguous. A decrease in \( B \) (remember \( \frac{dN}{dn} < 0 \)) makes consumers less informed, demand less elastic and it puts an upward pressure on prices. But an increase in \( n \) puts a downward pressure on the price due to more stores and therefore harder price competition, making the total effect ambiguous.

The effect of an increase in sensitivity to differentiation \( b \) is positive, i.e. \( \frac{db}{db} > 0 \). This is so because the marginal revenue of clustering increase as consumers get more sensitive to differentiation. Intuitively, this can be interpreted to mean that if consumers get more sensitive to differentiation stores will cluster more as a response to the increased need of consumers to find a brand that is matched to their preferences. Another interpretation, which will be used in the empirical section, is that consumers are more sensitive to differentiation for certain products which means that stores selling such products will cluster more than others.

\(^{21}\)One example is the much less rigid (and much more liberal) system for permitting the sales of alcohol in the Restaurants and Pubs of Stockholm which has been in use for a couple of years.
We also find that $\frac{d\Delta\pi}{dN} > 0$. That is, if the number of consumers increase, sensitivity to differentiation among consumers will have a stronger impact on the number of stores in a cluster. The intuition is that the marginal revenue of clustering increases if $N$ is larger since there are more consumers to compete for.

The total effect on mark-ups from increasing sensitivity is ambiguous due to one indirect and one direct effect. In the indirect effect an increase in $b$ leads to an increase in $B$ which makes consumers more informed, demand more elastic and puts a downward pressure on mark-ups. At the same time, in the direct effect, an increase in $b$ puts an upward pressure on mark-ups, making the total effect ambiguous.\textsuperscript{22}

When the number of consumers ($N$) on the market changes clustering goes up, i.e. $\frac{dN}{dN} > 0$. This is simply because the marginal revenue of clustering increases when there are more consumers. We also find that $\frac{d\Delta\pi}{dB} > 0$. That is, if the sensitivity of consumers to differentiation increases, an increasing number of consumers will have a larger impact on the number of stores in a cluster. If we interpret a change in $b$, which we do in the empirical section, as reflecting a change of the type of product then this latter result means that an increase in the number of consumers will have a stronger effect on clustering in markets where consumers are more sensitive to differentiation.

Regarding the mark-ups, they decrease as the number of consumers increases. This is because consumers are more informed due to the higher number of brands in a cluster ($\frac{dN}{dN} > 0$), making demand more elastic. We also find that $\frac{d\Delta\pi}{dN} < 0$ will be stronger as $b$ increase.

5 Welfare

In this section we will analyze whether we will get an optimal degree of clustering in the oligopoly equilibrium. First, we specify the social welfare function in terms of value added:

$$W = (y - c)N[1 - (1 - \theta)^n] - T - nM \tag{12}$$

The first term is the benefits net of production costs for those consumers who find any of the $n$ brands, that is for all $N$ consumers on the market. The second term $T$ is the aggregate

\textsuperscript{22}We also find that $\frac{d\pi - c}{\delta b}$ will be stronger as $N$ increase.
transport costs in characteristic space and reflects the losses from imperfect product matching. The third term is the cost of marketing which every store has to bear. To calculate $T$ we use the same technique as when we calculated the demand of the representative store (see section 3.4). The average travelling distance of the consumers which find their best available brand is $\bar{d}_1 = \frac{1}{4n}$, since the consumers in this group vary in distance from zero to $\frac{1}{2n}$. In the same way the average travelling distance of the consumers which find their second best available brand is $\bar{d}_2 = \frac{3}{4n}$. The general expression is

$$\bar{d}_k = \frac{(2k - 1)}{4n}, \text{ for } k = 1, 2, \ldots n$$  \hspace{1cm} (13)

We can now compute the average distance travelled by all consumers:

$$\bar{d} = \sum_{k=1}^{n} \theta_k \bar{d}_k = \sum_{k=1}^{n} \frac{(2k - 1)}{4n} \theta (1 - \theta)^{k-1}$$

We can now sum this series to:  \hspace{1cm} (14)

$$\bar{d} = \frac{1}{4n \theta} \left[ (2 - \theta) + (1 - \theta)^{n} (\theta - 2(1 + \theta n)) \right]$$

Doing the same approximation as before, that is $(1 - \theta)^n \approx 0$, and using $\theta(B)$ we can write:

$$\bar{d} = \frac{(2 - \theta(B))}{4n \theta(B)}$$

Aggregate transport costs in characteristic space are thus,

$$T = Nb\bar{d} = \frac{Nb(2 - \theta(B))}{4n \theta(B)}$$  \hspace{1cm} (14)

---

23 This is calculated by realizing that within any given group the average distance is $1/4n$ and that for every added group we will have an increased distance of $1/2n$.

24 Here we solve the expression according to the method given in Grossman and Shapiro [1984].
The social welfare function can now be written:

\[ W = [y - c] N - \frac{N b (2 - \theta(B))}{4 n \theta(B)} - n M \]  

(15)

The socially optimal \( B^s \) and \( n^s \) are:

\[ B : 0 < \frac{N b \theta_n(B^s)}{2 \theta(B^s)^2 |n^s|} \]  

(16)

\[ n : \frac{N b}{4 |n^s|^2 \theta(B^s)} \left( \frac{2}{\theta(B^s)} - 1 \right) = M \]  

(17)

**Proposition 5** In an oligopoly equilibrium the market determined clustering level \( B^* < B^s \)

**proof:**

Obvious, since the social marginal revenue of clustering will be positive until \( \theta_n(B^s) = 0 \).

This result says that society would like to have all stores in one cluster in order to minimize the travelling distance \( T \) in characteristic space. The society considers both the decreasing prices (which come with increasing clustering) and the increasing land rents as transfers between stores and consumers as well as between stores and land owners. Therefore society sees no costs and only gains from increasing clustering.

An obvious critique of this result is that there are no geographic travel costs. The defence for the result lies in the fact that there might be gains like time savings, convenience or environmental gains from larger and fewer clusters which are hard to model. That is, there are great difficulties in modelling all social costs and gains from clustering and it is possible that the society prefers both more or less clustering than the market is able to deliver. That is, the usual excessive clustering result hinges on modelling which might be questioned and it is therefore valuable to point out this result.

Concerning the condition for a socially optimal number of stores \( n \) in the market (17) it says that society wants more stores as the number of consumers \( N \) and/or their sensitivity to differentiation \( b \) increases. This is so because with more consumers, and more picky consumers, it is more important for society to have many choices for consumers. A dampening force comes
from the marketing cost $M$ which every store has to pay to be found by consumers. We also see in (17) that the need for more stores $n$ is weakened as stores cluster since the clustering increases consumer information and hence their number of choices, which means that the need to increase the number of stores in the market gets somewhat weaker.

6 Empirical predictions and empirical results

6.1 From theoretical to empirical model

From the theoretical model derived in the sections above we have some comparative statics results which we will now try to test on data from malls and mega centers in the Stockholm region. This empirical section has the modest purpose of testing whether the data is obviously at odds with the empirical predictions or if we can conclude that the model and the ideas it builds upon may have some insights to offer.

To be able to test empirical predictions of the model we need to make a few modifications. In the theoretical model the concept of the circular city was used to analyze competition between stores which sell differentiated versions (brands) of the same basic product. The stores were assumed to hold exogenously given locations in characteristic space and so were consumers whose goal is to maximize their utility by buying a brand with the best possible brand-price pair they can find. In the theoretical model a subset (a certain number of stores) of the stores that compete in characteristic space will locate themselves in a cluster to pool their marketing spending. Due to symmetry in the model all stores will locate themselves in a cluster and all those clusters will be of the same size in terms of the number of stores.

When we take the theory to data we interpret the characteristic space as a retail trade market. Stores which are active in a particular retail trade market in a particular mega center consequently form a cluster. In our data set there are observations on 77 different mega centers and in each mega center there are many different retail trade markets. Consequently we have observations on a large number of clusters.

To test the predictions on the effects of changing sensitivity to differentiation of consumers we obviously need variation in the parameter $b$. In the theoretical model the competing stores offer one brand each and the sensitivity parameter $b$ measures how sensitive consumers are to the distance in characteristic space between brands. In the empirical model we instead
interpret the sensitivity parameter as consumer sensitivity to the difference between stores. That is, if a store offers a unique concept, in the form of differentiated products and services, then $b$ measures how sensitive consumers are to such differences. If we consider the consumer population as a whole this sensitivity will arguably differ between different types of retail trade markets in the sense that the consumer population is more sensitive to differentiation between products in some markets than in others. This means that we can sort (in an ordinal ranking) the retail trade markets depending on the plausible level of $b$ for the product types sold in that particular market.

Since $b$ is a tricky parameter to measure directly we choose to measure it indirectly by choosing 20 different retail trade markets in which there are active stores in the 77 mega centers. The retail trade markets differ in the sense that in some of the markets there are more reasons to search many stores than in others. Some product types are inherently more heterogeneous (compare clothes to nails) and some product types have to be inspected before purchase, like shoes for example. Specifically, consumers are more likely to shop around for shoes than when they want to rent a film on video.

We hence test the prediction $\frac{d N}{d b} > 0$ by calculating the average number of stores in each of the 20 different retail trade markets in each of the 77 mega centers. If there is a positive monotonic relationship between the average number of stores in retail trade markets and the heterogeneity of the stores in retail trade markets we consider this as support for our empirical prediction. That is, we test if there are, on average, more stores in retail trade markets where people arguably like to shop around and vice versa.

Obviously, our ranking of the retail trade markets in terms of heterogeneity is based on subjective reasoning. It will therefore be for the reader to judge whether the empirical ordering of the markets, which the data determines, corresponds to (are highly correlated with) a ranking in terms of heterogeneity.

Fischer and Harrington [1996] do a similar exercise in their investigation of the relative concentration of stores in nine different retail trade markets. They find that the concentration level, defined as the geographic distance between each store and its closest neighbors, is higher in markets in which products arguably are more heterogenous. The straightforward theoretical motivation for the results are that more heterogenous products demand more scrutiny and comparison before purchase, and consequently it is more important for stores to facilitate search by clustering together.
We will also test whether the prediction \( \frac{dN}{dx} > 0 \) will be stronger in mega centers with more visitors, that is, \( \frac{dN}{dx} > 0 \). In the data the mega centers do not have the same share of the demand, i.e. they are not of the same size in terms of visitors or in terms of other proxies that we will use for the size of a mega center. That is, the uniform distribution of consumers over the clusters is not a valid assumption in the real world. The total demand in the empirical model will therefore be written as, \( N = \sum_{i=1}^{77} x_i N \), where \( x_i \) is the share of the demand that falls on a particular mega center.\(^{25}\) We hence have variation over mega centers in the number of visitors (and proxies) which makes it possible to test \( \frac{dN}{dx} > 0 \). This prediction says that if a mega center has a larger part \( x \) of the total demand \( N \) than another mega center then the effect of more sensitive consumers should have a stronger impact in the mega center with a larger part of the demand. Specifically, we expect a higher proportion of stores belonging to high-sensitivity markets in mega centers with a larger part of the demand.

To test \( \frac{dN}{dx} > 0 \) we construct a measure \( \frac{B_{high-b}}{B_{total}} \) which relates the number of stores in a mall which belong to a "high-\( b \)" retail trade market to the total number of stores in that mall. The prediction can hence be written, \( \frac{dN}{dx} > 0 \). We calculate for each mega center the proportion of stores in a specific retail trade market to the total number of stores in that mega center. We do this for all retail trade markets and then regress the proportion measures with the sizes of the mega centers.

We will also test whether \( \frac{dN}{dN} > 0 \). As explained above this predictions will be operationalized by using \( x_i \) instead of \( N \) so that we actually test whether \( \frac{dN}{dx} > 0 \). There are two problems with this prediction. First, it is somewhat trivial since it basically says that there will on average be more stores in a mega center which have a larger share of demand. A more fundamental problem is the causality. Positive and significant results may indicate both that more consumers induce more clustering and competing stores, or alternatively that more competing stores attract more consumers.

The prediction \( \frac{dN}{dx} > 0 \) is sharper than \( \frac{dN}{dN} > 0 \) since here we predict that the positive relationship between the demand share of a mega center and the number of stores in its retail trade markets is stronger in retail trade markets in which consumers are more sensitive to differentiation. That is, the difference between the number of stores in small and large clusters (small and large measured in terms of demand shares) is greater in retail trade markets where

\(^{25}\) The total demand can be written as \( N = \sum_{i=1}^{77} x_i N \), where \( \sum_{i=1}^{77} x_i = 1 \). The demand faced by a store is given by \( \frac{dN}{dx} \) and the demand share of the mall is \( x_i \).
consumers are more sensitive to differentiation. Here we do not have a causality problem since consumer preferences are arguably not caused by the relationship between $B$ and $x$ (whatever its direction).

To test this prediction we run regressions on the relationship between the number of stores in a retail trade market and the size $x$ of a mega center for each of the 20 retail trade markets. We then rank the retail trade markets according to the strength of the estimates. If we judge that the ranking has a positive monotonic relationship to the sensitivity of consumers to differentiation we take this result as support for the empirical prediction.

Since we have data from just one point in time, the year (1997), we have no variation in the $n$ variable. Therefore we cannot test the empirical predictions from changes in the number of stores in the market $n$. Concerning the price predictions we have no data on costs, margins or prices so we are not able to test the predictions on prices.

In sum, there are four empirical predictions from the comparative statics section which we will test on data:

1. In a given mega center we expect more stores $B$ in retail trade markets where consumers are more sensitive to differentiation $b$, i.e. $\frac{dB}{db} > 0$.

2. In a mega center with a bigger share $x$ of $N$ the effect on the number of stores in a retail trade market from higher consumer sensitivity to differentiation is stronger, i.e. the effect predicted in 1., $\frac{d(\frac{dB}{dx})}{dx} > 0$, is stronger in mega centers with a bigger $x$. More intuitively; in mega centers with a large share of demand there are proportionally more stores in markets with more heterogenous products.

3. In a given retail trade market there are more stores $B$ in a mega center with a bigger share $x$ of $N$, i.e. $\frac{dB}{dx} > 0$.

4. In a retail trade market where consumers are more sensitive to differentiation the effect on the number of stores from a larger share $x$ of $N$ is stronger, i.e. the effect predicted in 3. is stronger in markets where consumers are more sensitive to differentiation, $\frac{d(\frac{dB}{dx})}{db} > 0$. More intuitively; the share of demand in the mega center has a greater impact on the number of stores in heterogenous markets than in more homogenous markets.

6.2 Data

I have chosen to investigate mega centers and malls in the most prosperous region of Sweden, the Stockholm region, which consists of 20% of the Swedish population (SCB[1998]). I use
cross sectional data on store composition from 1997 (the latest available). Store composition data, which might be used for studies of changes of store composition over time, has been collected approximately every third year since 1988. The data has been collected by Centrum Development [1998/1999] through a survey sent to those who run the specific mega centers in which the stores are located.26

Information is available on when the mega center opened, how big the parking lot is, how big the retail trade turnover is, which specific stores resides in the mega center and so on. By using this information it will be possible to test some of the empirical predictions of the model. Unfortunately we have no data available on sales margins or prices of stores so price predictions can not be tested.

We also use data from Statistics Sweden (SCB, [2000]) to control for the total number (in Sweden) of stores in the 20 retail trade markets we investigate. Even though the data is not from 1997 and even though it covers the whole of Sweden it is still useful (to be explained below) in the analysis of the empirical results below.

6.3 Empirical Results

The test of the first empirical prediction gave the following results which can be found in the table below:

---

26 This may be the manager of the mall or the person responsible for agreements with the stores that resides in the mall or mega center.
<table>
<thead>
<tr>
<th>Service</th>
<th>Average number of stores in a mega center</th>
<th>Total number of stores in retail trade markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clothes</td>
<td>7.48</td>
<td>6536</td>
</tr>
<tr>
<td>Restaurants</td>
<td>2.14</td>
<td>17353</td>
</tr>
<tr>
<td>Groceries</td>
<td>1.49</td>
<td>7641</td>
</tr>
<tr>
<td>Café</td>
<td>1.36</td>
<td>n.a</td>
</tr>
<tr>
<td>Shoes</td>
<td>1.21</td>
<td>1154</td>
</tr>
<tr>
<td>Banks</td>
<td>1.19</td>
<td>2083</td>
</tr>
<tr>
<td>Hairdresser</td>
<td>1.12</td>
<td>13045</td>
</tr>
<tr>
<td>Kiosk</td>
<td>1.04</td>
<td>4008</td>
</tr>
<tr>
<td>Sports/Cycles</td>
<td>0.86</td>
<td>3442</td>
</tr>
<tr>
<td>Home Styling</td>
<td>0.84</td>
<td>2979</td>
</tr>
<tr>
<td>Flowers</td>
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<td>2327</td>
</tr>
<tr>
<td>Fruit/Candy</td>
<td>0.65</td>
<td>1257</td>
</tr>
<tr>
<td>Bags</td>
<td>0.65</td>
<td>328</td>
</tr>
<tr>
<td>Toys</td>
<td>0.64</td>
<td>665</td>
</tr>
<tr>
<td>Hamburger/Grill</td>
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<td>n.a</td>
</tr>
<tr>
<td>Books</td>
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</tr>
<tr>
<td>Furniture</td>
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<td>1219</td>
</tr>
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<td>Video Rental</td>
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<td>Travel Agent</td>
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<tr>
<td>Paint Store</td>
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<td>872</td>
</tr>
</tbody>
</table>

The second column in the table has the purpose of controlling for the total number of stores in the 20 retail trade markets for the whole of Sweden. That is, the explanation for why the average mall contains different number of stores in different retail trade markets could simply be that the total number of stores differs between the retail trade markets. But looking in the table indicates and a correlation analysis immediately confirms that the correlation between the columns is quite low (0.372). There are, for example, 17353 restaurants in Sweden and only 6536 cloth stores but the cloth stores are still much more common in malls. There are more toy stores than furniture stores in malls but furniture stores are much more common in

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27This column of the table gives the total number of stores in each retail trade market, respectively, for the whole of Sweden for the year of 2000. Source, SCB (Statistics Sweden) [2000].
the total. Hence, the observation that there are much larger number of stores in certain retail trade markets in malls can not be explained solely by a greater total number of stores in those retail trade markets.

We now ask ourselves whether the ordering of the retail trade markets in the table above corresponds to an ordering of the markets in terms of consumer sensitivity, that is does the table show that \( \frac{dP}{dM} > 0 \)?

By inspection we see that in the top there are markets like clothes, restaurants, groceries, cafés, shoes and banks. In the bottom there are paint stores, travel agents, video rentals, furniture- and book stores. This seems to correspond reasonably well to an intuitive ranking of consumer heterogeneity. It is reasonable that people want to shop around more as they buy clothes, shoes and restaurants. Such stores sell more heterogenous products and consumers are likely to check out many alternatives before choosing where to buy. Concerning groceries it is somewhat surprising that it lies on the third place. One would expect a grocery store to cover most of the available products on the market, and also that its least efficient scale would imply comparatively few stores. One obvious explanation is that groceries is by far the biggest retail store category in terms of consumer expenses in a year,\(^{28}\) which might explain the high average number of grocery stores.

Concerning the furniture market one would expect that furniture is a type of goods for which consumers are highly sensitive to differentiation. The explanation for the relatively small number of stores may be that furniture stores have a quite high efficient scale which means that it is not possible for the market to support that many stores. Especially since furniture and home styling combined accounts for just 3\% of household expenditures.\(^{29}\)

Finally it is somewhat surprising that banks are frequently represented in clusters. Since consumers arguably do not shop around for banks and also since people do not visit banks that frequently. One explanation for the break of the pattern may be that the bank industry is not very competitive. That is, the competition does not make banks abstain from clustering.

We conclude that the ordering in the table corresponds to a rough ranking of the retail markets in terms of their heterogeneity. There is therefore support for our empirical prediction that in a given mega center there are more stores in retail trade markets where stores sell

\(^{28}\)The Swedish authority for official statistics, Statistics Sweden, reports in SCB, [1996] that expenses on groceries uses 14\% of the average household budget, which is at least three times bigger then the any other category of consumer spending on retail trade goods.

\(^{29}\)see SCB, [1996]
products for which consumers are more sensitive to differentiation.

The second prediction $\frac{d|\theta|}{dx} > 0$ sharpens the first prediction and it is tested empirically by constructing a measure $\frac{p_{\text{high}|-1}}{p_{\text{low}|-1}}$ which relates the number of stores in a mall within retail trade markets where consumers are sensitive to differentiation to the total number of stores in that mall. We consequently get a measure of the distribution of stores over the different retail trade markets in a mall. The prediction can hence be written, $\frac{d|\theta|}{dx} > 0$. Specifically, we expect a higher proportion of stores belonging to high sensitivity markets in mega centers with larger share of demand.

Since we lack data on the number of visitors for about half of the mega centers we will also use a proxy for $x$, namely the total revenue of retail trade stores in the mega center. The correlation between the two measures "visitors" and "retail trade revenues" are quite low (0.19) so if both measures deliver similar results the support for the tested empirical prediction is stronger. We also use two additional proxies, namely the total area (square meter) of the mega center and the number of parking places in the mega center. These measures arguably should have a connection to the number of visitors in the mega center. The correlation between "total area" and "retail trade revenue" are high (over 80 %) but the correlation between "total area" and "number of parking places" are very low (under 5 %).

The results from the regressions, for the revenue proxy, the total area proxy, the parking place proxy and the number of visitors, are ambiguous. That is, in mega centers with higher proportion of the demand there is not a significantly higher (or lower) proportion clothes-, restaurant- or other stores in categories with high $b$. In sum, we do not find support for the second prediction that larger mega centers have proportionally more stores in retail trade markets where consumers are more sensitive to differentiation.

The third prediction $\frac{dN}{dx} > 0$ says that in a larger mega center we expect more competing stores in a given retail trade market. This prediction must be interpreted very carefully since the causality might as well go in the opposite direction, i.e. mega centers with more competing stores get more visitors. Not surprisingly the regressions for the number of visitors $x$, for the revenue proxy as well as for the area proxy show positive relationships which are

\[30\] With a richer data set we could have controlled for factors like income per capita and population density in the area of a particular mega center. Other important control factors would have been proxies for the efficient scale of stores in different retail trade markets as well as proportion in the consumer/family household budget for goods in the retail trade markets, respectively. Such data are either not available or the existing data can not be satisfactory matched with our data set.
highly significant.

Specifically, we find that an increase in sales in a mega center by 100 M Skr corresponds to an increase in the average number of stores in a given retail trade market by 3.35.\textsuperscript{31} Similarly an increase in visitors by 1 million corresponds to an increase by 4.37 stores. Moreover, an increase in total square meter area by 1000 sqm corresponds to an increase of the average number of stores by 0.88 in a given market. The number of parking places has no significant effect.

In sum, using a few different empirical measures, we find strong support for the empirical prediction that there are, for a given market, more competing stores in a mega center with a larger share of total demand. However, the relationship might also be reversed, i.e. there might instead be more visitors (higher revenues) if there are more competing stores in a given retail trade market.

The fourth prediction sharpens the third by telling us that the effect of more visitors (or more sales, or more space) on the number of stores is stronger in those retail trade markets in which consumers are more sensitive to differentiation. We empirically confirm the result that \(\frac{dI_{1/n}}{dx} > 0\), both when \(x\) is taken to be the number of visitors, when we use the proxy retail trade revenues and when we use the proxy total square meter area. Intuitively the confirmation of this prediction means that we observe a stronger increase in the number of stores in high \(b\) retail trade markets as we vary the size of mega centers.

To test this fourth prediction we ran regressions on each retail trade market using the three proxies, each at a time, as explanatory variables. Then we ranked the estimates according to their strength so that the retail trade market with the strongest impact from \(x\) on \(B\) ranked highest and so on. Taking the average rank of each retail trade market from the three regressions gave us the following average ranking of the markets:\textsuperscript{32}

\textsuperscript{31} The reasonableness of this figure may be compared with an investigation on Swedish retail trade stores where median revenues 1997 were 1.9 million Skr (approx. 190,000 USD) (HUI, [2001]). 3.35*20=67 gives the expected number of additional stores in a mall with 20 retail trade markets when turnover increase by 100Mskr (10 million USD). If we divide 100/67=1.49. That is, 1.49 million Skr to compare with 1.9 million Skr.

\textsuperscript{32} See Appendix 1 for more details. By average position is meant that for example the category clothes ranks 10 or better, on average, in the three tests in which we use the three different proxies as explanatory variables. The category furniture, on the other hand, ranks 11 or worse, on average, in the tests and so on.
<table>
<thead>
<tr>
<th>average rank</th>
<th>average rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>11-20</td>
</tr>
<tr>
<td>clothes</td>
<td>furniture</td>
</tr>
<tr>
<td>shoes</td>
<td>candy/fruit</td>
</tr>
<tr>
<td>café</td>
<td>books</td>
</tr>
<tr>
<td>restaurant</td>
<td>toys</td>
</tr>
<tr>
<td>home styling</td>
<td>kiosk</td>
</tr>
<tr>
<td>sport</td>
<td>groceries</td>
</tr>
<tr>
<td>bags</td>
<td>hair dresser</td>
</tr>
<tr>
<td>banks</td>
<td>grill/hamburger</td>
</tr>
<tr>
<td></td>
<td>flowers</td>
</tr>
<tr>
<td></td>
<td>travel agent</td>
</tr>
<tr>
<td></td>
<td>paint</td>
</tr>
<tr>
<td></td>
<td>video rental</td>
</tr>
</tbody>
</table>

The table gives a quite clear message. The proportion of the consumer population $x$ (visitors, retail trade turnover and total square meter area, respectively) has a greater impact on clustering in markets where consumers are more sensitive to differentiation, i.e. markets where people like to shop around.

It is somewhat problematic that the fourth prediction are confirmed in data but not the second. That is, these predictions essentially say the same thing so they should both be confirmed or none of them. A plausible explanation for this contradiction is that the second prediction is tested by using quantitative data; the proportions of high sensitivity markets are regressed on the number of visitors and the proxies. The fourth is tested by inspection of tables with correlations between the number of stores and the number of consumers in the different retail trade markets. A confirmation of the second prediction would mean a stronger (more reliable) support for our hypothesis. Nonetheless, the empirical rankings give support to our fourth prediction which says that the difference between mega centers in terms of the number of stores (resulting from different proportions of the consumer population or some proxies of that) is greatest in heterogenous retail trade markets.
7 Conclusions

In this model stores cluster to pool their marketing spending in order to achieve greater visibility among consumers. Comparative statics show that in malls/mega centers we should expect more competing stores in retail trade markets where people like to shop around, that is where products are more heterogenous and people like to compare products before they buy. This effect is expected to be strengthened if a mall is larger in terms of more visitors or more retail trade revenues. We also expect that the proportion of the consumer population that visit the mega center (as well as proxies) is positively correlated with the number of stores in that mall, i.e. more consumers means more stores. This latter effect will be greatest in the most heterogenous retail trade markets.

We also show that in this model there will be too little clustering compared to what a social planner would have preferred. The usual result in the literature is that clustering is excessive. The exclusion of geographic travel costs of consumers is of course a problem in our welfare result, but as discussed in the analysis it is valuable to point out that the excessiveness result might be reversed with other assumptions on the welfare gains and losses of clustering.

In the theoretical part of the paper there are two natural extensions. First, it would be a great step forward to specify in more detail how clustering and pooling of marketing expenses increase the visibility of individual stores. Second, more efforts are needed to increase the theoretical understanding of the social pros and cons of clustering.

In our empirical investigation of malls and mega centers in the Stockholm region we find support for the prediction that in retail trade markets where products arguably are more heterogenous there are more competing stores in mega centers. We also find an increase in the number of competing stores when the number of visitors (and some proxies for visitors) in a mega center increase. This effect is more pronounced in markets where products are more heterogenous.

8 References


[12] HUI (The Swedish Research Institute of Trade) [2000], (in Swedish) "Handelns Strukturomwandling i Stockholmsregionen", www.hui.se


Interview:

9 Appendix 1

Results from the test of the fourth empirical prediction above. Three different proxies for the demand share of a mega center. As can be seen from the three tables below there are some results saying that $\frac{du}{dn} < 0$, but these are highly insignificant. Inspecting the tables below and taking the average place on the list for each retail trade market give the picture that the categories in the top of the tables are categories for which $b$ is high. The sign * indicates significance on at least the 10 % level. The columns report changes ($\Delta$) in the number of stores from changes in the three proxies, respectively.
<table>
<thead>
<tr>
<th>retail trade revenue</th>
<th>Δ stores from 100MSkr</th>
<th>visitors</th>
<th>Δ stores from 1 M visitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>clothes</td>
<td>1.52*</td>
<td>clothes</td>
<td>2.42*</td>
</tr>
<tr>
<td>shoes</td>
<td>0.22*</td>
<td>café</td>
<td>0.43*</td>
</tr>
<tr>
<td>sports/cycles</td>
<td>0.18*</td>
<td>restaurant</td>
<td>0.27</td>
</tr>
<tr>
<td>café</td>
<td>0.18*</td>
<td>home styling</td>
<td>0.23*</td>
</tr>
<tr>
<td>home styling</td>
<td>0.18*</td>
<td>shoes</td>
<td>0.17*</td>
</tr>
<tr>
<td>bags</td>
<td>0.16*</td>
<td>kiosk</td>
<td>0.12*</td>
</tr>
<tr>
<td>furniture</td>
<td>0.12*</td>
<td>candy/fruit</td>
<td>0.12*</td>
</tr>
<tr>
<td>toys</td>
<td>0.12*</td>
<td>books</td>
<td>0.11*</td>
</tr>
<tr>
<td>groceries</td>
<td>0.11*</td>
<td>hair dresser</td>
<td>0.08</td>
</tr>
<tr>
<td>restaurants</td>
<td>0.11</td>
<td>flowers</td>
<td>0.08*</td>
</tr>
<tr>
<td>banks</td>
<td>0.10*</td>
<td>bank</td>
<td>0.08</td>
</tr>
<tr>
<td>books</td>
<td>0.10*</td>
<td>bags</td>
<td>0.08</td>
</tr>
<tr>
<td>candy/fruit</td>
<td>0.09*</td>
<td>sports/cycles</td>
<td>0.06</td>
</tr>
<tr>
<td>grill/hamburger</td>
<td>0.05*</td>
<td>furniture</td>
<td>0.05</td>
</tr>
<tr>
<td>kiosk</td>
<td>0.05</td>
<td>grill/hamburger</td>
<td>0.04</td>
</tr>
<tr>
<td>travel agent</td>
<td>0.02</td>
<td>travel agent</td>
<td>0.03</td>
</tr>
<tr>
<td>flowers</td>
<td>0.02</td>
<td>toys</td>
<td>0.03</td>
</tr>
<tr>
<td>paint</td>
<td>0.008</td>
<td>video rental</td>
<td>0.003</td>
</tr>
<tr>
<td>hair dresser</td>
<td>-0.006</td>
<td>paint</td>
<td>0</td>
</tr>
<tr>
<td>video rental</td>
<td>-0.006</td>
<td>groceries</td>
<td>-0.03</td>
</tr>
</tbody>
</table>
total square meters \( \Delta \) stores from 10 thousand sqm

<table>
<thead>
<tr>
<th>Item</th>
<th>( \Delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>clothes</td>
<td>2.4*</td>
</tr>
<tr>
<td>shoes</td>
<td>0.53*</td>
</tr>
<tr>
<td>restaurant</td>
<td>0.47*</td>
</tr>
<tr>
<td>café</td>
<td>0.39*</td>
</tr>
<tr>
<td>cycles/sport</td>
<td>0.38*</td>
</tr>
<tr>
<td>bags</td>
<td>0.31*</td>
</tr>
<tr>
<td>banks</td>
<td>0.31*</td>
</tr>
<tr>
<td>home styling</td>
<td>0.27*</td>
</tr>
<tr>
<td>groceries</td>
<td>0.25*</td>
</tr>
<tr>
<td>toys</td>
<td>0.25*</td>
</tr>
<tr>
<td>furniture</td>
<td>0.24*</td>
</tr>
<tr>
<td>candy</td>
<td>0.22*</td>
</tr>
<tr>
<td>books</td>
<td>0.19*</td>
</tr>
<tr>
<td>grill/hamburger</td>
<td>0.15*</td>
</tr>
<tr>
<td>kiosk</td>
<td>0.14*</td>
</tr>
<tr>
<td>travel agent</td>
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</tr>
<tr>
<td>hair dresser</td>
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</tr>
<tr>
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<td>0.07*</td>
</tr>
<tr>
<td>paint</td>
<td>0.02</td>
</tr>
<tr>
<td>video rental</td>
<td>0.01</td>
</tr>
</tbody>
</table>

10 Appendix 2

To prove the comparative statics result we combine (9) and (10) to get:
\[
\frac{bN}{n^2} = \frac{[\theta(B^*)]^2}{\theta_B(B^*)} R_B(B^*)
\]

An exogenous increase in the number of brands \( n \) in the market may be due to abolished regulations\(^{33}\) or new technologies that allow more differentiation of a product (more brands). If one remembers that \( \theta_B(B^*) > 0; \theta_B(B^*) < 0; R_B(B^*) > 0; R_B(B^*) < 0 \) it is easy to see in (11) above that an exogenous increase in the number of brands \( n \) leads to a decrease in the number of stores in clusters, that is \( \frac{dn}{dn} < 0 \).

This result is interesting since one would perhaps expect that more brands available on the market would lead to more brands in a cluster. To see why these results occur we look in the first order conditions (9) and (10). As we see in (10) if \( n \) increases the marginal revenue of clustering decreases which must be compensated by decreasing \( B \) to decrease clustering costs and increase the price \( p \).

The effect on mark-ups is ambiguous which can be seen by using (11) and rewrite to get
\[
bN = \frac{n^2 \theta^2 B}{\theta_B}.
\]
As \( n \) increase \( B \) has to decrease which put an upward pressure on the price which can be seen in (9). But we also see in (9) that an increase in \( n \) put a downward pressure on the price. The total effect of these effects is ambiguous. Therefore, \( \frac{dn}{dn} = ? \).

Concerning the effect of an exogenous increase in sensitivity to differentiation among consumers we see easily in (11) that this leads to an increase in the number of stores in clusters, i.e. \( \frac{dn}{dn} > 0 \). Total differentiation of (11) gives
\[
\frac{dn}{dn} = \frac{2N}{n^2 [R_B B[2R_B B^2 - 2] + 2R_B [R_B B^2 - 1]]} - \frac{\theta_B}{\theta_B} \frac{dn}{dn}
\]
which is positive, confirming \( \frac{dn}{dn} > 0 \). A second result (discussed under the table above) which we see from the total differentiation of (11) is that the effect will be bigger the bigger is \( N \). The intuition for the first result is that more sensitive consumers put an upward pressure on mark ups which we see in (9). The upward pressure on mark-ups increase marginal revenue from

\(^{33}\)An example is the much less rigid (and much more liberal) system for permitting the sales of alcohol in Stockholm Restaurants and Pubs which has been used for a couple of years.
clustering (10) which explains why clustering increase. The intuition for the second result is that marginal revenues increase even more if \( N \) gets larger.

The total effect on mark-ups from increasing sensitivity is ambiguous which can be seen if we first combine the total differentiation of (11) and the total differentiation of (9) with respect to \( B \), that is \( \frac{dN}{db} \frac{dp}{dB} \). We get an indirect effect from \( b \) via \( B \) to the price \( p \), but there is also a direct effect which we find if we differentiate (9) w.r.t \( b \), which give us \( \frac{dp}{db} = \frac{1}{nB} \). The total effect is ambiguous.

Finally we want to consider what happens when the number of consumers \( (N) \) on the market changes. It follows immediately from (11) that \( \frac{dN}{dN} > 0 \). This is simply because the marginal revenue of clustering increases when there is more consumers (10).

Regarding the mark-ups we see in (9) and (10) that they go down as the number of consumers go up. This is because consumers are more informed due to the higher number of brands in a cluster. If we total differentiate (11) we get: \( \frac{dB}{dN} = \frac{2h}{n^2[BH-2][2BH-3][BH-1]-2h-n} \), which is positive and confirm our result. We also see that the more sensitive consumers are (higher \( b \)) the stronger the effect on \( B \) from \( N \) and vice versa.