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The effects of geographical competition and demand on grocery price premium

Kari Halme, Laurea University of Applied Sciences, Ratatie 22, 01300 Vantaa, Finland, kari.halme (at) laurea.fi

Abstract
Due to the duopolistic characteristics of the Finnish grocery retail trade proprietor-run stores operate as adaptive price setters on the market. This paper examined the effects of geographical competition and demand on proprietor-run grocery stores' pricing in Finland's most populated province –Uusimaa. The assumption is that the price premium of a proprietor-operated store compared to the nearest co-operative competitor reflects the characteristics of competition and demand. Hypotheses on the influence of competition environment and demand environment on proprietor-operated store's price premium were constructed based on literature review. The respective prices of a twelve-item shopping basket were collected for the study by on-site observations in all of the supermarkets and hypermarkets in Uusimaa. A linear multiple regression analysis showed a statistical significance in explaining the price premium by average home floor space in a store's catchment area and store format compared to the closest co-operative competitor. A semiparametric geographically weighted regression slightly improves the linear model.

Keywords: grocery trade, Uusimaa, price premium, geographically weighted regression

1. Introduction

The price of products is the only element of retail marketing mix that generates revenue for a grocery store, and therefore of crucial importance in generating profit for a proprietor. Retail pricing is a complex matter. There are numerous factors that influence the price level retailers choose to set for their product assortment.

Ville Aalto-Setälä (2002) conducted an earlier study on Finnish retail grocery pricing, which was based on data from the years 1995 and 1997. Since his study, the structure of the Finnish retail grocery market has become more concentrated. Two major retail organizations in Finland command 79,7% of the grocery market in Finland leaving the rest to a handful of smaller chains and independent shops (Nielsen 2014). The market share of SOK, the market leader in the grocery retail trade, was 45,7% in 2013(Nielsen 2014). Later in this text SOK is referred to as a co-operative. The national market share in the grocery retail trade of Kesko, the follower, was 34,0% (Nielsen 2014). Kesko is a type of retail franchising company listed in Helsinki stock exchange. Later in this text the proprietors under Kesko are referred to as proprietors.
Clarke (2000, 983) states that in a duopolistic situation retailers have a choice whether to pass on their purchasing power or to retain the margin to themselves. Even though the Finnish grocery market is very close to duopoly it follows a different logic. The goal of the co-operative is to supply goods to the consumer-owners at prices that ensure the continuity of the company without excess profits. Kesko strives to create profits for both the owners of company stocks and the franchisees i.e. proprietors who run the stores.

Geographical economics assume that agents (sellers and buyers) occupy effectively identical positions in an undifferentiated space, where spatial separation is predominantly modeled as a "distance friction" parameter (Plummer & Sheppard 2008, 3-4). In this approach equilibrium prices depend on the location of consumers relative to businesses and on conjectures about pricing behavior of competitors. Duan and Mela (2009, 274) state that the omission of spatial correlation in demand leads to downward biased estimates of price effects and marginal costs in the small sample sizes common in the outlet location problem. Studies on gasoline prices in relation to pump location dominate the research on spatial factors influence on prices (Ning & Hainining 2003, Bettendorf, van der Geest & Varkevisser 2003, Heppenstall, Evans & Birkin 2006, Deltas 2008, Birkin & Heppenstall 2011). In these studies consumers are assumed to behave deterministically, purchasing from the cheapest producer.

Retail marketing is an alternative approach for studying price variation based on location. It takes into account a wider set of independent variables to explain the price-level of different retail stores. These variables include product attributes and brands (Nevo 2001), product and service ranges (Burt & Sparks 2003), demographic characteristics of demand and competitive environment (Hoch, Byung-Do, Montgomery & Rossi 1995) and micro-marketing (Montgomery 1997). The retail marketing approach to spatial price discrimination may offer a more realistic approach to consumer decision making processes than the geographical economics approach because it does not inflexibly aim at price equilibrium. However, the approach does fall short in incorporating the spatial aspect into models explaining spatial price discrimination.
A few perspectives in retail marketing prices and pricing in relation to space have been studied: spatial price discrimination (Bronnenberg & Albuquerque 2003, Vogel 2008), profit margin (Montgomery 1997, Hernant, Andersson, & Hilmoila 2007), and price elasticity (Hoch, Byung-Do, Montgomery, & Rossi 1995). These approaches have been based on the variation of the price of a single product or product composite over a geographical space and therefore share very much in common. Studies of the retail marketing approach to spatial price discrimination are somewhat older than the studies of geographical economics to spatial price discrimination.

Both Bronnenberg and Albuquerque (2003) and Plummer and Sheppard (2008) recognize that geographical space influences the pricing decisions of retail firms. Bronnenberg and Albuquerque (2003, 231-233) argue that spatial price discrimination is one likely outcome of retailers using geographical space as a source of differentiation in competition

when product differentiation is not enough to sustain profits. Plummer and Sheppard (2008, 3) note that retail firms operate under oligopolistic competition in spatially interdependent markets. They reason that individual stores occupy fixed locations in a heterogeneous space, setting prices under conditions of uncertainty, trying to sell a homogeneous set of products to spatially dispersed consumers who choose retailers based on their personal or household preferences.
Plummer and Sheppard (2008, 6) call for research on comparative cases of retailers pursuing best-response adjustment strategies. This paper is based on a perspective that individual proprietors attempt to benefit from all asymmetries prevailing in the geographic space surrounding their stores. Contrary to an earlier Finnish study on retail grocery pricing, which indicated that a larger market share lead to higher prices (Aalto-Setälä, 2002), the basic assumption of this paper is that a proprietor always tries to maximize the price premium that can be set on the price-level of the closest co-operative rival (see also Duan & Mela 2009, 267).

This study aims to detect whether price premium exists and which of the spatial variables affect it and how. Digal and Ahmadi-Esfahani (2002, 572) call for disaggregated data to analyse retail prices of fast moving food products. They argue that geographically aggregated data distorts price relationships. In this study the analysis of catchment area demographic characteristics has been based on Grid Database Finland 2006 (Statistics Finland 2006), which locates all the permanent residents in the country and aggregates their demographic characteristics into 250m*250m grid cells. This enables a store-level analysis of the demographic characteristics of a catchment area on a low aggregation level. In contrast to Chisholm and Norman's (2012, 222) approach where they treat price as a competitive factor explaining movie theatre attendance, this study treats price and specifically price premium as a dependent factor which reflects the location of a grocery store. In this study price premium is the difference in euros that a proprietor-run store charges over its nearest co-operative competitor for an identical twelve item shopping basket.

Stores in supermarket and hypermarket formats make up the population of this study. The study area is the province of Uusimaa, which is located in Southern Finland. Uusimaa is the most populated of Finland's provinces with a population of 1,6 million inhabitants and population density of 170/km^2. In the earlier retail studies the effects of spatial variables were not allowed to change over space, but they were treated as regular independent (global) variables. In order to understand a store-level pricing dynamics geographically weighted regression (GWR) analysis was applied to the collected data. GWR calculates the equation for each store and detects variables whose influence varies over space. Semiparametric GWR can incorporate both global and local variables in analysis, which fit well to the setting of this study where both influences of both chain management (global) and proprietor's decision making are present (see also Aalto-Setälä 2002, 207).

This paper is organized as follows. First, the literature on the effects of spatial competition on grocery store is reviewed and hypotheses based on the findings are established. In the next section the factors making up the demand of a grocery store are summarized based on literature. The literature review of both spatial competition and demand indicate that dependencies of price-levels of grocery stores on local competition and demand are established in several studies. In the methodology chapter the market situation of the study area market situation is briefly presented, as well as a description of the data collection, secondary data sources and methods for analyzing the data. The following section includes the results of the study. Finally the implications of the results are discussed and avenues for future research are recognized.

2. Grocery retail competition

An assumption behind this study is that the price premium that a proprietor can set over the co-operative competitors stems from two set of explicit types of factors: the competitive setting and the demand, i.e. geodemographic characteristics of the population in a store's catchment area. In this study only horizontal competition is explored, vertical competition within the retail market is excluded. Plummer and Sheppard (2008, 17) conclude that the geography of competition makes a significant difference to the nature and degree of competition between firms and the resulting distribution of prices, outputs and profits. Spatial heterogeneity, and persistent unequal prices and profits, would also occur if patterns of heterogeneity vary across space. They continue that persistent out-of-equilibrium dynamics are associated with non-trivial distributions of prices and profit rates across firms in the same sector, whose shape and evolution complexly depend on spatiality of the market and the dynamical regime.

Dobson and Waterson (1996, 33-34) define retail as localized competition of services, which means that retail is able to exercise market power over competitors and geographically constrained consumers. Both Clarke (2000, 981) and Hernant, Andersson and Hilmoila (2007, 916-917) argue that perfect competition does not characterize the retail market even though rivals are selling homogeneous products. Retail does not provide a physical product but a utility of time and place at a point of sale. The market is not a single homogenous surface but a composition of geographically fragmented clusters. Space separating stores introduces monopolistic elements to competition within retail. Therefore, all stores possess some degree of monopoly power over their immediate market area. Naturally the conditions of local competition vary a lot ranging from near monopoly to nearly perfect competition. Clarke (2000, 981) argues that individual retail establishments have a degree of monopoly power resulting from their local uniqueness. The uniqueness arises from consumer ignorance resulting from high consumer search costs and strong preference to one-stop-shopping.
Both Hoch et al. (1995, 17) and Montgomery (1997, 315) were able to identify both demographic and competitive variables that explained a significant proportion of the variation in price elasticities. Wood and McCarthy (2013, 11) state

that characteristics of store competition – brand, store size, range, facilities and location in relation to competitors limit the pricing freedom. Hernant et al. (2007) established a significant dependency of retail chain profitability on local competitive conditions. They operationalized competition through five components: number of competitive stores within catchment area, number of equivalent stores, number of equivalent chains, distance to nearest competitor and store's share of total selling area (Hernant et al. 2007, 920).

In alignment with Zhu and Singh (2009, 3) the premise of this study is that price premium reveals the characteristics of a proprietor-operated store's spatial competition environment and characteristics of local demand environment. Chisholm and Norman (2012, 214) used two location measures to test competition or agglomeration effects: the Euclidean distance to from each theatre to its nearest first-run neighbor; and the number of theatres within a defined radius of the theatre. In this study the effect of agglomeration was assumed negative, more competitors within catchment area lower the price premium. Hoch et al. (1995, 19) hypothesized that trading (or catchment) areas with greater retail density display greater price dispersion. They used the average distance in miles to the nearest five supermarket competitors as an independent variable. In this study the effect of competition intensity is formalized in hypothesis 1 (H1).

H1 The lower the number of competing stores within the catchment area of the proprietor-operated store is the higher the price premium of the proprietor store is.

In models of geographical economics, the trade cost of goods is a key parameter (Brakman & Gerretsen, 2003, 641). The retailers need to find a trade-off between proximity to competitors and the desirability of certain location characteristics (Zhu & Singh, 2009, 5). Based on previous theory Chisholm and Norman (2012, 212) made an assumption within the movie theatre industry that theatres located distant from their neighbours would charge higher prices than their co-located counterparts, taking advantage of their relatively isolated position in the market. However, in their study Chisholm and Norman found that variation in prices was limited and not-significantly dependent on spatial competition. Within this study the distance to competitor variable is retained, based on the higher proportion of groceries of consumption and the nature of the product group in consumers' and households' need hierarchy. Chisholm and Norman (2012, 225) found that within the movie-theatre industry the attendance is positively correlated with the distance to the nearest neighbour. The assumption behind the second hypothesis (H2) is that the longer the distance to the closest competitor the more the store has a kind of primary catchment area i.e. customers who perceive travel cost too high to overcome the competitors offering.

H2 The longer the distance to the nearest co-operative store, the higher the price premium of the proprietor-operated store is.

Deltas (2008, 618) states that the variation of retail margins in gasoline prices is largely due to variation in local market power. When studying price elasticities Hoch et al. (1995, 19-20) used retail format as one of the independent variables and they found that larger volume stores would be more price sensitive than smaller stores. Zhu and Singh (2009, 25) report that in the proximity of a Wal-Mart Supercenter competitors are able to attract significantly lower proportion of the surrounding population as loyal customers. Montgomery (1997, 330) found that the prices of the stores close to warehouse competitors are 10% lower. Because of the duopolistic competition on the Finnish grocery market, the hypothesis (H3) on the influence of format is formulated as follows:

H3 The bigger the format of the proprietor-run store compared to the nearest co-operative is the lower the price premium of the proprietor-run store is.

Later on in the text these three hypotheses are referred to as the proprietor-operated store's competitive environment.

3. Demand factors of retail

According to Wood and McCarthy (2013, 11) the size and characteristics of the local population and its location in relation to store constitute the basic demand potential. Bronnenberg and Albuquerque (2003, 222) define that a consumer belongs to a market when spatial limits also restrict his/her arbitrage. In his cost-price margin study Nevo (2001, 316) adds demographic variables to the model consequently improving it. He states that city-specific valuations may be a function of demographics, and if demographics are correlated within a region these valuations will be correlated.

Schroeter and Azzam (1991, 995) concluded that within the packed pork meat market, the size of a population of an area explains the price margin companies are able to charge. In a similar fashion Zhu and Singh (2009, 21) found that closer population contributes more to profitability of grocery stores than distant. The fourth hypothesis (H4) is simply formulated as follows:

H4 The more population the catchment area of the store has the more the proprietor has pricing freedom.

Identical retail offers may perform quite differently across space due to differences between their respective catchment areas, not least due to the characteristics of local consumers (Wood & McCarthy 2013, 9). Hoch et al. (1995, 23) used the percentage of the population over 60 years, college education, households with five or more members as variables predicting negative relationship with price elasticity. They also included median income and percentage of the homes with a value greater than $150 000 in independent variables. Nevo (2001, 235) reports that the prices of cereals increases with income, while age and household size are nonsignificant. Both Hoch et al. (1995,23) and Nevo (2011, 237) found that older consumers are less price sensitive. This leads to the following hypothesis (H5):

H5 The higher the proportion of older population within the catchment area of a proprietor-run store, the higher the price difference is.

More educated consumers have higher opportunity costs, so they devote less attention to shopping and therefore are less price sensitive (Hoch et al. 1995, 28, Nevo 2001, 237). This result is converted to the following hypothesis (H6):

H6 The higher the proportion of more educated population within the catchment area of a proprietor-operated store, the higher the price difference is.

A second finding of Hoch et al. (1995, 28) was that large families are more price sensitive. The resulting hypothesis (H7) in this paper is:

H7 The bigger the average household size within the catchment area of a proprietor-operated store the lower the price premium is.

In addition Hoch et al. (1995, 28) found that households with larger more expensive homes are less price sensitive. A straightforward approach would be to think that larger homes indicate more prosperous households. However, families need to find a trade-off between home floor space, convenient location and price. Lower average home floor space indicates smaller families and less opportunity to use car for grocery shopping. This aligns with Montgomery's (1997, 330) finding that stores in urban locations set the price level 10 % higher. Therefore, the next hypothesis (H8) is formulated as follows:

H8 The lower the average home floor space within the catchment area of a proprietor-operated store, the higher the price premium is.

Poorer consumers are found to be more price and distance sensitive than richer consumers (Beckert 2010, 27; Nevo 2001, 237). Finnish data contains annual purchasing power per household which is used for establishing the income variable of demand environment. Purchasing power per household is the result of the sum of income subtracted by state and municipal taxes divided by the amount of households within a geographical statistical unit. The resulting hypothesis (H9) is:

H9 The higher the annual purchasing power per household within the catchment area, the higher the price premium of the proprietor-operated store is.

Lal and Pathak (2011, 105) report that 30% of all urban travel behavior involves trips to more than two shops and often involve more than one purpose. Within Uusimaa, which makes up the study area 41% of the labor force commutes outside its' home town or municipality (Huhta & Pyykkönen, 2013). Consumers' tendency to combine shopping with work is taken in account in the following hypotheses (H10).

H10 The higher the sum of employment within the catchment area of a proprietor-operated store is the higher the price premium is.

Later in this text variables constructed on hypotheses 4-10 are referred to as the proprietor-operated store's demand environment.

4. Methodology

4.1 Research context

The grocery retail trade is heavily concentrated in Finland. Four main players constitute a total of 93,4% of the market share. One of the main players is SOK, which is a federation of provincial co-operatives that cover the whole country. The co-operatives are owned by consumers and the mission of SOK is to supply groceries cost-efficiently. SOK retains only sufficient profit to maintain its competitive store network. It runs successful national chains both in supermarket and hypermarket formats.

Another main player is Kesko that has shares listed in the Helsinki Stock Exchange. The main shareholder group of the company is the proprietors of independent stores. Kesko is responsible for managing the national-level and province-level marketing of the proprietor-run supermarket and hypermarket format stores. The proprietors are in charge of the local marketing of their own stores. Proprietors receive pricing guidelines for their sales range from Kesko but are only committed to uniform prices shown in national or provincial advertising campaigns. The idea should be that proprietors are able to adjust the product and service range, marketing communication and price-level of their stores so that they can maximize their profitability. The two other significant chains Suomen Lähikauppa (7,0%) and Lidl (6,6%) do not run stores in supermarket or hypermarket formats. Therefore, the analysis of their impact on the proprietor-run stores' price-level is excluded even though it is highly realistic to assume that they have locally differing influence especially on the proprietor supermarkets. Currently, Kesko has made a bid to buy Suomen Lähikauppa. If the contract materializes, it will strengthen the duopolistic characteristics of the Finnish grocery trade.

Every proprietary-run store and co-operative store in supermarket and hypermarket formats was visited in the Province of Uusimaa. Only four supermarket format stores located in the study area were excluded from the data collection of this study. They are run by an upscale department store chain called Stockmann.

4.2 Data Collection

Location planning research has produced plenty of methods for defining catchment areas for individual stores or shopping destinations (Yrigoyen & Otero 1998). However, there remains an interesting gap between academia and industry in the catchment area definition. Academics rarely gain an access to the loyalty card information of major retailers (Newing, Clarke & Clarke 2013, 490), which would clearly help in establishing the robust models for catchment area analysis.

Huff's model is a classic solution within the discipline of retail catchment area definition but it is more applicable to retail shopping destinations rather than modelling on site competition of consumers with diverse aspirations. Thiessen polygons (Yrigoyen & Otero 1998), Euclidean distance, driving and walking distance and time (Competition Commission of United Kingdom 2005; Roig-Tierno, Baviera-Buig & Baviera-Buig 2013) have been used as basis for defining catchment areas. More sophisticated approaches have included proprietors' own definitions of catchment area (Hernant et al. 2007), critical number of available stores for consumers (Beckert 2010) and catchment area that is based on store's sales revenue (Hoch et al. 1995).

Because the goal of this study is not to establish norms for placing grocery stores profitably on the market but rather to analyse the impact of demand and competition factors on price-level, the catchment area definition is based on more simple criteria. This work combines both walking time and driving time approaches to the catchment area. The goal of these dual catchment areas is to reveal whether close range or long range catchment areas have a different effect on the price premium that proprietor-owned stores can charge. Walking catchment is represented by 500 meters Euclidean distance around the store. This complies with Guy and David's (2004) study in which they define urban areas with over 500 meters distance to a grocery store as food deserts. Marjanen and Malmari (2012, 48) found in their survey that the longest acceptable walking distance to a grocery store is one kilometer for 80% of respondents. In addition, they found clear evidence to define catchment areas of stores based on distance to stores and consumer behavior. The second catchment area constitutes of 5 kilometers road access around a proprietor-operated grocery store. Same independent variables were included from both 500 meters Euclidean walking distance and 5 km road distance. This choice was based on an explorative study on Grid Data Finland 2006. In the province of Uusimaa 95,2% of the population live within 5 kilometers driving distance of a proprietor-operated supermarket or hypermarket. Also, this catchment area definition covers 86,8% of grid cells in the study area. As Kananen (2008, 105) notes this approach includes an unrealistic 100% consumer catchment assumption, but in this study it is mitigated with the inclusion of the following independent variables: distance to closest competitor, density of competitors and format comparison to closest co-operative.

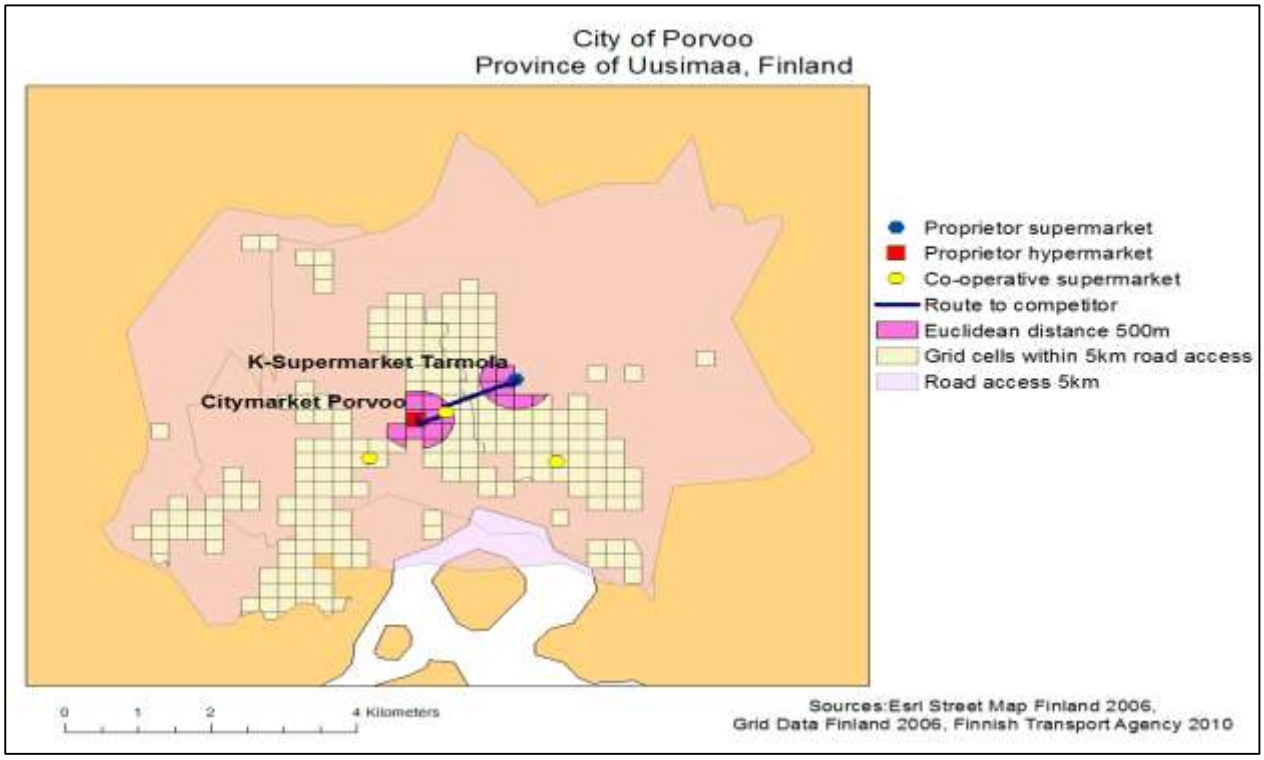

Figure 1. Example of data collection at one of the locations of the study.

Figure 1 visualizes the data collection setting of this study. Both competitive and demand factors are incorporated into the map. The example is from the city of Porvoo which is located 50km east of Helsinki. Proprietor-run stores are placed on the map with labels, since they are of main interest in this study. The map portrays two catchment areas applied in this

work: 500meters Euclidean distance which strives to denote the walking catchment area and 5kilometers road distance that is referred to as the driving catchment area. The idea is that in some environments these two might differ significantly in their characteristics. Co-operative competitors within the walking and driving catchment areas are mapped without a label as yellow hexagons. In this example for both Citymarket Porvoo and K-Supermarket Tarmola four competitors are regarded in the analysis, three co-operative stores and one of the aforementioned. For both proprietor-run stores the closest co-operative competitor is the one located between them. The price difference is based on the comparison of the total shopping basket sum to the closest co-operative competitor. The closest competitor is defined based on the closest facility function in ArcGis Network Analyst, with the Road and Street Network of Finland by Esri (Suomen Tie- ja katuaineisto) being used as the network dataset.

The grid cells of the Grid Database Finland 2006 contain the information on the demand factors. This study manages to use relatively finely aggregated data. The Grid Database Finland covers the whole of Finland, where 99 sosio-economic variables are aggregated into 250m*250m cells. The variables are categorized into 8 groups: age and sex, education, individual consumption, household size and the phase of family life cycle, household consumption, building and accommodation, employment, and industry. Statistics Finland, the national statistics authority, receives data from various government data sources, merges them and maps them.

Firgo, Pennerstorfer & Weiss (2011, 9) recognize that many studies delimit local markets using borderlines of census tracts, municipalities or counties. That limitation does not apply to this study because all used datasets are independent of administrative borders with the exception that the study area is defined based on provincial border.

The shopping basket was created based on earlier studies of grocery shopping baskets in Finland (Pietarinen 2012, Inkinen 2013). The basket included twelve branded food products; the aim was to include products that have the best distribution coverage and to ensure comparability between grocery stores. A group of students of Laurea University of Applied Sciences collected the price data in February 2014 by visiting all the 152 stores in the study area. The total price data consists of 1968 cells of which 78 were missing. The missing price data was replaced with a chain average for that product. Table 1 presents the composition and key figures of the shopping basket.

Table 1. Shopping basket key statistics.

	Minimum	Maximum	Mean	S. D.
”HK” Ground Beef 400g	3,29	4,30	3,50	0,15
“Valio” Butter-Oil Mix Spread 400g	2,35	3,49	2,77	0,10
”Vaasan” Rye Bread	1,35	1,99	1,87	0,12
”Myllyn Paras” Dried Pasta 400g	0,18	0,39	0,29	0,03
“Valio Oltermanni” Cheese 1kg	5,19	11,39	6,54	0,95
”Valio” Skimmed Milk 1l	0,90	1,85	1,17	0,09
“Valio” Strawberry Flavored Yogurt 200g	0,31	0,58	0,47	0,03
Pepsi Max 1,5l	1,79	2,90	2,47	0,14
”HK Sininen Lenkki” Sausage 580g	1,99	2,99	2,87	0,18
”Saarioinen” Pizza Bolognese 200g	0,99	1,69	1,23	0,27
“Apetit” Bell Pepper-Pea-Corn Mix 200g	0,29	0,89	0,65	0,07
”Juissi” Mixed Juice 1l	0,84	1,39	1,12	0,13

The prices showed promising variation for analysis based on the key figures. There were 73 proprietor-operated stores, which were the main interest of this study. A sum of the shopping basket prices was calculated for each store and then the difference of basket price between each proprietor store and its closest co-operative competitor was calculated. Later in the text it is called Basket Difference, which is the dependent variable in this study.

4.3 Data analysis

Montgomery (1997, 325) argues that interstore competition must occur through general price levels. Reynolds and Wood (2010, 837) list multiple regression in the top 3 of spatial statistics analysis method used by retail location planning techniques. Earlier in this paper basket difference has been referred as the price-premium, being asymptotically a positive difference. The linear multiple regression was constructed as follows:

$$\text{BASKET DIFFERENCE}_i = \beta_0 + \beta_1 \text{COMPETITIVE ENVIRONMENT} + \beta_2 \text{DEMAND ENVIRONMENT} + \varepsilon_i$$

This construct aligns with Chisholm and Norman’s (2012, 211) model of the attendance volume of a movie theater, where attendance depends on location, attributes, relative attributes and demographics. In their model location is the

measure of theater clustering, attributes measure the theatre's attributes, while relative attributes measure theater's attributes relative to its nearest neighbors', and demographics control for the demographic characteristics of the population within a defined radius of the theater.

For hypothesis 3 the status of format of proprietor-run store was operationalized as follows. When a proprietor-run store was of a bigger format, it received the value +1. This was the status in eight cases. In eleven cases the proprietor store was of a smaller format than its nearest co-operative competitor, this was coded as -1. Equal format received the value 0.

The main task in geographical analysis is to recognize the unique, spatially autocorrelated and stationary characteristics of different store locations. Brunsdon, Fotheringham and Charlton (1996) developed geographically weighted regression (GWR) to extend regression analysis to reveal spatial dependencies between dependent and independent variables. The global linear regression analysis is not capable of detecting these spatial dependencies. The nature how locations differ from each other could be analyzed with GWR.

For this work the (GWR) model was built according to the procedure suggested by Fotheringham et al. (2012, 8-11). First, global linear regression was run. The variables were excluded from the regression equation using stepwise process. Afterwards the global linear regression, GWR was applied for additional analysis to reveal potential location dependent differences in shopping basket prices. The variables that indicated statistically significant impact in linear multiple regression were included in the GWR.

The assumption was that the price-level difference varies over the geographical area under study and that GWR explains the difference better than a global linear regression. The purpose of using GWR was also to reveal the geographically varying strength of independent variables over price-level difference. In GWR the parameters of regression equation are not constant but a function of location (Brunsdon et al. 1996, 284-287). Closer observations influence the regression more.

Geographically weighted regression software version four (GWR4) was used for analyzing the data of this study. It was developed by Nakaya, Charlton, Lewis, Brunsdon, Yao and Fotheringham (2012).

5. Results

The key descriptive statistics of the variables in Table 2 show that the dependent variable Basket Difference contains reasonable variation which warrants this study. Both Kolmogorov-Smirnov (sig. 0,184) and Shapiro-Wilk (sig. 0,075) tests of normality indicated that Basket Difference is normally distributed.

Table 2. Descriptive statistics of the variables.

Variable type	Variable name	Mean	S.D.
Dependent	Basket Difference	2,35	1,33
Competition	Distance	1106,67	1374,20
Competition	Format Strength	0,27	0,44
Competition	Amount of Comp 500m	0,64	0,54
Demand	Population 500m	4271	2995
Demand	Retired Pct 500m %	15,70	7,90
Demand	Academic Pct 500m %	15,50	7,40
Demand	Avg Household Size 500m	2,12	0,34
Demand	Avg Prch Pwr Hhld 500m	33,84	7,73
Demand	Avg HomeArea m² 500m	73,10	14,16
Demand	Sum of Emplmnt 500m	2109	4459
Competition	Amount of Comp 5km	5,53	3,82
Demand	Population 5km	92662	87783
Demand	Retired Pct 5km %	13,00	4,40
Demand	Academic Pct 5km	15,71	6,13
Demand	Avg Hhld Size 5km	2,36	0,29
Demand	Avg Prch Pwr Hhld 5km	38,99	6,65
Demand	Avg Home Area m² 5km	84,58	12,69
Demand	Sum of Emplmnt 5km	35251	58024

Of the independent variables Average Household Size and Average Home Floorspace m² in both catchment areas turned out to be highly correlated (500m ρ=0,857 and 5km ρ=0,912) (see Appendix 1). This could indicate that hypotheses 7 and 8 are overlapping. Similarly, Population 5km and Sum of Employment 5km reached a high correlation score (ρ=0,848), which also refers to collinearity (Metsämuuronen 2009, 645).

Following the procedure of GWR by Fotheringham et al. (2012, 8) global linear multiple regression was run first. Table 3 lists the results of the linear multiple regression.

Table 3. Estimates of coefficients and t-values.

Dependent variable: Basket Difference			
	Coefficient	Beta	t-score
(Constant)	-22,581		
Distance	0,00	-0,17	-1,23
Format Strength	-0,92**	-0,31	-2,71
Amount of Comp 500m	0,22	0,09	0,65
Population 500m	0,00	0,30	1,68
Retired Pct 500m %	-0,56	-0,03	-0,16
Academic Pct 500m %	-2,95	-0,16	-0,67
Avg Household Size 500m	-4,75	-1,22	-1,43
Avg Prch Pwr Hhld 500m	0,00	0,01	0,03
Avg HomeArea m² 500m	0,15	1,55	1,42
Sum of Emplmnt 500m	0,00	-0,36	-1,57
Amount of Comp 5km	0,09	0,26	1,61
Population 5km	0,00	-0,19	-0,56
Retired Pct 5km %	-4,82	-0,16	-0,48
Academic Pct 5km	5,79	0,27	0,55
Avg Hhld Size 5km	12,80	2,74	1,69
Avg Prch Pwr Hhld 5km	-0,06	-0,28	-0,55
Avg Home Area m² 5km[i]	-0,38	-3,64	-1,97
Sum of Emplmnt 5km	0,00	0,54	1,15

*Significance level p< 0,05, ** p<0,01

[i] Included in the final model

According to the results of regression analysis the spatial density of competition in nether catchment areas does not affect the price premium proprietors can charge. H1 was rejected. Contrary to multitude of studies in geographical economics, a proprietor stores' distance to the closest co-operative competitor doesn't strengthen the ability to set a higher price premium. H2 was rejected.

An overview of the results of the shopping basket prices among studied chains are shown in Table 4. S-market and K-Supermarket represent the supermarket format and Prisma and Citymarket belong to the hypermarket format.

Table 4. Shopping basket prices in the studied chains.

Chain	N	Mean	S.D.
S-Market, co-operative supermarket	73	24,22	0,43
K-Supermarket, proprietor-operated supermarket	54	26,45	1,33
Prisma, co-operative hypermarket	16	22,92	0,59
K-Citymarket, prorietor-operated hypermarket	19	25,52	0,67

Variance analysis assuming unequal variance showed significant statistical variation in the mean basket prices between the chains on 95% confidence level. The format of a proprietor in comparison to the closest co-operative competitor influenced the Basket Difference on a statistically significant level. This results aligns with the basket price averages presented in Table 4. It should be noted that Format Strength differed from zero in only 14 cases but despite that statistical significance of the variable was established. H3 was confirmed.

Typically in areas of high population density the cost of space is higher, which would require offsetting the higher cost by higher price level. According to the results the population of the proprietor stores catchment area did not influence the price premium that can be set on the assortment. H4 was rejected.

A higher proportion of retired people did not affect the price premium that the proprietors can set, despite a considerable variation of the variable especially in the 500m catchment area. H5 was rejected.

Due to the strong progression of income taxation in Finland, the academically trained people don't gain significantly more disposable income than people with lower education. The proportion of academically educated residents in the catchment area did not influence the price premium a proprietor can set. H6 was rejected.

According to Metsämuuronen (2009, 724) the collinearity of independent variables doesn't cause problems when stepwise method is used. When stepwise method, which used criteria p<0,05 of F to enter or p>0,010 of F to remove an independent variable, was applied, the variable Average Home Floor Space m² 5km was included in the model. Variables Average Home Floor Space m^2 5km and Household size 5km showed high collinearity but the inclusion of the former variable resulted higher adjusted R-square making H7 redundant in this study. Adjusted R-square reached 0,222 implying that nearly 80% of the variation in shopping basket price difference is dependent on other factors than included in this study. Akaike information criteria corrected (AICc) for finite sample sizes for model was 235,252.

According to the regression analysis average households' purchasing power in the catchment area doesn't affect the proprietor's price level. H9 was rejected.

Population 5km and Sum of Employment 5km reached a high correlation score (ρ=0,848), which also refers to collinearity. As with population the amount working places around a proprietor's store did not affect Basket Difference, therefore H10 was rejected.

Because Format Strength is a derived position based on managerial decision, it could be regarded as a global variable which is independent of location. In turn, Average Home Floor Space can be seen as a phenomenon that is affected by a multitude of geographical factors, it can be regarded as a local independent variable. In geographically weighted regression (GWR), this kind of set up is called semiparametric formation (Nakaya et al. 2012, 2). In this model the adjusted R-square of the semiparametric model increased to 0,249 and AICc scored 234.351. Inclusion of the geographical variation improved the model slightly. This semiparametric GWR analysis confirmed H8. As for H3, the interpretation aligned according to the expected behavior of store chain formats. In the cases where the closest neighbor of the proprietor run store is of a bigger format, the negative sign of the coefficient produced a rational estimate, it increased the expected price premium. In cases where the closest co-operative store was of a smaller format the positive sign of the coefficient causes a smaller estimate for the basket difference.

An exploratory outlier analysis of all the seventy-three shopping basket price comparisons indicated four statistically significant price differences. Surprisingly in two cases the difference was negative. The proprietor had to set the basket price lower than the closest competitor. Figure 2 visualizes the main result of the GWR analysis. The outlier stores are located on the map and the color ramp represents the variation of average home floor space in greater Helsinki area. The cells are retrieved from Grid Database Finland 2006. The map confirms the analysis result that smaller homes in the 5km driving catchment area could lead to added pricing freedom for the proprietor. On the opposite, bigger homes and the lower price premium might refer to higher car-ownership in those areas and consumers added propensity to do shopping by car.

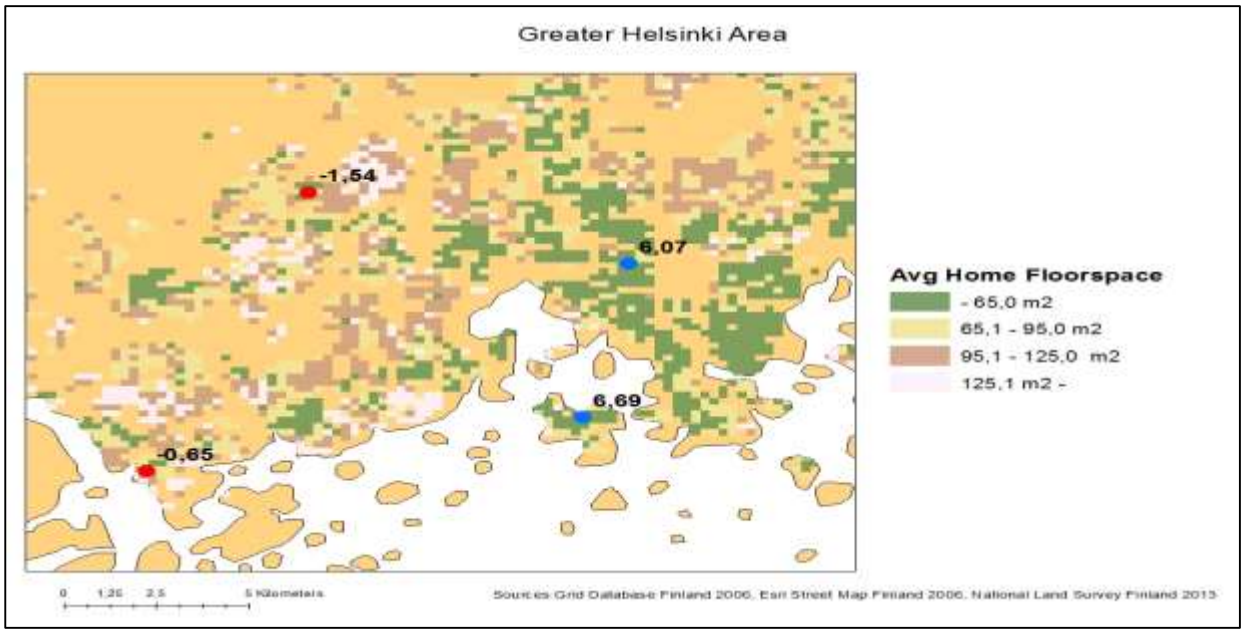

Figure 2. The largest basket differences and average home floor space in their neighboring grid cells.

6. Discussion

In the Finnish grocery retail market a proprietor-operated store faces challenges to accommodate all of its marketing parameters according to the competition and demand environment. The advanced usability of geographical information

software and improved availability of georeferenced data enable the inclusion of a wide range of variables within the competition and demand environment of a grocery store into analysis of pricing premium. This study examined the influence of competition and demand factors on a proprietor-operated stores' price-level, which was compared to its nearest co-operative competitor.

The initial assumption proved to be correct. The proprietors set their price level higher than co-operatives. This result indicates that the objective of running business better explains the price level than the market share, which is contrary to Aalto-Setälä's (2002) earlier finding where market share was the strongest independent variable affecting price level. The results of this study show that many hypotheses derived from previous research are not confirmed in the grocery retail industry of Finland. The variables proprietor's format strength and average home floor space in a 5 kilometers driving catchment area affect the price premium that can be set. The results of this study also indicate that retail chain management influence the shopping basket price difference between different retail formats. Variance analysis of the shopping basket prices between the four chains under study revealed clear statistically significant differences in the prices of the shopping baskets. Format Strength of proprietor stores was included in the semiparametric GWR as a global independent variable. Hence, one of the three hypotheses on retail competition was confirmed.

The results indicate that a larger average home floor space in a 5 km catchment area results in a smaller shopping basket price difference. Semiparametric GWR shows that the effect of Average Floor Space in a 5km catchment area varies geographically and inclusion of spatial variance improves the model. Only one of the hypotheses of the demand environment was confirmed. The results weakly indicate that for stores in supermarket and hypermarket formats the immediate proximity affects less on the price premium, since no variable from the 500m catchment area affected the price premium on a statistically significant level.

Many hypotheses based on the current retail marketing literature had to be rejected. The reasons can emerge from two sources: 1) in the province of Uusimaa the social compositions of residential areas are so homogeneous compared to each other that they don't enable/justify differences in price premium, and 2) the chain management overpowers a proprietor thus limiting the ability to set price premium according to the geographical demand and competition of the store's catchment area. Also the duopolistic competition may limit the need to price variation and responsiveness to local demand and competition characteristics. It is easy for the rivals to compare and match each other's location strategies and marketing activities.

This study combined a wide range of geodemographic and competition factors from the catchment area of a retail store, and utilized spatial analysis on a low aggregation level thus enabling a store-level exploration of the catchment area. In international comparison Finnish demographic data is spatially finely grained and its variables cover a wide range of topics that would enable a very detailed tuning of retail marketing activities on store-level. Use of established spatial analysis processes and methods would enable better reasoned decision making in the grocery retail context.

The semi-parametric geographically weighted regression analysis method proved to be a rather good fit to retail pricing because it allowed some of the variables to vary spatially and some to stay constant over space. Compared to the linear multiple regression the semiparametric (GWR) regression added value to the analysis of the shopping basket price differences. The semiparametric GWR explained approximately 25% of the differences in shopping basket prices between proprietary-run stores compared to their nearest co-operative competitor. A wider shopping basket might have confirmed the hypotheses more. However, the comparability might be more challenging, because the correspondence of larger shopping baskets across different stores is harder to attain due to private labels and variance of selection in different stores.

The limitation of this study lies in the assumption that the price premium of an independent retailer depends solely on geographic competition and demand factors. The factors which remain unobserved in this study follow the factors Zhu and Singh (2009, 4) have recognized: operational costs and managerial talent. The wholesaler – proprietor contracts and the individual goals of the proprietors remain unrevealed and unstudied. However, Duan and Mela (2009, 272) remark that supply side prices (costs) vary less than demand side prices. They deduce that the cost of capital, utilities, labour and supplies are more global.

Since price makes up only the second half of the revenue, the other half - the sales volume stayed uncovered in this study. Incorporation of the sales revenue of the stores could reveal stronger geographical dependencies on both competitive and demand factors. In addition, research from other country markets would enable the evaluation of the outcomes of different market structures on grocery pricing.

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Appendix 1. Correlation matrix of variables.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Basket Difference	-,080	-,307**	,098	,270*	,103	,046	-,254*	-,129	-,174	,113	,174	,226	,166	,055	-,371**	-,268*	-,398**	,280*
2. Distance		-,189	-,473**	-,157	-,061	-,071	,211	,179	,326**	-,109	-,006	-,060	,084	-,091	,014	-,038	,006	-,077
3. Format Strength			,159	-,060	,046	-,089	-,024	-,128	-,092	,006	-,001	-,079	,114	-,038	-,019	-,025	,036	-,050
4. Amount of Comp 500m				,111	,061	-,183	-,166	-,246*	-,203	,037	-,163	-,180	,085	-,196	-,012	-,179	-,025	-,114
5. Population 500m					-,099	,321**	-,427**	-,128	-,538**	,508**	,386**	,496**	,000	,365**	-,392**	,005	-,463**	,442**
6. Retired Pct 500m						-,200	-,572**	-,534**	-,258*	,000	-,210	-,170	,618**	-,251*	-,302**	-,445**	-,114	-,073
7. Academic Pct 500m							-,136	,541**	-,224	,445**	,437**	,543**	-,028	,786**	-,340**	,437**	-,288*	,616**
8. Avg Household Size 500m								,600**	,857**	-,350**	-,142	-,231*	-,452**	-,113	,564**	,335**	,438**	-,322**
9. Avg Prch Pwr Hhld 500m									,489**	,274*	,227	,224	-,359**	,388**	,150	,458**	,073	,291*
10. Avg HomeArea m² 500m										-,428**	-,266*	-,376**	-,309**	-,265*	,556**	,202	,484**	-,434**
11. Sum of Emplmnt 500m											,314**	,450**	,087	,359**	-,472**	-,089	-,462**	,709**
12. Amount of Comp 5km												,657**	-,075	,345**	-,297*	,025	-,457**	,510**
13. Population 5km													-,034	,551**	-,524**	,019	-,671**	,848**
14. Retired Pct 5km														-,136	-,679**	-,559**	-,436**	,086
15. Academic Pct 5km															-,296*	,648**	-,234*	,605**
16. Avg Hhld Size 5km																,481**	,912**	-,674**
17. Avg Prch Pwr Hhld 5km																	,515**	-,063
18. Avg Home Area m² 5km																		-,716**
19. Sum of Emplmnt 5km																		

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).