Assortment Choice and Market Power under Uniform Pricing

Alina Ozhegova

*Norwegian School of Economics**

Preliminary and incomplete

Abstract

This paper studies how retailers use assortment to respond to local market structure when prices are set at a national level. Since the pricing channel is unavailable for firms under uniform pricing, retailers can instead vary assortment to adjust to demand and market shocks. Extensive store-level data and a structural equilibrium model of store competition allow me to disentangle the market power effect on assortment choice from other market forces, such as local preferences and logistics. The counterfactual analysis points to the retailers' incentives to exercise local market power when consumers have limited choice by providing fewer and more expensive positions of lower quality. While the policy of local assortment negatively affects consumers in concentrated markets, an alternative scenario with uniform assortment would be costly for consumers overall.

Keywords: non-price competition, uniform pricing, assortment choice, grocery retail market, multi-store firms.

JEL classification: L11, L81, L13.

*PhD Research scholar, email: alina.ozhegova@nhh.no

1 Introduction

Prices are generally considered a crucial tool for firms to adjust to local shocks (Handbury, 2019; Dubé et al., 2010). Growing evidence shows that many firms deviate from the strategy of price differentiation. In particular, multi-store retailers tend to engage in uniform pricing, where they charge the same prices in markets characterized by different demographics, preferences, and levels of competition (DellaVigna and Gentzkow, 2019; Adams and Williams, 2019; Hitsch et al., 2019). The documented widespread use of uniform pricing challenges our understanding of strategic firms' optimal behavior, where we expect prices to be tailored to local conditions across markets. There are studies that show that firms use non-price attributes to adjust to local market conditions along with product prices (Crawford et al., 2019; Ater and Shany, 2021). However, how firms use non-price attributes under uniform pricing has not been sufficiently studied in the literature. In this paper, I study how multi-store firms strategically set assortment in response to local competition and demand conditions when product-level prices are fixed.

To address this question, I focus on the Norwegian grocery market. The grocery market provides a relevant setting for studying how chains choose assortment in local markets to maximize profits. First, since consumers typically buy multiple products on a shopping trip, the selection of products could be a potentially powerful channel for retailers to increase profits. Second, as shown in previous literature (DellaVigna and Gentzkow, 2019), supermarkets in many countries, including Norway, which is the focus of this study, follow uniform (national) pricing (Adams and Williams, 2019). Third, consumers are not willing to travel long distances, making competition stronger on a local level. In particular, the Norwegian market is highly geographically sparse and has been operating fully offline until recently, making market competition more localized. Finally, over the past thirty years, successive waves of mergers have dramatically increased the concentration of the food retail sector in most Western countries (Allain et al., 2017). The Norwegian market has also experienced some mergers over the past twenty years, which has resulted in the market now being highly concentrated both nationally and locally with generally high prices, which raises a lot of concern from the

Norwegian competition authorities about excess market power[1].

The analysis in this paper is based on assortment differences across stores, measured by the availability of expensive and low-priced goods, the total number of unique products, and the quality of items on the shelf. When choosing which store to shop at, getting the best value for money and product variety are traditionally considered leading factors. Differences in product-level prices have gained much attention in the literature (see, e.g. Handbury and Weinstein (2015), Handbury (2019)). Such differences are typically attributed to local income-specific tastes (Handbury, 2019; Eizenberg et al., 2021). In the current setting, the price channel on a store level is unavailable for retailers due to chains setting uniform prices nationally, but they have discretion over assortment instead. Product variety has been studied recently in the context of how demand heterogeneity and the emergence of online retail affect the assortment width (Quan and Williams, 2018; Kim and Yeo, 2021). To my knowledge, this is the first study that examines the effect of competition and local demand conditions on product variety in the important setting of uniform pricing.

To explore how retailers choose assortment in different market conditions, I estimate a structural demand model where consumers choose a store to shop at. The supply model describes the retailer's assortment decision given the estimated consumers' preferences. To tease out the impact of market competition on assortment, I examine a counterfactual effect of exogenously changed market structure on optimal assortment as a result of merger simulations. I find that retailers that gained a higher presence in a market, would provide fewer, lower-quality, and more expensive positions in a category. This result is consistent with theoretical findings that firms appear to reposition products after mergers (Gandhi et al., 2008; Mazzeo et al., 2018) and empirical evidence that firms adjust non-price attributes (Ater and Shany, 2021).

To investigate the effect of local competition on assortment under uniform pricing, I aggregate individual product items into a composite good whose price, variety, and quality are measured at the store level. In the ideal setting, I would model store managers' decisions on whether to have each particular product on a shelf, as this more accurately reflects the actual assortment selection process. However, this setting is not computationally

[1]There have been a number of investigations initiated by the Norwegian Competition Authorities against grocery chains in Norway. See more: https://e24.no/naeringsliv/i/ja1KMb/den-nye-konkurransedirektoeren-ingen-hemmelighet-at-vi-er-bekymret-for-dagligvarebransjen.

tractable, as each store makes thousands of decisions of this type. Therefore, I simplify the setting by using variables describing the assortment: price captures the price level of the assortment, variety measures assortment breadth, and quality measures the availability of high-/low-end options. The idea to use a composite good is in line with the relevant industrial organization (Handbury, 2019; DellaVigna and Gentzkow, 2019; Eizenberg et al., 2021) and urban economics literature (MacDonald and Nelson Jr, 1991) and makes particular sense in the setting when one needs to compare stores by relative shopping costs. When designing the price of the composite good, I calculate revenue-weighted average expenses for purchasing products offered by a store. I follow a recent study by Eizenberg et al. (2021) focusing on the most popular everyday product categories. When measuring assortment breadth, I calculate the number of unique products presented in a particular store across chosen categories, following the papers by Kim and Yeo (2021) and Argentesi et al. (2021). Finally, I recover the quality of assortment from the residual term of the demand model.

The data that I use to test the hypotheses comes from two sources. The primary data source is weekly sales at a product and store level for all stores belonging to a large Norwegian retail group. The secondary source is the database provided by Geodata, the primary Norwegian provider of spatial data. The database contains information on yearly store-level revenue, profit, location, and other store characteristics for all grocery stores in Norway.

The empirical framework is based on the empirical analysis of differentiated product markets pioneered by Berry (1994) and Berry et al. (1995). On the demand side, I specify a discrete-continuous choice model of how consumers decide which store to shop at and their grocery expenditures, which allows for obtaining empirical estimates of semi-elasticity of utility by price and the willingness to pay for a unit of variety and quality. The supply model endogenizes retailers' assortment decisions through a choice of price, variety, and quality of the composite good. I also specify retailers' cost function, which accounts for logistics costs and depends on store characteristics, including assortment breadth and quality. Estimation is implemented by a generalized method of moments (GMM) using moments generated by demand and the suppliers' first-order conditions for prices, variety, and quality. Based on the results, I run a series of counterfactual analyses. First, I explore how retailers choose assortment in response to market structure change in merger exercises. Second, I compute how assortment and welfare would change if retailers provided equal assortment within stores of one chain.

The results show that retailers exercise local market power under uniform pricing by choosing how many and which products to provide in a store. In particular, those stores that gain a stronger market position tend to change the assortment towards fewer but more expensive items of lower quality. At the same time, for other players, the effect is the opposite. This result captures the incentives of dominant players to strategically choose assortment to increase margins and the desire of small retailers to compete for consumers. The effect on assortment also depends on the increase in market share as a result of a merger. Thus, smaller players involved in a merger obtain a greater increase in market share, leading to a more significant impact on assortment. They more noticeably shift their assortment towards expensive items. Simultaneously, they reduce the assortment breadth and quality to a greater extent than larger players. Various counterfactual scenarios support the evidence and establish that the findings are not a subject of one particular exercise but rather a consistent result robust to changes in counterfactual settings.

Finally, I simulate the scenario where retailers unify assortment decisions across stores instead of providing local assortment in each store. Although the policy of local assortment discriminates against consumers in concentrated markets, an equal assortment policy would have a negative effect on consumers overall, as assortment would change towards more expensive products, narrower choice, and lower quality on average for consumers in competitive markets, which constitute the majority of consumers. Even though this result looks somewhat surprising at first glance, it corresponds to theoretical predictions that the welfare impact of discrimination (in this case, by assortment) is unclear and depends on the nature of competition, consumer preferences, and consumer heterogeneity (Stole, 2007).

The study builds on and extends the existing empirical literature that explores the effects of competition on non-price attributes. Although there is extensive literature on price-setting under imperfect competition, much less attention has been paid to the impact of competition on quality and non-price attributes in a more general sense. As with prices, firms in imperfectly competitive industries tend to deviate from socially optimal levels of quality, but unlike prices, the direction of this distortion is not clear. Crawford et al. (2019) and Fan and Yang (2020) show that under competitive pressure, firms tend to provide higher quality and higher prices than socially optimal. The studies by Mazzeo et al. (2018) and Sweeting (2010) explore whether a merger affects product offerings on the market. Matsa (2011) studies how

competition affects quality in a grocery context, where quality is measured as a number of shortfalls. Continuing discussion of how retailers can use non-price attributes, Ater and Shany (2021) show that firms strategically use service time when the competitive environment changes. My study differs from that paper in that I show that players with a dominant position in a market choose more expensive and narrower assortment of lower quality, strategically exploiting market power.

This paper also contributes to the growing literature on food price and assortment inequality among markets with different socio-demographic and economic characteristics (Dubois et al., 2014; Handbury and Weinstein, 2015; Allcott et al., 2019; Handbury, 2019; Eizenberg et al., 2021). Berry and Waldfogel (2001) show that product assortment varies with the market size. The findings in Handbury (2019) suggest that low-income households face different assortment and prices than high-income households mainly due to their income-specific tastes. In this vein, the presence of heterogeneous local tastes can be beneficial for all consumers in a market, leading to increased variety (Quan and Williams, 2018). Alternatively, Eizenberg et al. (2021) attribute differences in prices within stores in a city to spatial frictions. Residents living in centrally located areas have a better choice of products due to higher competition between stores in a center. In contrast, non-affluent peripheral neighborhoods tend to have a poorer choice and higher prices. In this paper, I focus on assortment differences rather than on product-level prices. Still, the result is similar: residents of more competitive and often wealthier markets have better access to a cheaper assortment than residents of remote and often concentrated regions.

The paper is also related to a growing literature on uniform pricing (DellaVigna and Gentzkow, 2019; Hitsch et al., 2019; Adams and Williams, 2019). Several recent papers show that multi-store retailers in different markets set equal prices across stores (Hitsch et al., 2019; DellaVigna and Gentzkow, 2019). DellaVigna and Gentzkow (2019) document that uniform pricing makes food shopping more costly for poor households and less costly for wealthy households. In contrast, Adams and Williams (2019) find that zone pricing could shield consumers from higher prices in less competitive markets, where, in the case of finer pricing zones, chains could exercise their market power through higher prices. This study adds to this strand of literature by showing that when firms follow uniform pricing and are unable to adjust prices directly, they use other non-price channels, in this case, assortment, to respond to changes in market structure. Moreover, in a counterfac-

tual analysis, I show that a policy of equal assortment can shield consumers in concentrated markets from more expensive products at the expense of the consumers in competitive markets.

The paper proceeds as follows. In the next section, I describe the institutional features of the Norwegian grocery industry, the data used in the analysis, and some preliminary analysis results. In section III, I describe the demand model, discuss the specification and identification details and present the results for the demand side. In section IV, I elaborate on the supply framework in a similar manner. Section V presents the results from the counterfactual experiments. Section VI concludes.

2 Industry Background, Data, and Preliminary Evidence

I begin by describing the Norwegian grocery landscape and the uniform pricing regime that the chains follow. Additional subsections describe data sources used in the study and how the price, variety, and quality measures are constructed. Based on that, I provide a preliminary analysis that assortment varies with changes in the market structure.

2.1 Industry Background

The Norwegian grocery market is quite peculiar due to its geographic characteristics. Since the landscape is quite mountainous, markets are sparse and isolated from each other. While around 40% of the population resides in the five large cities, the other 60% live in smaller municipalities, some of which are hard to reach. These factors make serving these markets costly for grocery chains. In addition to logistics, high income further contributes to high prices.

Like the other Scandinavian markets, the Norwegian grocery industry is highly concentrated. As of 2018, four retail groups control 99.9% of the market[2]: NorgesGruppen (NG), Rema1000, Coop, and Bunnpris. Table 1 presents selected statistics for the Norwegian grocery market. Some of the retail groups have multiple chains representing different grocery formats. For example, the market leader NorgesGruppen has a discount format (Kiwi), a

[2]Nielsen, Grocery report 2017

convenience store format (Joker), supermarkets (Spar), and high-quality supermarkets (Meny). Such differentiation allows for serving various consumer segments. Independent stores not belonging to the listed four retail groups constitute a small part of the market (less than 0.1%). Most of them are located in large cities and usually provide a specific assortment, such as imported products targeted at consumers with non-Norwegian backgrounds.

Table 1: Market structure of the Norwegian grocery industry, 2018

	Market share	Revenue	Number of stores
NorgesGruppen	42.5	72614	1734
Kiwi	20.4	34892	646
Meny	10.8	18428	193
Spar/Eurospar	7.1	12054	282
Joker	3.6	6156	448
Coop	29.6	50469	1114
Coop Extra	13.3	22726	424
Coop Obs	5.6	9523	30
Coop Prix	4.4	7456	254
Coop Mega	3.9	6716	75
Coop Marked	1.7	2949	227
Rema 1000	24.1	41153	589
Bunnpris	3.8	6510	246

Note: Market shares are in percent, revenues are in million Norwegian krones. Numbers were retrieved from companies' annual reports.

Norway's retail chains follow uniform pricing as in other countries' grocery industries. DellaVigna and Gentzkow (2019) show that it is an industry norm among grocery chains in the US and Europe to follow uniform pricing. While setting optimal prices for thousands of products is simply costly for a company, reputation and fairness concerns are also often mentioned as an explanation for charging equal prices. In Norway, uniform pricing is implemented at the level of a particular chain so that prices are set for all stores belonging to one chain throughout the country. It is worth noticing that uniform pricing does not apply to prices for vegetables and fruits since their supply is mainly determined locally on a regional level. That is why these categories are not included in the analysis.

In general, variety and price decisions are organized at three levels. The retail group is responsible for purchasing goods from producers and delivering them to a distribution center. Then the grocery chain observes the goods and sets prices that will not vary across stores of this chain. Finally, observing prices and total assortment in a distribution center and local demand conditions, each store manager decides what products to bring into a store.

2.2 Data

The data comes from multiple sources. The primary data source is scanner data from one of the largest players in the market. The data covers all grocery purchases for March 2018 in all stores belonging to the retail group. Using this data source, I reveal assortment and prices in stores located in different parts of Norway. It is worth noticing that this retail group covers the whole country and has stores of all existing formats in a market (discounter, convenience store, supermarket). The data set contains information about prices with and without discount for a particular product in a receipt, quantity purchased, store and product IDs, and store location. For products, I observe producer, package size, measuring units, and products' topology by categories.

The second important data source is a store-level panel provided by Geodata, the Norwegian spatial data provider. Geodata's database contains yearly information on store-level turnover and profit for 2010-2021. Additionally, it includes information on location, store opening date, store size, and the number of employees. Geodata's database covers the whole grocery market in Norway. Using the store location as a unique identifier, I link Geodata's database to the scanner data.

Additionally, I use some demographic characteristics provided by Statistics Norway, such as population density, average income, number of registered cars, and the average number of workers. I use this data on two levels: municipality and the smallest geographical unit - a basic unit (BU). Since BU is too small to be considered as a separate market[3], I use municipality for the purpose of geographic market definition. Norway is divided into 356[4]

[3]Average basic unit is typically smaller than an area of one zip code. The basic unit is similar to a census block in the US.

[4]The number of municipalities has been changing over time. Here I use the country's partition as of 2020.

municipalities and around 14000 basic units. Table 2 reports descriptive statistics.

Table 2: Distribution of Demographics Across Municipalities

	Mean	SD	Min	Median	Max
Area (sq. km)	1320	1219	70	969	9727
Population (thousands)	15.1	44.3	0.2	5.2	693.5
Population density (people per sq.km)	30.6	100.6	0.2	5.3	1441.0
Average income (thousands of NOK)	719	176	395	673	1736
Car density (cars per person)	0.69	0.09	0.34	0.69	0.94

Source: Geodata.

2.3 Composite Good

To document assortment differences across stores in Norway, I cannot simply compare prices of products across stores because, under uniform pricing, unique products have the same prices within stores of the same chain. Therefore, I need to make up a composite good whose price reflects the price differences associated with the selection of the store's assortment (Handbury, 2019; Eizenberg et al., 2021; DellaVigna and Gentzkow, 2019).

To document assortment differences across stores in Norway, I aggregate individual product items into a *composite good* representing a basket of grocery goods that an average consumer purchases. The *composite good* is characterized by price (price point), variety, and quality measures at a store level.

To calculate these measures, I focus on nine popular product categories consumed every day by most households[5]. Each category includes from 10 to 162 products, where a product is associated with a unique universal product code (UPC) and identical across all stores in Norway.

The product-level prices are collected from the scanner data. Scanner data records the product's price, quantity purchased, unique identifier of a product, and package size. Given this information, I can calculate a price for a standardized product unit (for example, a kilogram of cheese or a liter of milk).

[5]Product categories include cheese, eggs, milk, juice, beer, frozen pizza, frozen fish, jam, and dry bread

To aggregate product-level prices into a category-level price, I calculate a revenue-weighted average price for each category and store by weighting the price of each product by its relative revenue across all stores belonging to a chain. Thereby, more popular products have higher weights in a category-level price index. Then the difference in a category-level price will indicate a strategic selection of expensive or cheap SKUs into category assortment in a particular store. To estimate costs associated with purchasing a category in a store, one needs to multiply the category-level price of a standardized unit by the average number of standardized units purchased across all observed transactions within a chain (average basket in units). Let ω_i and p_i be the weight and price of product i, Ω_{cj} is a set of products observed in a store j in a category c, then the category-level revenue-weighted average price p_{cj} is

$$p_{cj} = avg.basket_c \times \left(\frac{\sum_{i \in \Omega_{cj}} w_i p_i}{\sum_{k \in \Omega_{cj}} w_k} \right). \tag{1}$$

This category-level price to some extent approximates expenditures in a particular product category in a particular store.

Finally, I calculate a price of a single unit of the composite good for each store p_j by averaging across category-level prices p_{cj}:

$$p_j = \frac{1}{n} \sum_{c \in C} p_{cj}. \tag{2}$$

The assortment breadth ν_j is measured as an average number of unique products presented in a particular store across chosen categories:

$$\nu_j = \frac{1}{C} \sum_{c \in C} \nu_{cj}. \tag{3}$$

Table 3 provides statistics for a composite good's price and variety measures. As expected, on average, discount stores offer a cheaper assortment than supermarkets and convenience. Convenience stores are usually smaller and provide the most narrow assortment compared to other formats. One can notice that the price of a composite good does not change significantly across stores. However, note that these prices are calculated for the stores of one chain under a uniform pricing scheme. Hence, this difference originates only from the difference in the assortment. Further notice that this small

variation in price is translated into 10% difference in the price of composite good on average for convenience stores, 7% - for discounters, and 9% - for supermarkets, which can result in significant welfare losses. Assortment varies noticeably across stores of one chain too. Aside from market power, this variation could be explained by many confounding factors, including the size of a store and local tastes. I will explore these differences further in the preliminary analysis.

It is worth noticing that I reveal assortment from the transaction data since information about assortment in stock is unavailable. Here I assume that each product presented in a store has been purchased at least once during the observed month; otherwise, store managers would not shelve a product. Grocery chains in Norway have three periods per year, so-called *launch windows* (in February, in June, and in October), when they allow changes in assortment. The period that I have data on is in between *launch windows*, so I assume that the chains did not change assortment in a given month. Lastly, chains within one retail group share the same wholesale and distribution channels. However, the pricing and assortment decisions are made independently on the level of a particular grocery chain.

Table 3: Price and Variety Summary Statistics

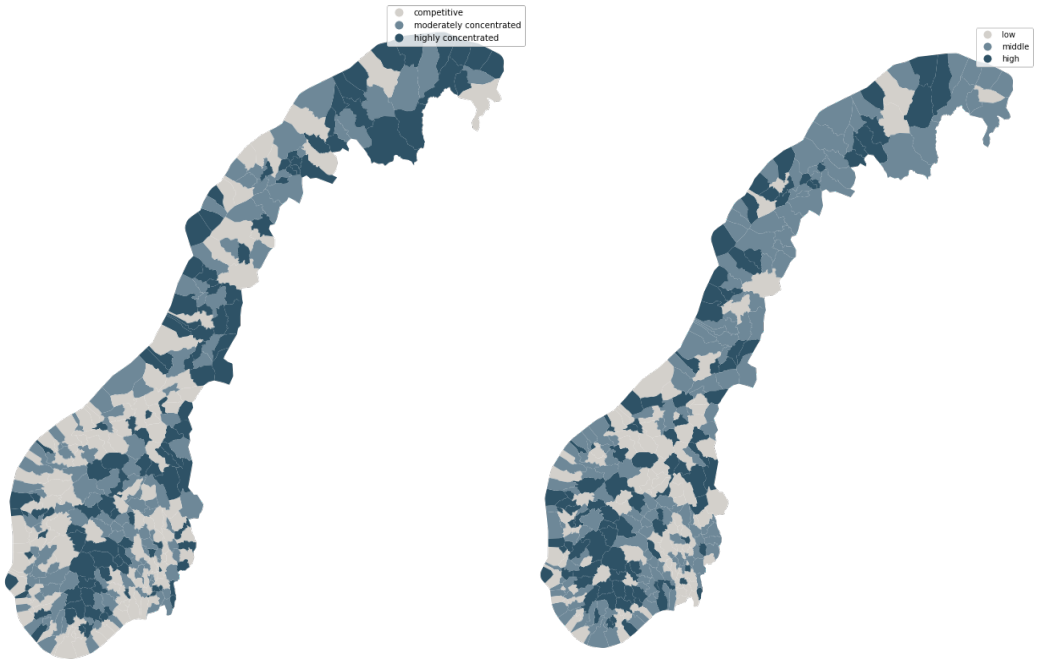
	Mean	SD	Min	Median	Max
Price					
Convenience store	59.85	1.44	56.08	59.78	65.48
Discount	53.02	0.89	51.21	52.98	61.44
Supermarket store	60.6	1.41	52.14	60.79	67.49
Variety					
Convenience store	27.21	6.15	14.64	26.43	53.36
Discount	48.43	5.19	16.64	48.43	94.36
Supermarket store	69.45	22.04	30.57	66.71	135.93

2.4 Preliminary Evidence

Figure 1 displays the average composite good prices and market concentration in March 2018. The figure illustrates that retailers in peripheral, more isolated markets provide a more expensive assortment. To explore the role of market concentration, I go one step further. Figure 2 plots composite good prices and assortment width against market concentration, along with fitted

regression lines. The main message of the plot is that assortment tends to be more expensive and narrower in more concentrated markets.

Figure 1: Market Concentration and Price



(a) Market concentration (HHI) **(b)** Price

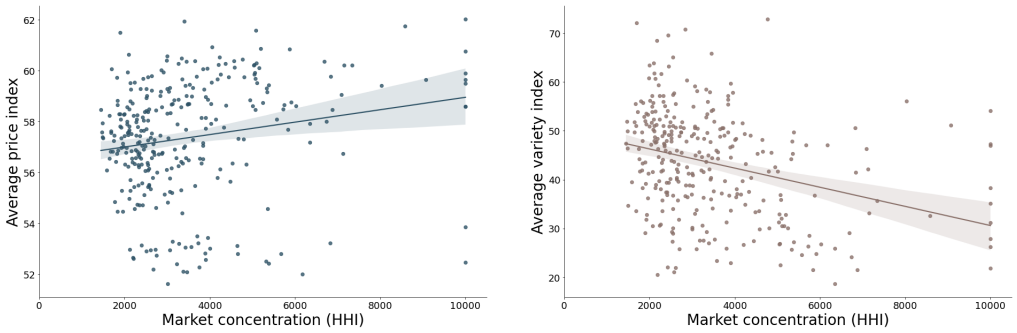
Note: Low prices belong to the first tercile $[51.6; 56.7]$, *middle* prices belong to the second tercile $[56.7; 58.6]$, and *high* prices belong to the last tercile $[58.6; 62.0]$.

Aside from market power, many other factors affect the choice of assortment. While it should depend on stores' capacity constraints and logistics costs, Handbury (2019) shows that choice of assortment is also correlated with local tastes[6]. To distinguish the market concentration effect on assortment, I run a store-level regression of price and variety on a concentrated market indicator controlling for logistics costs, market-level average income, and store characteristics, including chain dummies. Market concentration is measured by HHI calculated based on the chains' market shares[7]. The

[6]Local tastes are typically measured by demographic characteristics such as income.

[7]As the authors of the paper (Miller et al., 2021) warn I do not interpret this regression as establishing causation but rather as a purely descriptive exercise.

Figure 2: Assortment and Market Concentration



(a) Price index of assortment **(b)** Assortment variety

Note: Each dot in the figures represents one municipality. The left panel shows the average price of assortment across stores in a municipality. The right panel shows the average assortment width across stores in a municipality. HHI is calculated based revenue of chains in a municipality.

specification is as follows:

$$y_{jm} = \beta_1 HHI^m + x_{jm}\gamma + \epsilon_{jm}, \tag{4}$$

where y_{jm} is either price p_{jm} or variety ν_{jm}. Results are reported in columns I and III of Table 4. After controlling for other price and variety determinants, stores in more concentrated markets have on average narrower assortment, the result for the price is insignificant.

However, the regression does not distinguish between situations when a chain has local market power. To determine how the market position affects the assortment decisions, I add controls for market concentration, an indicator of whether the store belongs to a chain with the highest market share, and an indicator of whether - in a concentrated market - the store belongs to a chain with the highest market share. As before, I also add store-level controls, chain dummies, market-level average income, and logistics costs. Therefore, I estimate a model of the following form:

$$\begin{aligned} y_{jm} = \beta_1 HHI_m + \beta_2 \mathbf{1}\{\text{Store} \in \text{Leading chain}\}_{jm} + \\ + \beta_3 HHI_m \times \mathbf{1}\{\text{Store} \in \text{Leading chain}\}_{jm} + x_{jm}\gamma + \epsilon_{jm} \end{aligned} \tag{5}$$

The estimates for this specification are in columns II and IV of Table 4. On average, stores in concentrated markets have less expensive and narrower

assortment. While the result for variety looks reasonable, the effect for the price might look less intuitive. It might be explained by the fact that in the presence of a dominant player in a market, smaller players provide cheaper products to attract consumers, which could drive the average effect on the price down. This could happen if consumers have different price elasticity and will be addressed further in the demand model. A leader's behavior does not differ in a competitive market, but if a chain has local market power in a concentrated market, it provides more expensive assortment. In concentrated markets, both leaders and followers reduce assortment variety equally.

Table 4: Market leader and assortment choice

	Dep. var.: price		Dep. var.: variety	
	I	II	III	IV
HHI	0.0017	-0.0105*	-0.0626*	-0.1520**
	(0.004)	(0.007)	(0.037)	(0.060)
Leading chain		-0.0005		0.0342
		(0.003)		(0.024)
$HHI \times$ Leading chain		0.0135*		0.0464
		(0.008)		(0.077)

Also controlling for logistics costs, local income, and store characteristics

Also note that while the preliminary analysis points to higher prices in concentrated markets, it is important to distinguish whether this difference in the assortment is due to products with higher markups or products with higher quality. Thus, one needs to account for quality differences in the assortment. Since data on input prices of individual products or marginal costs is unavailable, I will use a demand model to reveal differences in assortment quality among stores.

While reduced-form analysis gives some evidence on how market power is related to the choice of assortment, it is still not enough informative to claim that retailers exert market power through assortment choice. To tease out the causal effect and further quantify its welfare consequences, I next estimate a structural model of demand and assortment choice.

3 Demand Model

I follow previous studies of the supermarket industry (Bjornerstedt and Verboven, 2016; Duarte et al., 2020; Atal et al., 2022) and employ a discrete-continuous choice demand model initially proposed by Hanemann (1984) and later extended by Bjornerstedt and Verboven (2016). The model departs from the standard discrete choice framework with some differences. First, it assumes that instead of purchasing one unit of product, the consumer spends a constant share φ of income y_i on groceries. It seems more realistic for the grocery shopping setting rather than a unit-good assumption. Secondly, market shares are measured in values instead of quantities, and the potential market is defined as the potential aggregate budget instead of the potential number of consumers or shopping trips. In addition, the constant expenditure specification dictates a functional form of indirect utility where price enters logarithmically.

Consider a market m[8] served by several grocery chains g. Consumer i chooses in which store j of chain g to buy a continuous quantity of bundles of grocery goods (composite goods) among all the stores in the market m. Each supermarket j sells a basket of grocery products characterized by price, variety, and quality. To simplify notation, I omit the subscripts m and g in what follows in the demand model. The indirect utility of consumer i for store j is:

$$u_{ij} = \frac{\alpha_i}{\varphi} \ln y_i - \alpha_i \ln p_j + \gamma \nu_j + x_j \beta + \xi_j + \epsilon_{ij},$$

where y_i is the income of consumer, φ is the share of income that the consumer spends on groceries, p_j and ν_j are the price and variety of the basket of goods, and ξ_j is unobserved component of store's utility.

As mentioned earlier, one needs to control for the quality of the assortment. Since data that would allow capturing the quality of assortment is typically unobserved for researchers, I recover the quality from the demand model unobserved component ξ_j. As it is commonly assumed, players observe ξ_j, then we can treat ξ_j as a strategic variable along with price and variety.

Since the retailers observe ξ_j when choosing assortment, I have to specify a reasonable set of instrumental variables to deal with the endogeneity of a store's variety and price with respect to ξ_j. Here I build on existing

[8]Market is defined by a municipality.

literature and use differentiation instruments calculated based on observed product characteristics (Gandhi and Houde, 2019). Conlon and Gortmaker (2020) show that differentiation instrumental variables generally outperform commonly used BLP instruments. Then the structural parameters are estimated via a 2-step GMM procedure with moments satisfying $E[z_j \xi_j] = 0$.

Table 5 summarizes results for the logit model and the logit model with random coefficients. Both the price and the assortment breadth have the expected sign and are statistically significant. Variety, store size, opening hours, and the fact that the store is open on Sundays are characteristics that consumers appreciate. Since the parameter of the distribution of unobserved consumer heterogeneity is statistically significant, I use the random coefficients logit model as the main specification later.

Table 5: Demand Parameters Estimates

	Logit	RC Logit
Log price	-7.018***	-6.809***
	(1.302)	(1.351)
Variety	0.015*	0.025***
	(0.008)	(0.009)
Store size	0.321	0.073
	(0.232)	(0.239)
Opening hours	0.073***	0.091***
	(0.016)	(0.018)
Store age	-0.002**	-0.001
	(0.001)	(0.001)
Dicounters	-0.787***	-0.441*
	(0.223)	(0.240)
Mall	0.117**	0.077
	(0.053)	(0.053)
In center	0.017	0.009
	(0.025)	(0.025)
Sunday	0.209***	0.146***
	(0.061)	(0.064)
σ_{price}	-	3.479***
		(1.151)
σ_{const}	-	2.371***
		(0.043)
Market FE	Yes	Yes

4 Supply Model

In the supply model, store managers decide assortment via a choice of three strategic variables: price, variety, and quality. If M_m is a size of market m, then the maximization problem for a multi-store firm in a market m looks as follows:

$$\max_{\{p_{jgm},\nu_{jgm},\xi_{jgm}\}_{j\in\mathfrak{J}_{gm}}} \sum_{j\in\mathfrak{J}_{gm}} M_m s_{jgm}(p_{\cdot m},\nu_{\cdot m},\bar{Y}_m,\xi_{\cdot m};\theta_d)(p_{jgm}-mc(\nu_{jgm},\xi_{jgm},\mathbf{w_{jgm}};\theta_s)), \tag{6}$$

where $\mathfrak{J}_{gm}$ is a set of stores belonging to chain g in market m. The marginal cost of a store j belonging to a chain g in a market m is given by:

$$mc_{jgm} = mc(\nu_{jgm},\xi_{jgm},\mathbf{w_{jgm}};\theta_s), \tag{7}$$

where $\mathbf{w_{jgm}}$ denotes a vector of observable cost shifters, θ_s is a vector of supply-side cost function parameters.

The first-order conditions for profit-maximizing firm over price, variety and quality are:

$$F.O.C.[p_{jgm}] : s_{jgm} + \sum_{r\in\mathfrak{J}_{gm}} (p_{rgm} - mc_{rgm})\frac{\partial s_{rgm}}{\partial p_{jgm}} = 0, \tag{8}$$

$$F.O.C.[\nu_{jgm}] : -\frac{\partial mc_{jgm}}{\partial \nu_{jgm}} s_{jgm} + \sum_{r\in\mathfrak{J}_{gm}} (p_{rgm} - mc_{rgm})\frac{\partial s_{rgm}}{\partial \nu_{jgm}} = 0, \tag{9}$$

$$F.O.C.[\xi_{jgm}] : -\frac{\partial mc_{jgm}}{\partial \xi_{jgm}} s_{jgm} + \sum_{r\in\mathfrak{J}_{gm}} (p_{rgm} - mc_{rgm})\frac{\partial s_{rgm}}{\partial \xi_{jgm}} = 0. \tag{10}$$

For the counterfactual analysis, I need to specify the marginal cost function. Following (Crawford et al., 2019) I specify a flexible function for marginal costs where c_{0jgm}, c_{1jgm} and c_{2jgm} are store specific:

$$mc_{jgm} = \exp(c_{0jgm} + c_{1jgm}\nu_{jgm} + c_{2jgm}\xi_{jgm}). \tag{11}$$

The exponential functional form reflects the nature of the retail industry, where store capacity is limited. Note that in the given specification, I assume that the marginal costs do not change with the quantity of a composite good consumed (no economies of scale). However, I allow the marginal costs to change with the assortment breadth ν_{jgm} and ξ_{jgm} to make it costly to provide more items on a shelf and provide goods of higher quality.

I also allow the marginal costs to be dependent on observed and unobserved cost-shifters, so I specify the coefficient c_0 as a linear function of cost shifters:

$$c_{0jgm} = \mathbf{w_{jgm}}\theta_s + \zeta_{jgm}. \tag{12}$$

The first-order conditions in equations 8-10 give analytical expressions for $\partial\widehat{mc}_{jgm}/\partial\nu_{jgm}$ and $\partial\widehat{mc}_{jgm}/\partial\xi_{jgm}$, which are in turn used to compute c_{0jgm}, c_{1jgm}, and c_{2jgm}:

$$\hat{c}_{0jgm} = ln(\widehat{mc}_{jgm}) - \frac{\partial\widehat{mc}_{jgm}/\partial\nu_{jgm}}{\widehat{mc}_{jgm}}\nu_{jgm}, \tag{13}$$

$$\hat{c}_{1jgm} = \frac{\partial\widehat{mc}_{jgm}/\partial\nu_{jgm}}{\widehat{mc}_{jgm}}, \tag{14}$$

$$\hat{c}_{2jgm} = \frac{\partial\widehat{mc}_{jgm}/\partial\xi_{jgm}}{\widehat{mc}_{jgm}}. \tag{15}$$

The identification of the supply-side parameters is built on a 2-step GMM procedure where equations 13-15 serve as constraints for a minimization problem of GMM objective $E[z_{jgm}\zeta_{jgm}]$, where z_{jgm} is a vector of supply-side instruments.

The descriptive statistics of the marginal costs and markups are reported in Table 6. Supermarket stores, as a format that provides higher quality and variety, have higher marginal costs on average. In contrast, discounters have the lowest marginal costs. As for markups, there is no noticeable difference between stores of different formats. The estimates of markups are similar to what other studies obtained when dealing with a composite good (Duarte et al., 2020; Eizenberg et al., 2021)

Estimates of the marginal cost functions are reported in Table 7. As expected, the provision of higher variety and quality is costly for a retailer. Other estimates of the supply-side function also look reasonable. The further the distance to the distribution center, the more expensive it is to transport goods. Stores open on Sundays have higher marginal costs, as by Norwegian legislation, they have to pay higher taxes. Supermarket stores have higher marginal costs compared to discounters and convenience stores as they usually have more employees. Lower estimates of marginal costs for stores located in shopping malls might be attributed to the higher efficiency of area usage and lower utility costs compared to other types of buildings. Larger

Table 6: Summary Statistics for Costs and Margins

	Price	MC	Markup
Mean (all)	56.47	47.09	0.16
Median (all)	55.75	47.03	0.15
By formats			
Median (discounter)	54.15	45.35	0.16
Median (convenience)	58.73	50.43	0.14
Median (supermarket)	60.67	51.36	0.15

retail groups have lower marginal costs, which could be explained by lower input prices and the economy of scale. The negative effect of store size and the number of hours the store works could also be attributed to the economy of scale.

5 Counterfactual

5.1 Merger Analysis

The existence of incentives for exercising market power through assortment is inferred from the difference between the equilibrium price, variety, and quality before and after an exogenous change in market structure. For consistency, I assume that the demand and supply sides do not change structurally, so I use estimates to simulate demand, firms' marginal costs, and compute equilibrium prices, variety, and quality. Note that stores' marginal costs depend on variety and quality, so marginal costs also respond to changes in market structure.

I implement three merger exercises to show how retailers would adjust their assortment if their market power increased. In the first exercise, one of the two leading discounters *Kiwi* is merged with *Bunnpris* (the smallest retail group that runs a chain of discounters). In a second exercise, another large discounter, Rema, increases its market power through its merger with *Bunnpris*. In these two exercises, *Bunnpris* stores adopt another chain's logistics and pricing system, keeping the other location-specific characteristics fixed. Lastly, I merge two supermarket chains, Meny and Spar, within one retail group NorgesGruppen. Since these chains already share one logistics

Table 7: Marginal Cost Function Parameters

Variable	Parameter
Const (c_0)	3.645
	(0.137)
Variety (c_1)	0.005
	-
Store-specific quality ξ_{jgm} (c_2)	0.154
	-
Other observed cost shifters	
Sunday	0.066***
	(0.004)
Open hours	-0.019***
	(0.001)
Store size	-0.139***
	(0.000)
Discounter	-0.018***
	(0.005)
Mall	-0.017***
	(0.005)
In center	-0.003
	(0.003)
Distance to dist.center (in hours)	0.006***
	(0.002)
Retail group: Bunnpris	0.008
	(0.006)
Retail group: Norgesgruppen	-0.012***
	(0.004)
Retail group: Rema	-0.033***
	(0.004)
R^2	0.608
# of obs.	3639

Note: Retail group: Coop is taken as a base category.

system, the merger will change only the pricing scheme.

The results are summarized in Table 8. First, I explore what happens with the price of a composite good after a merger when the assortment width and quality remain unchanged. Column 1 shows that the average price of a composite good rises in all three scenarios. Meanwhile, smaller players (*Bunnpris* in Scenario 1 and 2 and *Kiwi* in Scenario 3) experience greater increases in price and markup than larger players. Prior to the merger, smaller players had to attract consumers by providing cheaper assortment. Being a part of larger players, they can change assortment towards more expensive. As larger players in the mergers, Kiwi and Rema also change their assortment towards more expensive but to a lesser degree. The results between scenarios also vary because of the different number of markets where the chains are present together.

In column 2, I hold the price and quality of the composite good fixed and consider changes in the assortment breadth associated with a merger. In all three exercises, the average assortment slightly decreases. Similarly, I see that smaller players (Bunnpris in Scenario 1 and Kiwi in Scenario 3) involved in the mergers change their assortment breadth more than larger players involved in mergers. By narrowing assortment, they lower their marginal costs, which results in increased markup even under the same price of the composite good.

In column 3, retailers can adjust only the quality of a composite good, holding the price and variety fixed. The result is similar to the one when retailers adjust variety breadth. All players decrease quality, smaller retailers drop variety to a larger extent than larger ones. Finally, retailers can adjust all assortment dimensions (column 4). As previously, they adjust the assortment towards more narrow, expensive, and lower quality.

Although the result that firms set prices depending on local market conditions is relatively well studied in the literature, there is much less focus on the effect of market power on assortment. More generally, assortment choice is related to the topic of endogenous quality and market power over quality that has gained no consensus in the literature. I show that an increase in market power could lead to a change in assortment towards fewer, more expensive items of lower quality. The result is similar in spirit to the main conclusion of Crawford et al. (2019) that firms that manage quality tend to overprovide it, which translates into a more expensive assortment in this setting.

Table 8: Counterfactual Changes in Prices, Variety, and Quality

	Market power over price level		Market power over assortment width		Market power over quality		Total effect			
	Effect	Markup	Effect	Markup	Effect	Markup	Price	Variety	Quality	Markup
	(1)		(2)		(3)		(4)			
Scenario 1: $HHI^{obs} = 3304$, $HHI^{cf} = 3396$ (+2.8%)										
Bunnpris	3.05	9.41	-11.53	1.51	-28.01	9.41	0.44	-0.17	-28.01	9.41
Kiwi	0.54	1.51	-1.76	9.41	-4.66	1.51	0.08	-0.03	-4.66	1.51
Average	0.31	0.92	-1.12	0.93	-2.3	0.93	0.05	-0.02	-1.93	0.93
CV	-0.8	-	-0.2	-	-0.002	-	- 0.016	-	-	-
Scenario 2: $HHI^{obs} = 3304$, $HHI^{cf} = 3440$ (+4.13%)										
Bunnpris	5.28	15.9	-19.81	15.94	-	15.94	0.76	-0.30	-	15.94
Rema	0.73	1.95	-2.09	1.95	-	1.95	0.11	-0.04	-	1.95
Average	0.49	1.42	-1.72	1.42	-	1.42	0.07	-0.03	-	1.42
CV	-0.39	-	-0.2	-	-0.21	-	-0.26	-	-	-
Scenario 3: $HHI^{obs} = 3304$, $HHI^{cf} = 3346$ (+1.28%)										
Rema	4.79	12.32	-13.55	12.32	-25.7	12.32	0.73	-0.27	-21.13	12.32
Kiwi	5.76	15.08	-18.23	15.08	-47.95	15.08	0.88	-0.33	-39.54	15.08
Average	1.86	5.17	-5.59	5.17	-13.45	5.17	0.28	-0.11	-10.87	5.17
CV	-1.11	-	-0.19	-	-0.19	-	0.46	-	-	-

Note: The effect for the price and variety is calculated in percentage changes w.r.t. initial values.
The effect for the quality is calculated in percentage change w.r.t. standard deviation of the initial value.

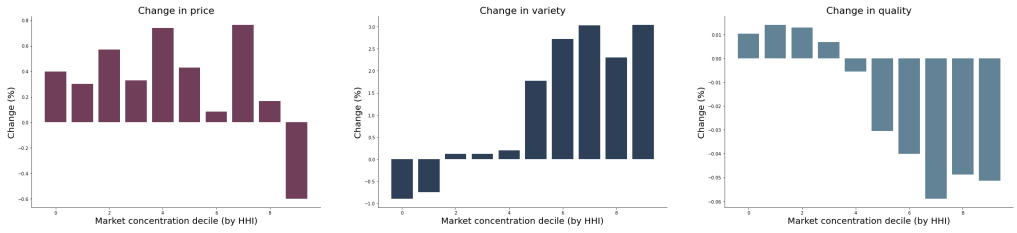
5.2 Welfare Analysis of Local Assortment

To quantify welfare effects from local assortment, one needs to compare observed assortment with counterfactual one when chains are forced to unify their assortment decisions and provide the same bundle of groceries in all stores. Then the maximization problem for a multi-store firm looks as follows:

$$\max_{\{p_g,\nu_g,\xi_g\}_{j\in\mathfrak{J}_g}} \sum_{j\in\mathfrak{J}_g} M_m s_{jgm}(p_{\cdot m},\nu_{\cdot m},\bar{Y}_m,\xi_{\cdot m};\theta_d)(p_g - mc(\nu_g,\xi_g,\mathbf{w_{jgm}};\theta_s)). \quad (16)$$

Using first-order conditions for problem 16, I calculate new counterfactual equilibrium price, variety, and quality of the composite good for each firm. The results are summarized in Figure 3. The bar charts show relative changes in price, variety, and quality of the grocery bundle on markets sorted by HHI deciles. When retailers were forced to unify assortment decisions, it would affect consumers in different markets differently. Consumers who reside in more concentrated markets would obtain relatively cheaper products and wider choice in a supermarket. However, they would also be offered a lower-quality assortment. In contrast, consumers living in more competitive areas would have reduced access to low-end products.

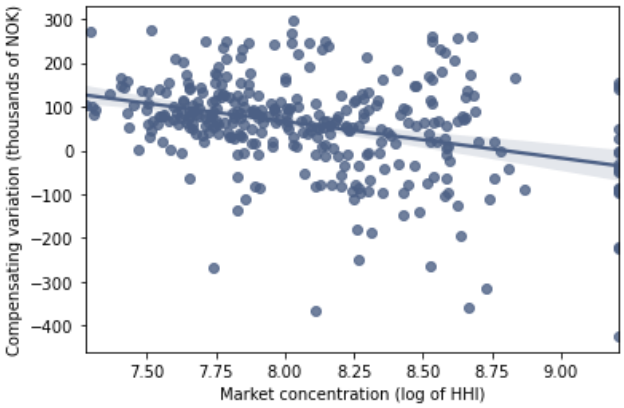
Figure 3: Counterfactual: Uniform Assortment



As Figure 3 shows, price, variety, and quality change in different directions. Therefore, the ultimate effect on welfare is ambiguous. Figure 4 shows compensating variation for different markets. Despite high dispersion, there is a general tendency for compensating variation to decrease with market concentration, meaning that consumers in more concentrated markets are more likely to benefit from the uniform assortment. Although this policy provides equal access to products, the implementation of this policy would

be costly for the majority of consumers, and the total consumers welfare would drop by 10.65%.

Figure 4: Compensating Variation for Uniform Assortment



6 Conclusion

In this paper, I study how retailers manage assortment under uniform pricing. I document that supermarkets can adjust local assortment in response to changes in market structure when prices for products are fixed. Therefore, I investigate whether these differences in assortment can be attributed to a leading position of a retailer in a market.

I estimate a structural model of demand and supply using the Norwegian grocery market data. The counterfactual analysis reveals that once a retailer gains a stronger position in a market, it adjusts assortment, particularly by choosing how many and which products to stock in a store. Different counterfactual scenarios show that increased market power could result in more expensive products on a shelf, a narrower choice of assortment, and lower quality of products. These are important insights into why assortment could differ in stores of the same chain even at uniform pricing and might be particularly important for policymakers concerned about market competition.

I also simulate an alternative scenario when retailers are constrained to provide equal assortment in stores of the same chain. I find that this pol-

icy would have heterogeneous effects on consumers in different markets. In particular, consumers living in more competitive areas would have reduced access to low-end products. In contrast, consumers in more concentrated markets would obtain relatively wider choice and cheaper products of lower quality. Although these consumers are more likely to benefit from the uniform assortment, implementing this policy would be costly for consumers in general, and the total consumer welfare would drop by 10.65%.

It is worth noting that I abstract from setting prices for individual products here. If, as a result of a merger, a firm obtains a significant increase in market power in all markets, this will likely lead to a revision of the entire pricing policy rather than marginal changes in the assortment. Instead, I show that if a retailer has local market power, it will adjust its assortment toward more expensive without changing product-level prices. Another aspect that remains outside the scope of this study is the choice of formats. When entering new markets, retail groups strategically choose a store format. Choice of format assumes a specific store size, prices, location, and other characteristics. In the current setting, I take stores' format as a given and analyze assortment decisions conditional on a format. The current setting still allows to analyze marginal changes in the assortment; however, one should account for the format choice to see the whole picture of the competition.

Therefore, one of the possible extensions could be to model retailers' choice in a broader context, where on the upper level, retailers make entry and format decisions and then, on the lower level, choose assortment within a format. I also assume that consumers have preferences over assortment measured by scalar price, variety, and quality measures. Ideally, one could model demand and supply for each product in a store. I also abstract from spatial competition between stores. Adding distance into a model would allow to measure local market power more accurately and study spatial heterogeneity of the effect of local market power on assortment.

A growing number of studies show that retailers choose to follow uniform pricing while competing on other non-price attributes. This evidence changes the way we think about competition (Butters et al., 2022). While the standard Bertrand model gives price the key role, it does not allow to answer the question of what happens with the competition when prices are fixed, but quality can differ. In this setting, I adapt the standard Bertrand model to offer an alternative view of competition between retailers under uniform pricing.

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