Pop the Cork on the Holidays

The Economic Determinants of Seasonal Patterns*

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Abstract

I show countercyclical pricing in the sparkling wine category during demand peaks. Demand for sparkling wine peaks during Christmas/New Year, Easter and carnival. In addition, I observe a demand shift to higher quality products in the Christmas and Easter period. I test different demand- and supply-side theories with an explanation for countercyclical prices and composition effects during demand peaks. I estimate a product-level demand system and document that, at least in the Christmas period, price declines are consistent with an increase in price sensitivity and a change in relative demand for different products. In addition, my findings suggest that an increase in search activity drives an increase in price sensitivity at Christmas. The findings provide little evidence, that for the sparkling wine data I examine, the loss-leader model of advertising or the change in consumer mix are the main explanation for the seasonal patterns.

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1 Introduction

A growing body of empirical research suggests that retail prices fall in periods of high demand, a phenomenon which is often referred to as "countercyclical pricing". Warner and Barsky (1995) show that the prices of several consumer appliances fall in the period prior to Christmas. MacDonald (2000) studies grocery prices and documents price declines for many items in periods of seasonal demand peaks. Chevalier, Kashyap and Rossi (2003) examine scanner data from a large retailer in the Chicago area and find that a price index for several products declines in periods of peak demand. In addition, there are further studies that focus on specific product categories, e.g. Nevo and Hatzitaskos (2006) on price declines for tuna during Lent or Perrone (2016) on price declines for ice cream during summer and in high temperatures. These results of countercyclical pricing during periods of peak demand are inconsistent with standard competition models and lead to the question of how to reconcile such pricing patterns with economic theory. The literature presents different explanations for the phenomena of countercyclical pricing that can be classified into supply- and demand-side explanations.

In this paper, I contribute to the literature by testing the established theories of countercyclical pricing in a new product category. The demand for sparkling wine in Germany peaks during Christmas/New Year, Easter and carnival, while the product category price significantly declines. Countercyclical pricing in the German grocery market, and especially in the market for sparkling wine, has not been the subject of analyses so far. I am only aware of the research by Bayot and Caminade (2016) that studies countercyclical pricing in the US sparkling market.[1]

An important interest of studying the price patterns of sparkling wine in periods of peak demand is related to the quality shifts observed in this category. To study quality shifts within the product category, I classify products with respect to two quality dimensions. The quality dimensions considered are whether the product is a national or store brand and whether the product is a premium or regular quality brand. I find evidence that during Christmas and Easter, consumers' product choices tend to shift from store to national brand products and from regular to premium quality products. Several factors might explain why consumers would prefer the national brand and premium quality products during demand peaks. From cocktail parties to elaborate dinners with family and friends, the holiday season is a special occasion where product quality is important. During the rest of the year, consumers purchase sparkling wine

[1]Nevertheless, the German sparkling wine sector was analysed in current investigations by the German competition authority (Bundeskartellamt (2014a, 2014b)). Thus, the supplier and buyer structure, the relevance of private labels, and the importance of cyclical demand are well understood.

mainly for personal regular consumption, so they care less about the quality of the product.

Similar to other papers that contribute to solving the puzzle of countercyclical pricing in periods of peak demand, I find that consumers exhibit a higher price sensitivity at least in the Christmas period. I then test several explanations as to why prices are lower and price elasticity is higher during demand peaks. The supply-side explanations argue that firms compete differently during periods of peak demand. I test a loss-leader advertising theory, according to which retailers are likely to advertise high-demand products at a low price in order to compete for consumers' store patronage (Lal and Matutes (1994)). The demand-side explanations focus on variations in price sensitivity among seasons. Changes in consumer price sensitivity may result from an increase in shopping behaviour during demand peaks (Warner and Barsky (1995)). Moreover, the variation in price sensitivity might be driven by a change in product-level demand, which can result from changes in the consumer mix (Bils (1989), Perrone (2016)) or a different product usage (Nevo and Hatzitaskos (2006)) during demand peaks.

In the empirical analysis I use the German Nielsen Homescan data on sparkling wine purchases for the years 2006 to 2012. For each product purchase there is information about the brand, price, product characteristics, purchase date, and retailer at which the product was purchased. The household consumer panel data also contain information on household demographics.

The rest of the paper proceeds as follows. In section 2 I review the literature and present explanations on countercyclical price movements during periods of peak demand. In section 3 I describe the data used in the analysis and provide some descriptive statistics of interest. The detailed empirical analysis is contained in sections 4 and 5. In section 4 I show evidence about the seasonality of prices, quantity demanded and demand composition. In section 5 I estimate a product-level demand system in order to calculate price sensitivities and examine the change in consumer preferences among seasons. Finally, I test different explanations that try to explain the observed seasonal patterns.

2 Literature

The economic theory suggests that retail prices increase in periods of exogenous high demand. However, there is growing empirical evidence that retail prices do not obey the standard model and that for certain product categories, demand peaks are periods of lower retail prices. Demand peaks can occur during periods of high overall demand (e.g. sparkling wine in the Christmas period, when demand for other products at the supermarket is also high) or they can occur idiosyncratically for a particular product category during a period of low or average overall demand (e.g. tuna during Lent or sparkling wine during carnival). The explanations offered by the literature for the phenomena of countercyclical pricing can be classified into supply- and demand-side explanations.

2.1 Supply-side explanations

The set of supply-side explanations posit that firms might compete differently in periods of peak demand than in non-season periods. The loss-leader model of advertising and the tacit collusion model are established supply-side explanations that are discussed in the following.

Loss-leader advertising

Regular seasonal periods of peak demand are anticipated by firms, which likely adjust their behavior these events. In the loss-leader model of advertising by Lal and Matutes (1994) retailers compete for customers via advertised prices. It is efficient for retailers to advertise and discount items that have a high relative demand in order to attract customers to the store. If customers have relatively high search costs, they will purchase the loss-leader product and all other products that are in their shopping basket at the same store. The prices of the products not advertised are set to reservation prices. In a comprehensive study, Chevalier et al. (2003) examine the loss-leader theory as one possible explanation for countercyclical pricing. In their study, they use the weekly data for several product categories from Dominick's Finer Foods, a large US retail chain in the Chicago area. They find empirical evidence of the loss-leader explanation by observing increases in advertising during peak demand for several product categories, including tuna (for which peak demand is during Lent) and snack crackers (with a peak demand during Thanksgiving and Christmas). The loss-leader model predicts price decreases during periods of overall peak demand and product-specific demand shifts as well. The model does not require any seasonal variation in price sensitivity.

Tacit collusion

A further model in the set of supply-side explanations is based on Rotemberg and Saloner (1986) in which retail prices should be lower in periods of high overall demand because the gains from defecting out of tacit collusion between retailers are highest during these periods and thus collusive price levels are difficult to maintain in these times. This model applies to periods of overall high demand but not to idiosyncratic demand peaks. Chevalier et al. (2003) find no empirical evidence of the tacit collusion model because the retail margins decline at both overall and idiosyncratic demand peaks.

2.2 Demand side explanations

The common implication of the demand-side explanations is that price sensitivity should vary systematically with seasonal demand peaks. If price sensitivity is higher during periods of peak demand, this will lead to a lower equilibrium price. The variation in price sensitivity might be driven by a change in consumer search behaviour or a change in product-level demand.

Search behaviour

Warner and Barsky's (1995) model generates cyclical demand elasticities due to economies of scale in search. In their analysis of retail pricing patterns for durable goods at retail stores in Michigan, they note that prices tend to be marked down in periods of exogenously high demand, more specifically before Christmas and on weekends. They argue that the higher total shopping basket leads to higher consumer incentives to be informed about prices, e.g. through increased price search and travel between stores. Thus, the demand faced by retailers becomes more elastic and therefore optimal prices are lower. The model is applicable to periods with overall high demand but does not predict changes in price sensitivity for periods of idiosyncratic peak demand. Alternatively, one could also interpret the search explanation as applying to search within a specific product category.[2] The implications of this model are also tested by Chevalier et al. (2003). They find no empirical evidence that the elasticity of demand for their studied food product categories varies in periods of peak demand and thus rule out this theory as an explanation for countercyclical pricing.

Product-level demand

Another set of demand-side explanations for price and elasticity variations during periods of peak demand is based on changes in product-level demand. The change in product-level demand could be driven either by a change in product preferences within a product category or by a change in the consumer mix. The change in product-level demand explanation works for both

[2] Perrone (2016) also applies the implications of the Warner and Barsky model to idiosyncratic demand peaks by assuming that consumers want to buy more of a specific product in these demand periods and thus they may be willing to pay additional search cost to find the best price. Then, one could also expect to see an increase in price sensitivity and a decrease in prices during periods of idiosyncratic peak demand.

periods of overall high demand and idiosyncratic demand peaks.

While Chevalier et al. (2003) emphasize the importance of incorporating retailer behaviour, their empirical analysis is performed at the category level. In a subsequent study, Nevo and Hatzitaskos (2006) draw more attention to product differentiation. In their detailed analysis of the tuna category, they explain the average price decrease during periods of peak demand by a relative market share shift towards cheaper products, accompanied by an increase in price sensitivity. The results show that consumers are more likely to substitute towards lower quality products during Lent and thus product-level demand changes. A detailed product-level analysis prevails that much of the increase in quantity sold is due to two relatively cheap products that are not advertised during Lent but nearly triple their market share. Perrone (2016) is formalising Nevo and Hatzitaskos's (2006) argument of product-level shift on demand in a model which shows that a positive exogenous demand shock increases cross-price elasticities, shifting consumers' quality choices towards lower quality products that are cheaper. The market share increase of cheaper products leads to a decrease of the average product category price. To test the implications of the model, consumer panel data on the purchase choices of ice cream in France are used, which have a peak during the summer. The estimation results corroborate the predications of the model.

Bils (1989) posits that the consumer mix might change during demand peaks, resulting from the entry of a segment of buyers who only enter the market during the season. Then, the effect of observing a higher price sensitivity during periods of peak demand could be attributed to a composition effect. The new customers, with weaker brand attachment, might be more price sensitive than the regular consumers. This in turn raises the incentives for retailers to reduce prices. Perrone (2016) finds no empirical evidence that price sensitivity varies between customers who purchase only during peak demand and regular consumers. However, Bayot and Caminade (2016) document the relevance of the consumer mix for countercyclical pricing and increases in price sensitivity in the US sparkling wine market during the holiday season. Using consumer panel data and scanner data on sparkling wine purchases in Portland, they find that the increase in aggregate elasticity is driven solely by the entry more price-elastic consumers who only purchase sparkling wine during seasonal peak demand.

3 Data description and seasonal patterns

I base my analysis on the German Nielsen Homescan data in the sparkling wine category for the years 2006 to 2012. The Nielsen Homescan data consist of a panel of households that record their grocery purchases. For each sparkling wine product, there is information on its brand and characteristics, including the price, retailer, bottle size and purchase date. The Homescan consumer panel data also contain information on household demographics. One challenge in the Homescan consumer panel research is that only the prices, quantities and product characteristics of the items bought are recorded. Therefore, I have to impute the quantities, prices and product characteristics of non-chosen alternatives as outlined in Appendix I.

From this data, I calculate the weekly volume market share and median price for each product. The unit of analysis are 0.75 litre bottles that account for more than 92% of total sparkling wine sales. At the retail level there are five large retail chains competing directly with each other that have a joint market share of 86%. All other retailers not considered have individual market shares of less than 3%. In addition, sales in outlets other than retail stores are not considered, e.g. sales through drugstores, kiosks, restaurants and also direct sales by wineries. My analysis is based on the retail chain level and does not discriminate between different retail formats of a given retail chain. However, I include the share of sales through discounter formats in the subsequently specified demand model in order to control for sales through such outlets for a given retail chain. I apply the common assumption in the literature that retail competition in German food retailing is at a national level (cf. Draganska et al. (2010), Draganska and Klapper (2011), Villas-Boas (2009)). This implies that retailers set uniform prices at a national level.

I restrict my attention to sparkling wine brands that have a market share of at least 1%. This leaves me with 17 brands that account for more than 82% of total sparkling wine sales in the grocery retail market. I define a product as a combination of the brand and retail chain. In particular, the number of products are equal to 47 products but only brands with a yearly market share of at least 2% of a given retailer chain are included in the analysis.[3]

Figure 1 presents the total weekly sales of sparkling wine throughout the sample period. The sparkling wine category exhibits demand peaks during three yearly events: Christmas with New Year's Eve, Easter and carnival.[4] Christmas is the most important sales period of the

[3] Given this restriction of market shares at the retail chain level, there remain, for example, only 43 products in the sample in the year 2008.

[4] In the entire analysis seasons are defined as follows: The Christmas season starts in the 50th week of the year and ends in the week of New Year's Eve. The Easter season encompasses the Holy Week and the previous

year. The weekly average quantity sold amounts to about 2.0 million bottles per week in the non-seasonal period and increases, on average, by more than 180% in the Christmas period. Furthermore, there is a large demand peak in the Easter period and a smaller demand increase in the carnival period.

Figure 2 shows the unweighted average weekly prices throughout the sample period and provides first evidence of countercyclical pricing in the sparkling wine market. For each year, the unweighted average price per week is lowest in the Christmas period. The unweighted average weekly product price is 3.70 Euro per bottle in the non-seasonal period. On average, I find that the price drops by around 6.5% in the Christmas period, relative to the average price in the non-seasonal period. In addition, I observe a price decline of around 4.5%, on average, at Easter. There are also small price declines during carnival (a 2.1% drop).

Figure 3 shows the sales-weighted average weekly price throughout the sample period. The sales-weighted average weekly product price is 3.19 Euro per bottle in the non-seasonal period. In general, the sales-weighted prices are lower than the unweighted prices, indicating that cheaper products have higher market shares. Interestingly, I find that the price weighted by weekly sales volume is not appreciably lower during the Christmas period in comparison to the rest of the year. The sales-weighted average price drop in the Christmas period is only 2.8% and thus much smaller than the decline of the unweighted price (6.5%.) I observe similar patterns in the Easter period. Only at carnival time does the unweighted and sales-weighted average weekly price not differ considerably. The results provide evidence of a composition effect. The market shares of more expensive products increase in the Christmas and Easter periods, pushing up the sales-weighted price, although retailers may be setting lower prices.

To analyse the composition effect, I classify products with regard to two quality dimensions: (1) whether the respective brand is a regular or premium brand, and (2) whether the respective brand is a national or store brand. In addition, the most brands have several taste varieties, such as rose, alcohol free and added sugar content. I follow other papers (cf. Cohen and Cotterill (2011)) and control for the share of each variety in the subsequent demand estimation.

First, the classification in regular and premium quality is according to production techniques, country of origin and price.[5] The sparkling wine production is complex because of the need for two fermentations; one to make the wine and the other to make the bubbles. There are two different standard methods for the second fermentation: traditional or classic bottle fermentation

week. The carnival season includes the week of Ash Wednesday and the week prior to that.

[5] Rhein et al. (2010) provide an exhaustive explanation of the production of sparkling wine and quality characteristics.

Figure 1: Weekly sales

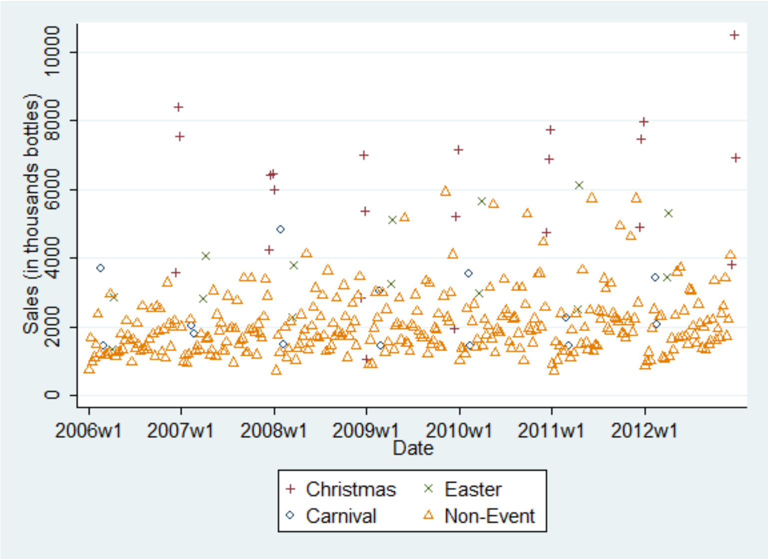
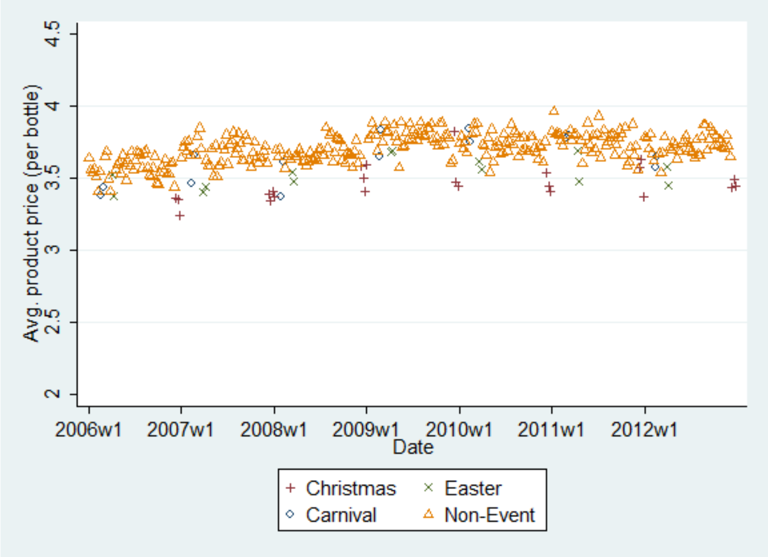
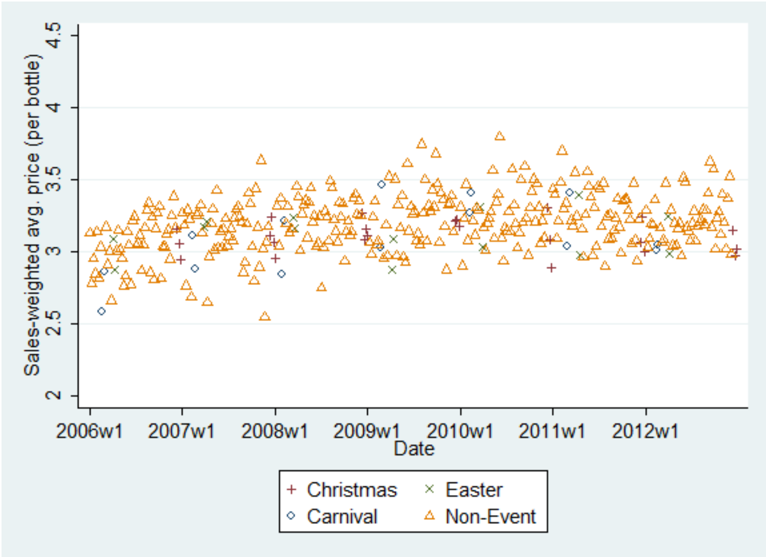


Figure 2: Average weekly price per bottle (unweighted)



Note: The figure displays the unweighted average weekly product price.

Figure 3: Average weekly price per bottle (sales-weighted)



Note: The figure displays weekly product prices weighted by weekly volume market shares.

and the tank method. Premium quality sparkling wines made by the traditional method require a second alcoholic fermentation of a base wine in sealed bottles. Regular quality sparkling wines are produced in tanks where the second fermentation takes place in a large closed pressure tank. In addition, variations in sparkling wine quality are in addition also a result of the used grapes and their country of origin. While sparkling wines in Germany are primarily produced from base wines from different countries in the European Union, countries such as France only recognise sparkling wines that are produced from wines with a very specific geographical origin (e.g. Champagne from the Champagne region). Besides that, sparkling wine quality is defined by price segments. Many research papers suggest that price is a reasonable proxy for (sparkling) wine quality (cf. Davis et al. (2008) and Costanigro et al. (2007)). Six out of the 17 considered brands are classified as premium quality based on these criteria.

In addition, I consider whether the product is a national or a store brand to classify the products with regard to quality. There are six store brands and 11 national brands. Although there might be the general belief that store brands are of lower quality than national brands, one store brand is classified as premium quality.

Table 1 displays the (unweighted) average product price and market shares per week for the quality combinations by seasons. In general, premium products are, on average, more expensive than regular products and national brand products are, on average, more expensive than national brand products in all seasons. The average price for national brand products declines in all three seasons of peak demand, irrespective of whether it is of a regular or premium quality. The average price for national brand products during the Christmas period is at its lowest level for the year. The price drops for national brands are of smaller magnitude at the other seasonal demand peaks, especially for regular quality products in the Easter and for premium quality products in the carnival period. There is no appreciable seasonal variation in price for store brand products, except a small price drop in the average price at carnival. Despite the price drop for national brand products at seasonal demand peaks, store brand products are, on average, still less expensive than the national brand.

Table 1: Seasonal patterns

Product quality		Season				
Premium	Store brand	Total	Christmas	Easter	Carnival	Non-event
Average price						
0	0	2.96	2.80	2.91	2.86	2.98
1	0	4.98	4.61	4.67	4.98	5.03
0	1	2.44	2.44	2.43	2.39	2.44
1	1	3.53	3.54	3.53	3.50	3.53
Average volume market share						
0	0	0.644	0.648	0.675	0.648	0.641
1	0	0.237	0.279	0.245	0.216	0.228
0	1	0.091	0.053	0.061	0.110	0.101
1	1	0.028	0.021	0.019	0.026	0.030

National brand products account for more than 88% of the annual sparkling wine consumption. The statistics for the seasonal average market shares clearly indicates a shift in demand from store brand to national brand products during Christmas and Easter. In fact, the average market share for store brand products declines by more than 5 percentage points during both seasonal events and this decline applies to both regular and premium quality products. During the Christmas period there is a strong increase in the demand for premium national brands, while the average market share for regular national brands remains fairly constant. In contrast, during the Easter period both premium and regular national brands gain market shares. In the carnival period, there are no appreciable changes in the market shares by quality dimensions.

4 Reduced form tests

In this section, I analyse the countercyclical pricing, seasonal demand peaks and the composition effect throughout the seasons in more detail. I apply different reduced form tests follwing Perrone (2016). In addition, I present product-level statistics.

Countercyclical pricing

First, I take a closer look at the price drops among the quality comibinations during seasonal demand peaks. I estimate a regression of the average weekly prices by quality dimensions on the interactions of seasons with premium, the interactions of seasons with store brands, and the interactions of seasons, store brand and premium. The estimation results are displayed in Table 2. In columns (1) and (2) the dependent variable is the weekly average price by quality dimensions, while in columns (3) and (4) the dependent variable is the weekly average logged price by quality dimensions in order to interpret the estimated coefficients in terms of percent change. Columns (1) and (3) include only seasonal dummies, while in columns (2) and (4) the interactions between quality dimensions and seasons are added.

Table 2: Prices at demand peaks

	(1)	(2)	(3)	(4)
Premium	2.03***	2.05***	0.52***	0.52***
	(0.01)	(0.01)	(0.00)	(0.00)
Store brand	-0.52***	-0.54***	-0.19***	-0.20***
	(0.01)	(0.01)	(0.00)	(0.00)
Premium x store brand	-0.94***	-0.97***	-0.15***	-0.16***
	(0.01)	(0.01)	(0.00)	(0.00)
Christmas	-0.15***	-0.17***	-0.04***	-0.06***
	(0.01)	(0.02)	(0.00)	(0.01)
Easter	-0.11***	-0.07**	-0.02***	-0.02***
	(0.02)	(0.03)	(0.00)	(0.01)
Carnival	-0.06***	-0.11***	-0.02***	-0.04***
	(0.02)	(0.03)	(0.00)	(0.01)
Christmas x premium		-0.25***		-0.03***
		(0.03)		(0.01)
Easter x premium		-0.29***		-0.05***
		(0.04)		(0.01)
Carnival x premium		0.06		0.03***
		(0.04)		(0.01)
Christmas x store brand		0.17***		0.06***
		(0.03)		(0.01)
Easter x store brand		0.05		0.02
		(0.04)		(0.01)
Carnival x store brand		0.07		0.02*
		(0.04)		(0.01)
Christmas x store brand x premium		0.26***		0.03**
		(0.05)		(0.01)
Easter x store brand x premium		0.31***		0.06***
		(0.06)		(0.02)
Carnival x store brand x premium		-0.04		-0.02
		(0.06)		(0.02)
Constant	2.88***	2.88***	1.06***	1.06***
	(0.01)	(0.01)	(0.00)	(0.00)
N	1460	1460	1460	1460

Note: Dependent variable is in specifications (1) and (2) the weekly average price by quality combinations, and in specifications (3) and (4) the weekly average logged price by quality combinations. The regression includes year fixed effects. Standard errors in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In all specifications the coefficient of premium is positive and significant, indicating that premium products are, on average, more expensive than regular products. Furthermore, the coefficient of store brand is negative and significant, confirming that store brand products are, on average, less expensive than national brand products. Finally, the coefficient of the interaction between store brand and premium is negative, thus premium store brand products are. on average, less expensive than premium national brand products.

The estimated seasonal coefficients are negative and significant in all specifications, indicating that there are appreciable price drops at seasonal demand peaks. The coefficient of the Christmas dummy indicates a price drop of 6.3% in the Christmas period (in specification (4)), this coefficient is lowest among all seasonal dummies and shows that the price drop is highest in the Christmas period.

The coefficient of the interactions between Christmas and premium and between Easter and premium are negative and significant, indicating that premium quality products seem to exhibit a higher price drop in the Christmas and Easter period than regular quality products. The coefficient of interaction between carnival and premium is positive, thus premium quality products seem to exhibit lower price reductions in the carnival period than regular quality products. Furthermore, the coefficient of the interaction between Christmas and store brand is positive and significant, indicating that store brand products seem to exhibit lower price reductions than national brand products. However, further taking into account the coefficient of the interaction between Christmas, premium and store brand, the price drop in the Christmas period that is indicated by the negative coeffcient of Christmas is approximately offset for store brands. Thus, prices for both regular and premium store brand products remain fairly constant at Christmas. I observe only appreciable price drops for national brand products in the Christmas period, whereby premium national brand products exhibit higher price drops than regular national brand products.

Although the coefficient of the interaction between Easter and store brand is not significant, I find similar price patterns among the quality dimension in the Easter period. There are again price drops for national brand products, but these are smaller in magnitude than in the Christmas period. In addition, within the national brand category premium quality products exhibit higher price drops than regular quality products. If all interactions are taken into account, there are no significant price drops for store brand products during Easter, irrespective of whether the product is of regular or premium quality.

The estimated coefficient on the interaction between carnival and premium is positive, but only significant in specification (4). In addition, the estimated coefficient of the interaction between carnival and store brand is positive but rarely statistically significant. Thus, within the national brand category regular quality products experience higher price drops than premium quality products. If all interactions are taken into account, there are small price drops among all quality dimensions in the carnival period.

These results provide important insights for the identification of quality shifts. Imagine that retailers set lower prices during anticipated demand peaks. Then, if the price of the premium quality and national brand products decreases more than the price of regular quality and store brand products, in equilibrium, the relative demand for higher quality products should increase as a response to these price variations. The estimated price drops at seasonal demand peaks are higher for national brand products than for store brand products and within the national brand category they are higher for premium quality products than for regular quality products. Thus, a migration towards premium quality products within the national brand category in the Christmas and Easter period may be just a demand response to changes in the price setting behaviour of retailers. The same logic applies in the carnival period, where the migration towards regular brand products within the national brand category might be a demand response to differences in price variations. Similarly, a shift from store brand to national brand products in the Christmas and Easter periods might be driven by differences in price variations.

Seasonal demand peaks

To analyse variations in market shares by quality dimensions and seasons, I regress the weekly volume market shares by quality dimensions on seasonal dummies. Table 3 displays the estimation results. The estimated coefficient of store brand is negative and significant and the coefficient of premium is positive and significant, indicating that national brand and regular quality products have higher market shares than their respective counterparts.

The coefficient of the interaction between Christmas and premium and between Christmas and store brand is negative and significant. These results suggest that demand shifts from regular to premium quality products and from store to national brand products at Christmas. In addition, the coefficient of the interaction between Christmas, store brand, and premium is close to zero and is not significant, indicating that demand does not shift from regular to premium quality products within the store brand category in the Christmas period. The estimated coefficient of the interaction between Easter and premium is positive but not significant, while the coefficient on the interaction between Easter and store brand is negative and significant. In

Table 3: Volume market shares at demand peaks

	(1)
Premium	-0.38***
	(0.01)
Store brand	-0.50***
	(0.01)
Premium x store brand	0.30***
	(0.01)
Christmas x premium	0.05***
	(0.02)
Easter x premium	0.03
	(0.02)
Carnival x premium	-0.01
	(0.02)
Christmas x store brand	-0.06***
	(0.02)
Easter x store brand	-0.05**
	(0.02)
Carnival x store brand	0.00
	(0.02)
Christmas x store brand x premium	-0.01
	(0.03)
Easter x store brand x premium	0.01
	(0.04)
Carnival x store brand x premium	0.00
	(0.04)
Constant	0.62**
	(0.01)
N	1460

Note: Dependent variable is weekly average market share by quality combinations. The regression includes year fixed effects. Standard errors in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

general, the results lead to the same conclusions regarding shifts to higher quality products in the Easter period as those obtained in the Christmas period. Finally, the estimated coefficients of the interactions between carnival and quality are all close to zero and statistically not significant. Thus, there are no appreciable variations in market shares among quality dimensions at carnival.

Composition Effect

In the subsequent section, I calculate category price indexes to analyse consumer quality shifts during seasonal demand peaks. There are two ways to measure the category level price: a variable weight and fixed weight price index (cf. Nevo and Hatzitaskos (2006), Perrone (2016)). While the fixed weight price index is used to identify price changes, the variable weight price index also captures potential composition effects. The indices are calculated by using weekly product prices. Let P_{jt} be the logarithm of the price per standard bottle of product j in week t. The price index at time t is:

$$P_t = \sum_j w_{jt} \cdot P_{jt} \tag{1}$$

where w_{jt} are the weights of the respective index. For the fixed weight price index, the weight w_{jt} is defined as the yearly revenue share. For the variable weight price index, the weight w_{jt} is given by the current (weekly) revenue share.

The following sketch of three scenarios illustrates the mechanism of both indices. First, consider the situation where prices drop during demand peaks and there is no product-level demand shift. In this case, the weights of both indices would remain constant and the indices would display the same price drop. In the second scenario, prices are assumed to be constant but there is a demand shift towards higher quality products during demand peaks, precisely from regular to premium quality products or from store to national brand products. Then, the variable weight price index would display an increase in prices during demand peaks due to demand shifts towards higher quality products that are more expensive. However, the fixed weight price index would not change, since the fixed weights are constant for a given year also during periods of peak demand. Finally, in the third scenario, the prices might decrease and there is a demand shift towards higher quality products at demand peaks. In this case, the variable weight price index would decrease because prices are lower and increase due to a demand shift towards higher quality products that are more expensive. However, the fixed weight price index would decrease solely due to the drop in prices.

Table 4 presents estimation results where the weekly variable weight and fixed weight price index are regressed on seasonal dummies. The displayed estimation results consider all products. In Appendix II the estimations are replicated seperately for national brand, store brand, regular quality, and premium quality products.

Table 4: Variable and fixed price index at demand peaks

	Variable weight price index	Fixed weight price index
Christmas	-0.031**	-0.084***
	(0.01)	(0.01)
Easter	-0.031*	-0.065***
	(0.02)	(0.01)
Carnival	-0.033**	-0.021*
	(0.02)	(0.01)
Constant	1.200***	1.257***
	(0.01)	(0.01)
N	365	365

Note: Dependent variable is weekly price measured by variable weight price index and fixed weight price index. The regression include year fixed effects. Standard errors are in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the fixed weight price index regression the coefficient of Christmas is negative, indicating price declines in the Christmas period. In the variable weight price index estimation the coefficient of Christmas is also negative but the decline is less sharp than in the fixed weight price index estimation. Thus, the results indicate that the weight of higher quality products that are more expensive increases. The estimation results for Easter are similar to the Christmas results. Although if both indices indicate a price decrease, the effect on the variable weight price index is not only less strong but also less significant than the effect on the fixed weight index. Both indices display nearly the same price drop for the carnival period. Thus, there is no empirical evidence of a composition effect in the carnival period.

Product-level statistics

Furthermore, I analyse the prices and market shares of each product among seasons to further verify which products are reduced in price and how market shares change. Table 5 presents product-level statistics for the 47 products considered in the analysis. The products are categorised according to the quality dimensions and the average market shares at the respective retailer. Columns (5) and (6) display the average weekly price and market share for each product. Columns (7)-(9) present the results from regressing weekly prices on seasonal dummies and columns (10)-(12) the results from regressing weekly market shares on seasonal dummies.

The most striking statistics in Table 5 are the changes in the prices and market shares

Table 5: Price, market share and seasonal changes per product

Product		Quality		Summary statistic		Price change			Market share change		
Chain	Brand	Pre-mium	Store brand	Price	Market Share	Christ-mas	Easter	Car-nival	Christ-mas	Easter	Car-nival
1	1	0	0	3.28	0.079	-0.280***	-0.276**	-0.037	0.012	0.009	0.016
1	2	0	0	2.58	0.028	-0.133**	0.109	-0.165**	-0.011	-0.010	0.003
1	3	0	0	2.80	0.024	-0.065	-0.128	-0.281**	-0.007	-0.011	-0.003
1	4	0	0	3.16	0.018	-0.042	0.091	0.113	-0.013***	-0.012*	-0.009
1	5	0	0	2.84	0.011	-0.255***	-0.113	-0.260**	-0.003	-0.005*	0.001
1	6	0	0	3.02	0.007	-0.02	-0.139	-0.314*	-0.011**	0.019***	0.007
1	7	1	0	4.66	0.025	-0.526***	-0.277	-0.154	0.021**	-0.010	0.001
1	8	1	0	4.68	0.011	-0.401***	-0.529***	0.089	0.002	0.017***	-0.003
1	9	1	0	4.08	0.011	-0.127	-0.103	-0.281**	-0.007**	-0.005	0.003
1	10	1	0	5.22	0.008	-0.353***	-0.203	-0.12	0.004**	-0.004*	-0.001
1	11	1	0	6.72	0.005	-1.014***	-0.868***	-0.481*	0.012***	0.000	-0.003
2	1	0	0	3.42	0.036	-0.278***	-0.387***	-0.073	0.004	-0.008	-0.006
2	3	0	0	2.92	0.016	-0.173**	0.154	-0.286***	-0.006	-0.014	-0.004
2	2	0	0	2.66	0.013	-0.159***	0.09	-0.119	-0.008*	-0.007	-0.003
2	4	0	0	3.14	0.011	-0.228***	0.024	-0.087	-0.006*	-0.010**	0.004
2	6	0	0	3.06	0.009	-0.084	-0.038	-0.062	-0.004*	-0.008**	-0.008**
2	5	0	0	2.85	0.007	0.089	0.083	-0.234**	-0.002	-0.001	-0.001
2	7	1	0	4.62	0.021	-0.327***	-0.023	-0.032	-0.003	0.003	-0.007
2	9	1	0	4.17	0.016	-0.173*	0.045	0.07	-0.002	-0.005	-0.003
2	8	1	0	4.93	0.009	-0.421***	-0.724***	-0.01	-0.003	0.001	-0.002
2	10	1	0	5.22	0.006	-0.207**	0.074	-0.274**	-0.001	-0.005**	0.002
2	11	1	0	7.19	0.006	-1.016***	-0.729***	0.076	0.007***	0.001	0.006**
3	1	0	0	3.40	0.056	-0.292***	-0.475***	-0.039	-0.001	-0.009	-0.022
3	3	0	0	2.88	0.018	-0.348***	-0.075	-0.411***	-0.001	-0.011	0.031***
3	4	0	0	3.07	0.017	-0.046	0.033	0.08	-0.009**	-0.011**	0.000
3	2	0	0	2.66	0.010	-0.003	-0.056	-0.276***	-0.006**	-0.005	-0.001
3	5	0	0	2.94	0.007	-0.152**	-0.017	0.132	0.001	-0.002	0.000
3	6	0	0	3.03	0.006	0.131	0.157	0.125	-0.005**	-0.006**	0.005*
3	7	1	0	4.57	0.023	-0.433***	-0.085	-0.138	0.004	-0.006	0.016*
3	8	1	0	4.84	0.015	-0.666***	-0.862***	0.194	-0.003	0.007	-0.006
3	9	1	0	4.12	0.009	-0.058	0.014	0.137	-0.006**	-0.003	-0.001
3	11	1	0	6.66	0.009	-0.811***	-0.963***	0.449**	0.001	0.006***	-0.006***
4	1	0	0	3.26	0.150	-0.466***	-0.434***	-0.061	0.071**	0.173***	-0.004
4	6	0	0	2.82	0.033	-0.333***	-0.12	0.136	-0.001	-0.002	-0.016
4	3	0	0	2.81	0.025	-0.283***	0.211**	-0.334***	0.008	-0.018*	0.038***
4	2	0	0	2.56	0.017	-0.283***	-0.036	-0.052	0.000	-0.011	-0.014
4	4	0	0	3.00	0.015	-0.327***	-0.124	-0.174*	0.011	-0.001	-0.011
4	5	0	0	2.58	0.007	-0.088	-0.163	0.098	0.009	-0.001	-0.006
4	8	1	0	4.62	0.024	-0.648***	-0.524***	-0.235	0.024***	0.044***	-0.011
4	9	1	0	3.80	0.021	0.123	0.014	-0.103	-0.001	-0.015	0.024**
4	7	1	0	4.74	0.019	-0.275*	-0.333*	-0.077	0.005	-0.002	-0.013*
4	12	0	1	2.27	0.030	-0.025	-0.042	-0.03	-0.017***	-0.013**	-0.006
4	13	0	1	2.55	0.025	-0.018	0.001	-0.140***	-0.010**	-0.014**	0.018***
5	14	0	1	2.56	0.022	0.027*	-0.011	-0.011	-0.012***	-0.006	0.003
5	15	0	1	2.25	0.017	0.013	-0.002	-0.030***	-0.009***	-0.004	-0.006*
5	16	0	1	2.56	0.017	-0.004	-0.018	-0.018	-0.011***	-0.008***	-0.006**
5	17	1	1	3.53	0.034	0.015**	0.007	-0.022**	-0.016***	-0.014***	-0.004

Note: The table displays in column (5) the average weekly price and column (6) the market share of the sparkling wine products considered in the sample. Columns (7)-(9) present the results from regressing weekly prices and columns (10)-(12) the results from regressing weekly market shares on season and year dummies. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$..

among seasons. In the Christmas period, the prices of 29 products drop significantly. There is a clear pattern of price drops and market share shifts among the quality dimensions: Only the price of national brand products decreases significantly during Christmas, while there is no decrease in the price of store brand products. However, in general there is no difference in the frequency of price reductions between regular and premium national brands during Christmas. The market share regression shows that price decreases do not necessarily correspond to market share increases. Only for six products with significant price drops during Christmas is the market share increase significant, out of which five products are premium products. Several products that have significant price decreases during Christmas are products that are even losing market shares. In addition, all store brand products lose market shares, which might be driven by the switch towards national brands or the absence of price reductions.

In the Easter period, price reductions are less frequent and only 12 products exhibit significant price reductions. As in the Christmas period, only the prices of national brand products are significantly reduced during Easter. There is only a significant market share increase for four out of the 12 national brand products with significant price drops during Easter, whereby two products are regular and two products are premium quality products. Again, there are no significant price drops for store brand products and they experience significant declines in market shares.

The carnival period shows different patterns. In the carnival period, the price drop of 16 products is significant, whereby three products are store brands. The market share for three out of the 16 products increases significantly, including one store brand. Interestingly, there is no significant increase in market share for any premium quality product at carnival.

Albeit there are some identification concerns, the results provide first evidence for a change in relative demand for different products in the Christmas and Easter periods. In particular, the shift to premium national brand products seems to be partially driven by a change in consumer preferences for quality. The national brand products gaining market shares have significant price reductions. However, there are also (premium) national brand products that lose or at least do not gain market shares despite significant price reductions. These results suggest that the observed changes in consumer preferences with respect to quality are not solely driven by pricing. In the Christmas and Easter period the sparkling wine product is used differently. Consumers might choose products of higher quality, in particular (premium) national brand products, to serve to family and friends during Christmas (including New Year's Eve) and Easter. There is no evidence of a change in product preferences during carnival.

5 Detailed analysis

5.1 Demand model framework

In this section, I estimate a product-level demand system to analyse whether there are seasonal changes in brand preferences and price sensitivity for sparkling wine. Berry (1994) and Berry, Levinsohn and Pakes (1995) established a framework to estimate a class of discrete choice models with aggregated sales data. I consider the logit model and the nested logit model as special cases.

Assume that each consumer i may choose either the outside good or a no-purchase alternative, $j = 0$, or one of the J differentiated products, $j = 1, ..., J$. Following the typical notation for discrete choice models of demand, consumer $i's$ conditional indirect utility from buying product j during week t is given by:

$$u_{ijt} = \beta x_{jt} - \alpha p_{jt} + \xi_{jt} + \epsilon_{ijt}. \tag{2}$$

The variable p_{jt} denotes the price of product j at time t. The vector x_{jt} contains the other observed product characteristics (including the share in taste varieties), seasonal dummy variables and product dummy variables. In addition, the observable product characteristics include the interaction between the price and seasonal dummy variables and the interaction between product dummies and seasonal dummies. ξ_{jt} refers to the product characteristics that are unobserved by the econometrician, such as unobserved promotions, changes in shelf display and changes in unobserved consumer preferences. ϵ_{ijt} is assumed to be an iid extreme value distributed error term over each product j.

Each consumer i chooses the product j that maximises its random utility u_{ijt}. The mean utility of product j at time t is:

$$\delta_{jt} = \beta x_{jt} - \alpha p_{jt} + \xi_{jt} \tag{3}$$

and the mean utility of the outside good $j = 0$ at each time is normalised to zero, $\delta_{0t} = 0$. Note that the price coefficient α is allowed to vary between seasons.

For grocery products there is a natural order of choice, which I exploit for my nesting structure. First, the consumer chooses a retailer for their current shopping trip. Let the retail chains be denoted as $g = 1, ..., G$. The outside good, $j = 0$, is the only component of group 0. In the second step, the consumer is at the retail outlet and chooses from different quality groups of sparkling wine. In the specific case, the segmentation is naturally given by the classification in premium and regular quality.[6] Thus, each group g is partitioned into H_g subgroups, $h = 1, ..., H_g$. Each subgroup h of group g contains J_{hg} products, so that $\sum_{g=1}^{G} \sum_{h=1}^{H_g} J_{hg} = J$. Finally, the consumer chooses the particular product in the subgroup.

I then apply a standard two-level nested logit model and assume a variance component error structure of ϵ_{ijt}. Following Verboven (1996), the relative market share of product j at time t takes the following linear function:

$$ln(s_{jt}) - ln(s_{0t}) = \delta_{jt} + \sigma_1 ln(s_{j|hg,t}) + \sigma_2 ln(s_{h|g,t}). \quad (4)$$

The variable s_{jt} is the market share of product j in the potential market, s_{0t} is the market share of the outside good, $s_{j|hg,t}$ is the market share of product j in its subgroup h of group g, and $s_{h|g,t}$ is the market share of subgroup h in group g.[7] I use wine and non-considered sparkling wine product purchases as the outside good.

The nesting parameter measures the consumers' preference correlation for products in the same subgroup (σ_1) or group (σ_2) and should satisfy $1 \geq \sigma_1 \geq \sigma_2 \geq 0$ (McFadden (1978)). If $\sigma_1 = \sigma_2 = 0$ the model reduces to a simple logit model without nests, so that preferences are not correlated across products from the same subgroup or group. If $\sigma_1 = \sigma_2$ the model reduces to a one-level nested logit model with only groups as nests and, finally, if $\sigma_1 \geq \sigma_2 = 0$ to a one-level nested logit model with only subgroups as nests.

Having estimated the demand equation, the coefficients can then be used to calculate the own- and cross-price elasticities for any given product. In Appendix III, I derive the price elasticities of demand. The simple logit model imposes some restrictions on cross-price elasticities and is therefore inadequate for many purposes. In the logit model, the cross-price elasticities of product j with respect to product k does not depend on the price or market share of product j or on similarities between products, instead it only depends on the market share and the price of product k. This is typically called the independence of irrelevant alternatives (IIA) problem. The nested logit model relaxes the IIA property of the simple logit model by allowing consumer

[6] I do not study a three-level nested logit model that may include a further nest for national/store brands. The described two-level nested logit model with the chain and premium nesting structure is plausible because store brands are only sold by two of five retailers. One retailer exclusively offers store brands, while the second retailer offers few store brands besides national brands. In addition, according to industry studies and talks, the application of a two-level nested logit model seems plausible and reflects the way consumers perceive the market for sparkling wine.

[7] More precisely, the inner-group market shares are defined as $s_{j|hg,t} = \frac{q_{jt}}{\sum_{j \in H_{hg}} q_{jt}}$ and $s_{h|g,t} = \frac{\sum_{j \in H_{hg}} q_{jt}}{\sum_{h=1}^{H_{hg}} \sum_{j \in H_{hg}} q_{jt}}$, where q_{jt} are the weekly sales of product j and H_{hg} is the number of products of subgroup h of group g.

preferences to be correlated for products of the same subgroup or group. In the nested logit model, the own- and cross-price elasticities are richer in their structure, even if they are still depending on market shares. Products belonging to the same subgroup have higher cross-price elasticities than products of a different subgroup and especially products of a different group. My main interest are the interactions between price and seasonal dummies. Even if the substitution patterns of the logit and nested logit model are restricted, there is no reason to believe that both models yield qualitatively different results than other more sophisticated demand models.[8]

I use cost shifters to instrument for prices. The cost shifters (interacted with seasons where appropriate) used in the analysis are the average weekly retail price of grape juice obtained from the Nielsen Homescan data and the monthly base wine price obtained from the German Federal Statistical Office. Following Villas-Boas (2009) and Bonnet and Réquillart (2013), amongst others, I interact the input prices with brand fixed effects. The intuition for interacting input prices with brand fixed effects as instruments is to allow the input prices to enter the production of each brand differently, due to different grapes or base wines used, for instance. In addition, I include a price promotion dummy variable as an instrument by considering short-term price variations due to temporal price reductions as exogenous.[9] The sub(group) market shares are also potentially endogenous. Berry et al. (1995) suggest using the sum of the other product characteristics as instruments. Following Berry (1994) and Björnerstedt and Verboven (2016), I use three standard instruments that account for the crowdedness in product space.[10]

5.2 Demand estimation results: Seasonal patterns

The demand estimation results are provided in Table 6. The first two columns present the results from the logit model and the following two columns present the results from the nested logit

[8]Nested logit models are recently widely used by practitioners and in an academic context. See for instance Björnerstedt and Verboven (2016), Shapiro (2016), and Ciliberto and Williams (2014).

[9]Following Erdem et al. (2008) and Kotschedoff (2018), the rationale behind this assumption follows from the observation of the pricing patterns of grocery products in retail chains. I observe the following pricing patterns in my data: There is a regular price that is usually constant over weeks. Then, there is a temporary price reduction for usually one week followed by the return to the former regular price. Only if the observed price variations are the reactions of the retailers to consumers' taste shocks one faces the problem of price endogeneity. In the sparkling wine category negotiations between retailers and manufacturers regarding whether a promotion for a particular product occurs in period t take place in advance, typically during the annual talks on conditions, however, at the latest in $t-1$. These decisions are unlikely to be reversed, also due to handling issues (e.g. advertising material has to be printed or a higher stock than usual is required at the stores). Thus, promotions cannot be regarded as the sudden reactions of retailers to consumers' taste shocks and I assume that short-term price variations due to temporary promotions are exogenous. Hence, I construct a promotion dummy variable to use it as an instrument in the first stage regression. The promotion dummy variable indicates a product price that is at least 20% below the median price in a given year. Despite there are widespread promotions during seasons, I also observe a regular season price. Thus, the promotion dummy variable is interacted with seasons where appropriate.

[10]My instruments are the number of products for a given retailer, the number of products within the regular/premium quality group by retailer, and the number of products for a given manufacturer by retailer.

Table 6: Demand parameter estimates

	Logit				Nested Logit			
	OLS		IV		OLS		IV	
Price	-0.70***	(0.02)	-1.18***	(0.04)	-0.17***	(0.01)	-0.27***	(0.03)
Christmas x price	-0.54***	(0.07)	-0.61***	(0.13)	-0.15***	(0.03)	-0.19***	(0.06)
Easter x price	-0.14	(0.09)	0.30	(0.19)	-0.00	(0.04)	0.04	(0.09)
Carnival x price	-0.10	(0.08)	-0.29**	(0.15)	-0.05	(0.04)	-0.07	(0.07)
Premium	1.31***	(0.08)	1.77***	(0.11)	0.12**	(0.05)	0.27**	(0.13)
Store brand	-0.51***	(0.13)	-0.11	(0.09)	-0.07*	(0.04)	-0.09**	(0.04)
Christmas x premium	0.63**	(0.30)	1.39***	(0.36)	0.29*	(0.15)	0.32*	(0.18)
Christmas x store brand	-1.78***	(0.35)	-0.50*	(0.30)	-0.06	(0.14)	-0.03	(0.15)
Easter x premium	-0.26	(0.62)	0.94**	(0.45)	0.13	(0.19)	0.01	(0.22)
Easter x store brand	-0.88*	(0.49)	0.24	(0.40)	0.00	(0.19)	0.00	(0.19)
Carnival x premium	1.54**	(0.61)	0.24	(0.48)	0.07	(0.20)	0.11	(0.23)
Carnival x store brand	-0.35	(0.49)	0.48	(0.39)	0.07	(0.18)	0.08	(0.19)
Alcohol-free share	-0.84***	(0.08)	-0.94***	(0.08)	-0.16***	(0.04)	-0.18***	(0.05)
Sugar share	-0.37**	(0.17)	0.04	(0.18)	-0.14*	(0.08)	-0.05	(0.08)
Rose share	-0.32***	(0.04)	-0.46***	(0.04)	-0.06***	(0.02)	-0.09***	(0.02)
Discounter share	0.13***	(0.03)	0.09**	(0.04)	0.05***	(0.02)	0.04***	(0.02)
Subgroup (σ_1)					0.88***	(0.00)	0.87***	(0.03)
Group (σ_2)					0.82***	(0.01)	0.79***	(0.06)
Constant	-3.95***	(0.13)	-2.93***	(0.13)	-2.97***	(0.04)	-2.71***	(0.06)
p-value of all product dummies x								
Christmas = 0	0.000		0.000		0.000		0.000	
Easter = 0	0.000		0.000		0.000		0.000	
Carnival = 0	0.000		0.000		0.893		0.914	
F-test excl. IV								
Price			31.12				31.10	
Christmas x price			45.34				44.39	
Easter x price			38.50				37.69	
Carnival x price			48.16				47.19	
σ_1							7.80	
σ_2							3.02	
N	16113		16113		16113		16113	

Note: Specifications include year fixed effects, season fixed effects, product fixed effects and product fixed effects interacted with Christmas, Easter and carnival. Standard errors are reported in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

model. In all specifications the price coefficient is negative and significantly different from zero. The price coefficient drops in both specifications if instrument variables are included. In the nested logit model, the coefficients σ_1 and σ_2 measure the correlation of consumers' preferences within the nests of retail chains and regular/premium quality. Both coefficients measuring the correlation of preferences within the two nests satisfy the restrictions from random utility theory ($0 \leq \sigma_2 \leq \sigma_1 \leq 1$).

In order to test whether price sensitivity changes during demand peaks, I interact the seasonal dummies and price. The estimated coefficient of the interaction between Christmas and price is negative and significant in all specifications. The negative interaction indicates that demand is becoming more price sensitive during Christmas and provides a rationale for price drops. The results of the estimated coefficient of the interaction between Easter and price are less clear. The estimated coefficient of the interaction between Easter and price is negative in both specifications without instrumental variables. Otherwise, both instrumental variable estimations indicate a positive interaction term, implying that consumers are less price sensitive during Easter. However, the estimated coefficients are not significant in all specifications. The interaction term of carnival and price is negative in all specifications, but is only significant different from zero in the logit specification with instrumental variables.

In order to interpret the estimates in terms of substitution patterns, I calculate the implied price elasticities. The own- and cross-price elasticities of the preferred nested logit specification are presented in Table 7. I average the elasticities by quality dimensions and seasons. Moreover, I distinguish between cross-price elasticities with respect to other products in the same subgroup, in a different subgroup within the same group, and in a different group. These results imply fairly high own-price elasticities, on average -5.58. The cross-price elasticities are higher for products within the same subgroup (2.69) than for products of a different subgroup (1.98) and especially for products of a different group (< 0.01). In the (nested) logit model the price elasticities tend to increase proportionally with price as one moves to higher quality segments, resulting in an average own-price elasticity that is around 2.5 times higher in the premium segment, the segment with the highest average product price, than in the store brand segment, the segment with the lowest average product price. The own- and cross-price elasticities are clearly higher during Christmas among all quality segments. The same patterns are observable for the carnival period. Only during Easter do consumers appear to be less price sensitive, however, the interaction between price and Easter was not significant in all specifications. Table 15 in appendix IV displays the price elasticities from the logit specification with instrumental variables that show

Table 7: Price elasticities nested logit model

Price Elasticity	Average	Regular	Premium	National Brand	Store Brand
Total					
Own	-5.58	-3.83	-8.20	-5.97	-3.15
	(-28.10, -0.71)	(-12.54, -0.71)	(-28.10, -1.72)	(-28.10, -0.71)	(-8.50, -1.18)
Cross: same subgroup	2.69	2.60	2.82	2.68	2.75
	(0.20, 11.59)	(0.49, 8.29)	(0.20, 11.59)	(0.20, 11.59)	(0.80, 8.93)
Cross: same group	1.98	2.14	1.74	2.00	1.80
	(0.03, 11.37)	(0.31, 6.51)	(0.03, 11.37)	(0.03, 11.37)	(0.34, 4.40)
Cross: diff. group	0.00	0.00	0.00	0.00	0.00
	(0.00, 0.22)	(0.00, 0.22)	(0.00, 0.07)	(0.00, 0.22)	(0.00, 0.03)
Christmas					
Own	-8.36	-6.13	-11.70	-8.86	-5.24
	(-28.10, -1.40)	(-12.54, -1.40)	(-28.10, -3.65)	(-28.10, -1.40)	(-8.50, -2.11)
Cross: same subgroup	4.12	3.73	4.69	4.10	4.23
	(0.55, 11.59)	(0.94, 8.29)	(0.55, 11.59)	(0.55, 11.59)	(1.07, 8.93)
Cross: same group	3.03	3.02	3.05	3.08	2.77
	(0.19, 11.37)	(0.55, 6.51)	(0.19, 11.37)	(0.19, 11.37)	(0.95, 4.40)
Cross: diff. group	0.01	0.01	0.01	0.01	0.00
	(0.00, 0.22)	(0.00, 0.22)	(0.00, 0.07)	(0.00, 0.22)	(0.00, 0.03)
Easter					
Own	-4.37	-3.21	-6.10	-4.65	-2.60
	(-12.58, -0.79)	(-5.72, -0.79)	(-12.58, -2.40)	(-12.58, -0.79)	(-3.98, -1.72)
Cross: same subgroup	2.15	1.99	2.40	2.14	2.22
	(0.20, 5.79)	(0.67, 4.18)	(0.20, 5.79)	(0.20, 5.79)	(0.80, 4.08)
Cross: same group	1.59	1.62	1.55	1.61	1.48
	(0.10, 5.07)	(0.49, 2.82)	(0.10, 5.07)	(0.10, 5.07)	(0.59, 2.26)
Cross: diff. group	0.00	0.00	0.00	0.00	0.00
	(0.00, 0.08)	(0.00, 0.08)	(0.00, 0.03)	(0.00, 0.08)	(0.00, 0.01)
Carnival					
Own	-6.61	-4.42	-9.86	-7.07	-3.68
	(-19.79, -1.28)	(-8.03, -1.28)	(-19.79, -3.03)	(-19.79, -1.28)	(-5.23, -2.09)
Cross: same subgroup	3.15	3.05	3.32	3.14	3.27
	(0.62, 9.24)	(0.94, 6.23)	(0.62, 9.24)	(0.62, 9.24)	(1.52, 6.36)
Cross: same group	2.33	2.51	2.07	2.37	2.12
	(0.12, 7.11)	(0.80, 4.54)	(0.12, 7.11)	(0.12, 7.11)	(0.69, 3.19)
Cross: diff. group	0.00	0.00	0.00	0.00	0.00
	(0.00, 0.09)	(0.00, 0.09)	(0.00, 0.03)	(0.00, 0.09)	(0.00, 0.01)
Non-Event					
Own	-5.38	-3.66	-7.95	-5.76	-2.99
	(-17.46, -0.71)	(-8.02, -0.71)	(-17.46, -1.72)	(-17.46, -0.71)	(-4.48, -1.18)
Cross: same subgroup	2.58	2.52	2.67	2.57	2.64
	(0.22, 7.65)	(0.49, 5.61)	(0.22, 7.65)	(0.22, 7.65)	(1.02, 5.39)
Cross: same group	1.90	2.07	1.63	1.92	1.72
	(0.03, 7.22)	(0.31, 4.53)	(0.03, 7.22)	(0.03, 7.22)	(0.34, 2.65)
Cross: diff. group	0.00	0.00	0.00	0.00	0.00
	(0.00, 0.13)	(0.00, 0.13)	(0.00, 0.04)	(0.00, 0.13)	(0.00, 0.03)

Note: The table reports the product-level own- and cross-price elasticities, and minimum and maximum values (in parentheses), based on the parameter estimates of the nested logit model with instrumental variables in Table 6. Elasticities are averaged by quality dimensions over the sample period. Cross-price elasticities are averaged across products from the same subgroup, from a different subgroup within the same group, and from different groups.

similar seasonal patterns.

I control for changes in quality preferences during seasonal demand peaks by interacting the season dummy variables with premium and store brand dummies in the demand specifications. The results are also displayed in Table 6. The interaction between Christmas and premium is positive in all specifications and significant in the instrumental variable estimations, indicating a demand shift towards premium products during Christmas. Moreover, the interaction between Christmas and store brand is negative in all specifications, but is only significant in the logit specification without instruments. The negative interaction implies that demand shifts from store brand to national brands during Christmas. The interaction between Easter and premium is positive in three specifications, however, only one of these coefficients is statistically significant. Differently than expected, the interaction between Easter and store brand is positive in three specifications. However, the interaction is negative in the logit model without instrumental variables and is significant only in this specification. The estimated coefficients for the interaction between carnival and premium are unexpectedly positive, but only significant in one specification. The estimated coefficients for the interaction between carnival and store brand are positive in three specifications, but never significant.

In the middle of the Table 6, I present the p-value of the joint hypothesis test that the interactions between the seasonal dummy variables and the product dummy variables are equal to zero. These statistics indicate whether the product dummy variables are the same during a specific seasonal event and the rest of the year. The hypothesis that the product dummy variables are equal during Christmas and non-Christmas periods is rejected at the 1% significance level in all specifications. Similarly, the hypothesis that the product dummy variables are the same during the Easter and non-Easter period is rejected in all specifications. However, the hypothesis that the product dummy variables are the same during the carnival and non-carnival period cannot be rejected in the nested logit specifications. These results confirm the reduced from test results that the relative demand for different products (with respect to quality) is changing during Christmas and Easter. There is no clear evidence that the relative demand for different products is changing in the carnival period.

5.3 Explanations for seasonal patterns

In this section, I test several explanations for the observed countercyclical pricing patterns and changes in price sensitivity during demand peaks. Subsequently, the different explanations are classified in supply- and demand-side explanations, as already introduced in section 2.

5.3.1 Supply-side explanations

In the set of supply-side explanations, I am only able to test the loss-leader theory due to the limitations of the Homescan consumer panel data. For example, information on margins would be useful for testing the tacit collusion model.

Loss-leader advertising

The loss-leader model of advertising, exemplified by Lal and Matutes (1994), suggests that seasonal demand peaks are anticipated by the retailers, which might increase their promotional activities for high-demand products to attract customers to the store. The rationale for the stronger effectiveness of advertising during peak demand is that in non-season periods advertising serves mainly to induce brand switching and to attract customers to the store. However, in periods of peak demand the overall demand is higher and therefore the effect of attracting customers to the store via advertised products also should be larger in these periods. Thus, the increase in demand for a loss-leader product should be much larger in periods of peak demand than in non-season periods. In order to test this implication, following Nevo and Hatzitaskos (2006), I include a promotion dummy variable and the interaction between seasonal dummies and the promotion dummy variable in the previously specified logit and nested logit demand model.

The estimation results are presented in Table 8. The effect of the promotion variable is, as expected, positive and statistically significant in both specifications. However, the estimated coefficients of the interactions between Christmas and promotion and between Easter and promotion are neither positive nor significant. Only the interaction between carnival and promotion is positive, but it is also not significant. These results imply that promotions are not more effective in periods of peak demand, providing evidence against the loss-leader theory.

5.3.2 Demand-side explanations

Apart from the loss-leader model of advertising that is focusing on the supply-side, there are further explanatory approaches on the demand-side. I analyse whether periods of peak demand are periods of increased search. Furthermore, I test whether the mix of consumers changes during periods of peak demand.

Table 8: Demand parameter estimates with promotion variable

	Logit		Nested Logit	
Price	-0.57***	(0.02)	-0.14***	(0.01)
Christmas x price	-0.47***	(0.07)	-0.15***	(0.04)
Easter x price	-0.23**	(0.10)	-0.01	(0.05)
Carnival x price	0.00	(0.09)	-0.02	(0.04)
Promotion	0.58***	(0.03)	0.14***	(0.02)
Christmas x promotion	-0.04	(0.10)	-0.04	(0.05)
Easter x promotion	-0.43***	(0.14)	-0.05	(0.07)
Carnival x promotion	0.18	(0.14)	0.07	(0.07)
Premium	1.18***	(0.08)	0.19***	(0.04)
Store brand	-0.45***	(0.12)	-1.35***	(0.06)
Subgroup (σ_1)			0.87***	(0.00)
Group (σ_2)			0.82***	(0.01)
Constant	-4.33***	(0.13)	-3.08***	(0.06)
N	16113		16113	

Note: Specifications include year fixed effects, season fixed effects, product fixed effects, product dummies interacted with seasonal dummies, premium variable interacted with seasonal dummies, store brand dummy interacted with seasonal dummies, and further product characteristics (alcohol free share, sugar share, rose share, discounter share). Standard errors are reported in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Search behaviour

First, in the spirit of the model by Warner and Barsky(1995), I test whether a change in search activity influences the price elasticity during demand peaks. The model suggests that in periods of overall high demand the higher total shopping basket results in increased price search and travel for bulk buying. To test the model implications, I use sales receipt data of the sample households to analyse the household spending patterns and retailer visits to grocery markets.

Table 9 displays the results from a regression of the average expenditures per store visit and the sum of weekly expenditures on season. Including year and household fixed effects, the Christmas and Easter coefficient is positive and significant in both specifications. The results show that the shopping baskets of households are largest during Christmas and thus confirm that Christmas is a period of overall high demand. The Easter period is also a period of overall high demand. Carnival is a period of idiosyncratic peak demand and thus, as expected, the sum of weekly expenditures per household remains fairly constant, while the average weekly expenditures per store visit even decline.

I analyse the household number of retailer visits per week and the number of different retailer visits per week as proxies for search behaviour.[11] Table 10 shows the regression results of the

[11] These proxies should be applied with caution. The number of different retailer visits are not necessarily an indicator for active search. Instead due to active search, an increase in the number of different retailer visits might be driven by different shopping trips during peak demand, where more retailer visits take place.

Table 9: Household expenditure patterns during peak demand

	Avg. expenditures per store visit		Sum of wkly. expenditures	
Christmas	3.666***	(0.031)	11.799***	(0.072)
Easter	2.276***	(0.039)	8.264***	(0.090)
Carnival	-0.407***	(0.039)	-0.083	(0.089)
Constant	27.271***	(0.021)	59.533***	(0.047)
Household FE	Yes		Yes	
Year FE	Yes		Yes	
N	3639947		3639947	

Note: Dependent variable is (I) the average expenditures made by a household per store visit in a certain week and (II) the sum of expenditures made by a household in a certain week. Standard errors in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Number of household weekly retailer visits during peak demand

	No. of retailer visits		No. of diff. retailer visits	
Christmas	0.076***	(0.003)	0.048***	(0.002)
Easter	0.105***	(0.004)	0.078***	(0.002)
Carnival	0.045***	(0.004)	0.040***	(0.002)
Constant	2.695***	(0.002)	2.048***	(0.001)
Household FE	Yes		Yes	
Year FE	Yes		Yes	
N	3639947		3639947	

Note: Dependent variable is (I) the number of retailer visits made by a household in a certain week and (II) the number of different retailers visited by a household in a certain week. Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

proxies for search on seasons. The estimated coefficients of Christmas and Easter are positive and significant in both specifications. Hence, during periods of overall peak demand there is a general increase in shopping trips and households tend to visit multiple stores. The carnival coefficient is also positive and significant, indicating that carnival is also a period of higher search intensity. Even when considering idiosyncratic demand peaks, the model implication for search behaviour could hold. If consumers want to buy more sparkling wine during carnival, they may be willing to pay additional search costs to find the best price. Therefore, consumers would be better informed about prices at different retailers and even small price variations could result in demand responses in the carnival period.

The results suggest that the increase in price sensitivity and price decline during Christmas might be driven by an increase in consumer search intensity. Even though there is no clear evidence for a change in price sensitivity during Easter, I observe an increase in search intensity in this period. Although carnival is a period of idiosyncratic peak demand for sparkling wine, the results show an increase in search intensity that might be related to a higher price sensitivity and lower prices during carnival. In periods of overall high demand with higher total weekly expenditures and increased search, (perceived) demand elasticity is assumed to be higher and the profit-maximising response of retailers is to lower prices. The implications could also hold for carnival, a period of idiosyncratic peak demand.

Consumer Mix

Finally, as argued by Nevo and Hatzitaskos (2006), the seasonal change in product-level demand and price sensitivity might also be caused by the entrant of seasonal buyers. The preferences of seasonal buyers may be distinct from the preferences of regular buyers. For example, there might be a buyer segment that only enters the market in the Christmas period and has a higher cross-price elasticity. Then, observing higher price elasticities during Christmas is not necessarily related to a behavioral change of the regular consumers. Instead, the new seasonal buyers are different and retailers might reduce their prices during demand peaks to attract these buyer segment.

I analyse how the preferences of seasonal buyers may be distinct from the preferences of regular buyers.[12] For this purpose, I take all sparkling wine purchases of the considered products throughout the sample period and partition them into the year around buyers and seasonal buyers. Within the seasonal buyer segment, I further distinguish between households who only ever bought sparkling wine during Christmas, Easter or carnival and these are respectively defined as "only Christmas", "only Easter" or "only carnival" buyers. The data include 11,988 households of which 10,413 households are regular sparkling wine buyers.

Table 11 summarises the purchasing patterns by buyer segments. Around 11.4% of the households in the sample only ever bought sparkling wine during Christmas and they account for around 8.5% of the total revenue during Christmas. Only Christmas households buy, on average, fewer bottles than regular buyers (1.73 vs. 2.44). Only Easter and only carnival households are less frequently and only account for a marginal revenue share in both seasons. Again, seasonal buyers purchase, on average, fewer bottles during Easter and carnival than regular buyers. Considering the revenue shares and frequency of seasonal buyers, the importance of seasonal buyers seems to be primarily relevant for Christmas.

[12] Bayot and Caminade (2016) run several tests that are applied subsequently.

Table 11: Purchasing patterns of regular and seasonal buyers

	Buyer segment			
	Year around	Only Christmas	Only Easter	Only Carnival
Overall revenue in EUR				
Christmas	126301	10,693		
Easter	49749		1,055	
Carnival	28735			687
None	569597			
Avg. bottles per purchase				
Christmas	2.44	1.73		
Easter	2.65		2.39	
Carnival	2.41			2.12
None	2.36			
Avg. premium quality share				
Christmas	0.284	0.317		
Easter	0.226		0.330	
Carnival	0.196			0.266
None	0.211			
Avg. store brand share				
Christmas	0.073	0.065		
Easter	0.078		0.060	
Carnival	0.137			0.110
None	0.140			
Number of households	10413	1364	122	99

The premium quality and store brand product share for each buyer segment provides further insights on the potential differences in price sensitivity among segments. Regular quality products tend to be cheaper than premium quality products and store brand products tend to be cheaper than national brand products. Thus, both the purchase of regular quality and store brand products reflect a consumer's price sensitivity. There are considerable differences in the premium quality and store brand product share between seasonal and regular buyers. The average premium quality share of seasonal buyers is higher than the share of regular buyers in all seasons, in particular during Easter. Moreover, the average store brand product share of seasonal buyers is higher than the share of regular buyers in all seasons. These differences in purchasing patterns suggest that seasonal buyers tend to be less price sensitive than regular buyers.

Furthermore, I examine potential differences in demographics among buyer segments. Table 12 displays the results. The average monthly household income tends to be significantly lower for only Christmas buyers (a difference of around 349 Euro). In addition, the comparison of regular buyers and only Christmas buyers shows that only Christmas buyers are more likely to be a single household and tend to have no children. If the marginal utility of income is decreasing then the observed income differences paired with the considerable fraction of only Christmas buyers increases price sensitivity during Christmas.

Table 12: Comparison of demographics between regular and seasonal buyers

	Only Christmas		Only Easter		Only Carnival	
Household income	349.21***	(51.27)	-18.46	(163.97)	110.33	(181.49)
Single	-0.04***	(0.01)	-0.06**	(0.01)	-0.10***	(0.04)
Household size	-0.02	(0.03)	0.19**	(0.10)	0.02	(0.11)
Children in household	-0.05***	(0.01)	0.01	(0.04)	-0.06*	(0.04)
Age head of household	2.47***	(0.41)	1.26	(1.30)	5.08***	(1.44)
N	11777		10535		10512	

Note: The table display the mean differences in demographics. One observation is one household. Each household is segmented in year around, only Christmas, only Easter, and only Carnival household. Standard errors in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The comparison of demographics between only Easter buyers and regular buyers shows that the average income tends to be higher for only Easter buyers. However, the effect is not significant. In addition, there are discernible differences between the two buyer segments regarding single households and household size. The average income tends to be lower for only carnival buyers but the difference is not significant. Moreover, there are differences between the two segments regarding single households and the presence of children in the household.

Despite the small fraction of only Easter households, the observed income differences might at least slightly decrease the price sensitivity during Easter. There are no further implications for the price sensitivity during carnival from the comparison of demographics between regular and seasonal buyers.

Furthermore, I explore differences in price sensitivity among regular and seasonal buyers by comparing the seasonal prices paid by seasonal and regular buyers. Table 13 displays the difference in (logged) prices paid during seasonal demand peaks across segments while controlling for premium, store brands and demographic characteristics. The results show that seasonal buyers tend to purchase more expensive sparkling wine than regular buyers. This effect is observable among all seasons; however, the effect is much higher during Easter (up to 5.9% more expensive) than during Christmas (up to 2.1% more expensive).

Table 13: Difference in prices paid between regular and seasonal buyers

	Price (log) Christmas	Price (log) Christmas	Price (log) Easter	Price (log) Easter	Price (log) Carnival	Price (log) Carnival
Only Christmas	0.02^{***}	0.02^{***}				
	(0.00)	(0.00)				
Only Easter			0.06^{***}	0.06^{***}		
			(0.01)	(0.01)		
Only Carnival					0.04^{**}	0.04^{**}
					(0.02)	(0.02)
Premium	0.44^{***}	0.44^{***}	0.41^{***}	0.40^{***}	0.42^{***}	0.41^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Store Brand	-0.14^{***}	-0.14^{***}	-0.14^{***}	-0.14^{***}	-0.15^{***}	-0.14^{***}
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.98^{***}	0.97^{***}	0.99^{***}	0.97^{***}	1.00^{***}	1.02^{***}
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
HH Demographics	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	18652	18652	6233	6233	4165	4165

Note: This table displays regressions of price on belonging to the seasonal segment. Standard errors in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In order to analyse the impact of income on price sensitivity in more detail, I replicate the logit demand specification and discriminate between income classes. For reasons of simplicity, I classify the household income into two main categories: low and high income. In addition, I restrict the analysis to selected products with substantial market shares, also after the categorisation into income classes. The demand estimation results are presented in Table 16 in Appendix V. The price coefficient is negative and statistically significant in all specifications and does not differ substantially between low and high income households. There are small differences in the estimated coefficients of the interaction between price and season, between low income and high income households. However, in general, the estimation results suggest that there are no substantial differences in price sensitivity between low and high income households. Thus, there is no reason to believe that the increase in price sensitivity during Christmas is driven by only Christmas buyers with a lower monthly household income in comparison to regular buyers.

In conclusion, the consumer mix analysis suggests that the seasonal consumer mix might have an influence on seasonal changes in price sensitivity, although the effect is not always unambiguous. There is a large fraction of seasonal buyers in the Christmas period and their average income tends to be lower in comparison to regular buyers. However, the effect of income on price sensitivity is ambiguous and, in addition, only Christmas buyers tend to buy premium and national brand products at higher prices than regular buyers. The fraction of seasonal buyers during Easter is fairly low. Only Easter buyers tend to have higher incomes and purchase higher quality products at higher prices. Finally, only carnival buyers have a negligible proportion of revenue in the carnival period.

6 Conclusion

I document that the sparkling wine category exhibits countercyclical pricing at seasonal peak demand. Demand for sparkling wine is significantly higher during seasons, in particular at Christmas/New Year, Easter and carnival. The cross-price elasticities from a structural demand model indicate that there is a change in price sensitivity during demand peaks, especially in the Christmas period. Furthermore, I identify a change in consumer product preferences with respect to quality in periods of overall peak demand. To unravel the empirical puzzle of countercyclical pricing, changes in price sensitivity, and changes in product preferences during demand peaks, this paper has examined established explanations that focus either on the demand- or supply-side.

Christmas is the most important purchasing period of the year in the sparkling wine category. There are significant price reductions at Christmas, but only for national brand products and not for store brand products. As in the Christmas period, I observe price drops for national brand products during Easter. Carnival is a period of idiosyncratic peak demand. In this period, there is a price drop among all quality dimensions.

The estimates of a nested logit demand model indicate an appreciable increase in price sensitivity only for the Christmas period. I observe no significant changes in price sensitivity in the Easter and carnival period. In addition, the estimates of the demand model suggest a change in product preferences at Christmas and Easter. In support of this observation, I find that the price reduction in a fixed weight price index is higher than the reduction in the variable weight price index in the Christmas and Easter period, which is consistent with a composition effect and a substitution towards national (premium) brand products that are more expensive.

My results suggest that demand-side explanations play a fundamental role in unravelling the empirical puzzle. However, there is not a general explanation that explains all observed effects in the respective seasons. The empirical results support the explanation by Nevo and Hatzitaskos (2006) that consumer preferences might change in periods of peak demand. In the Christmas period, I find significant price drops among nearly all products except for store brands. However, only a few national brand products that are mainly of premium quality gain market shares. Similar patterns are observable in the Easter period. During carnival all quality levels experience price reductions and no change in consumer product preferences is observable. Even though differences in price variation among quality levels might be a driver, the observed change in product-level demand suggests that sparkling wine is used differently at special holidays.

In addition, the results support the explanation by Warner and Barsky (1995) that consumers search more intensively for lower prices in periods of (overall) peak demand. I observe increased search during periods of overall and idiosyncratic peak demand. My results suggest that the increase in price sensitivity during Christmas might be driven by an increase in consumer search behaviour and this might lead to retailer price reductions. Although I observe no change in price sensitivity in the Easter and carnival period the implications of increased search might apply.

The empirical results offer evidence that is less consistent with a change in consumer mix as proposed by Bils (1989) and the loss-leader model of advertising by Lal and Matutes (1994). Although it still remains unclear what are the economic drivers for the difference in price sensitivity change between Christmas and Easter, the explanations I provide seem to be consistent with the examined data.

Fundamentally, it is difficult to explore the determinants of supply and demand separately. Retailers know that Christmas, Easter and carnival are periods of peak demand in the sparkling wine category and can plan price adjustements and promotions in advance. Further data, especially on margins and advertisement, would be helpful for verifying the empirical results. Finally, I do not claim that my explanations are exhaustive. It seems more likely that my explanations work jointly with some other theories like the tacit collusion model, the loss-leader model of advertising or the change in consumer mix story.

Appendix

Appendix I

There are a number of alternative ways of dealing with missing data.[13] I use regression predictions in order to impute missing weekly product quantities. For this purpose, I fit a regression model by setting the observed quantities as the response variable and product dummies, seasonal dummies, the interaction between seasonal dummies and product dummies, week dummies, year dummies, store brand dummy, premium dummy and promotion dummy as covariates. The coefficients are estimated and then missing values are predicted by the fitted model. However, if a negative product quantity is predicted, I impute the lowest weekly quantity sold for the respective year instead of the predicted value.

I fill in empty weeks for product prices with the price observed in the week where the lowest product quantity was sold in a given year. The missing values for product characteristics are replaced with the median values observed in a given year.

Appendix II

Table 14: Variable and fixed price index during demand peaks

	National brands		Store brands		Regular quality		Premium quality	
	Variable	Fixed	Variable	Fixed	Variable	Fixed	Variable	Fixed
Christmas	-0.049***	-0.094***	0.007	-0.001	-0.058***	-0.087***	-0.053***	-0.079***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Easter	-0.046**	-0.072***	-0.000	-0.004	-0.036***	-0.066***	-0.040***	-0.062***
	(0.02)	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)	(0.02)	(0.01)
Carnival	-0.032*	-0.022*	-0.036***	-0.017***	-0.042***	-0.026*	-0.019	-0.012
	(0.02)	(0.01)	(0.01)	(0.00)	(0.01)	(0.02)	(0.02)	(0.01)
Constant	1.232***	1.285***	0.976***	0.981***	1.051***	1.115***	1.491***	1.526***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
N	365	365	365	365	365	365	365	365

Note: Dependent variable is weekly price measured by variable weight price index and fixed weight price index. The regressions include year fixed effects. Standard errors are in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[13] See, for instance, Schafer (1997). In addition, there are several studies that estimate demand models by using imputed Homescan panel data (e.g. Bonnet and Réquillart (2013) and Keane (1997)).

Appendix III

I refer to Berry (1994) and Verboven (1996) for the derivation of the own- and cross-price elasticities in the two-level nested logit model. The own-price elasticity for a typical product j is:

$$e_{jj} = \frac{\partial q_{jt}}{\partial p_{jt}} \frac{p_{jt}}{q_{jt}} = \alpha p_{jt} \left(\frac{1}{1-\sigma_1} - \left(\frac{1}{1-\sigma_1} - \frac{1}{1-\sigma_2} \right) s_{jt|hg} - \frac{\sigma_2}{1-\sigma_2} s_{jt|g} - s_{jt} \right). \quad (5)$$

The cross-price elasticities for a typical product j are:

$$e_{jk} = \frac{\partial q_{kt}}{\partial p_{jt}} \frac{p_{jt}}{q_{kt}} = -\alpha p_{jt} \left(\left(\frac{1}{1-\sigma_1} - \frac{1}{1-\sigma_2} \right) s_{jt|hg} + \frac{\sigma_2}{1-\sigma_2} s_{jt|g} + s_{jt} \right), \quad (6)$$

where k indexes products that belong to the same subgroup,

$$e_{jk'} = \frac{\partial q_{k't}}{\partial p_{jt}} \frac{p_{jt}}{q_{k't}} = -\alpha p_{jt} \left(\frac{\sigma_2}{1-\sigma_2} s_{jt|g} + s_{jt} \right), \quad (7)$$

where k' indexes products that belong to a different subgroup within the same group, and

$$e_{jk''} = \frac{\partial q_{k''t}}{\partial p_{jt}} \frac{p_{jt}}{q_{k''t}} = -\alpha p_{jt} s_{jt}, \quad (8)$$

where k'' indexes products that belong to a different group.

If $\sigma_1 = \sigma_2 = 0$, the nested logit elasticities collapse to simple logit elasticities (without nests).

Appendix IV

Table 15: Prices elasticities logit model

Price Elasticity	Average	Regular	Premium	National Brand	Store Brand
Total					
Own	-4.46	-3.47	-5.95	-4.67	-3.18
	(-15.22, -1.70)	(-7.15, -1.70)	(-15.22, -2.51)	(-15.22, -1.70)	(-6.74, -1.75)
Cross	0.01	0.01	0.01	0.01	0.01
	(0.00, 0.87)	(0.00, 0.87)	(0.00, 0.28)	(0.00, 0.87)	(0.00, 0.11)
Christmas					
Own	-6.18	-4.88	-8.12	-6.41	-4.69
	(-15.22, -3.09)	(-7.15, -3.09)	(-15.22, -4.64)	(-15.22, -3.09)	(-6.74, -3.12)
Cross	0.03	0.03	0.03	0.03	0.01
	(0.00, 0.87)	(0.00, 0.87)	(0.00, 0.28)	(0.00, 0.87)	(0.00, 0.10)
Easter					
Own	-3.11	-2.47	-4.06	-3.24	-2.30
	(-7.48, -1.70)	(-3.52, -1.70)	(-7.48, -2.51)	(-7.48, -1.70)	(-3.16, -1.75)
Cross	0.01	0.01	0.01	0.01	0.01
	(0.00, 0.31)	(0.00, 0.31)	(0.00, 0.13)	(0.00, 0.31)	(0.00, 0.02)
Carnival					
Own	-5.32	-4.07	-7.19	-5.56	-3.78
	(-13.22, -2.06)	(-5.87, -2.06)	(-13.22, -4.33)	(-13.22, -2.06)	(-5.28, -2.57)
Cross	0.01	0.02	0.01	0.01	0.01
	(0.00, 0.37)	(0.00, 0.37)	(0.00, 0.12)	(0.00, 0.37)	(0.00, 0.06)
Non-Event					
Own	-4.36	-3.38	-5.82	-4.56	-3.08
	(-10.59, -1.87)	(-5.88, -1.87)	(-10.59, -2.92)	(-10.59, -1.87)	(-4.23, -2.26)
Cross	0.01	0.01	0.01	0.01	0.01
	(0.00, 0.57)	(0.00, 0.57)	(0.00, 0.18)	(0.00, 0.57)	(0.00, 0.11)

Note: The table reports the product-level own- and cross-price elasticities, and minimum and maximum values (in parentheses), based on the parameter estimates of the logit model with instrumental variables in Table 6. Elasticities are averaged by quality dimensions over the whole time period.

Appendix V

Table 16: Demand parameter estimates

	Low income households				High income households			
	OLS		IV		OLS		IV	
Price	-0.59***	(0.02)	-1.05***	(0.06)	-0.64***	(0.02)	-1.08***	(0.06)
Christmas x price	-0.75***	(0.10)	-0.30***	(0.12)	-0.67***	(0.11)	-0.70***	(0.22)
Easter x price	-0.20	(0.14)	0.24	(0.15)	-0.34**	(0.14)	-0.14	(0.32)
Carnival x price	0.14	(0.12)	0.59***	(0.13)	-0.18	(0.12)	-0.33	(0.24)
Premium	0.95***	(0.09)	1.90***	(0.13)	1.12***	(0.09)	2.15***	(0.14)
Store brand	-0.21**	(0.08)	0.18**	(0.09)	0.07	(0.08)	-0.38***	(0.09)
Christmas x premium	1.03***	(0.32)	0.28	(0.36)	0.85***	(0.33)	1.56***	(0.46)
Christmas x store brand	-0.29	(0.33)	-0.95***	(0.32)	-0.00	(0.33)	-0.43	(0.33)
Easter x premium	1.55**	(0.71)	0.59	(0.45)	2.05***	(0.72)	0.93*	(0.56)
Easter x store brand	-0.77*	(0.42)	0.35	(0.42)	-0.87**	(0.43)	0.06	(0.49)
Carnival x premium	-0.53	(0.66)	-2.07***	(0.48)	0.78	(0.67)	-0.10	(0.62)
Carnival x store brand	0.11	(0.41)	-0.06	(0.41)	0.35	(0.42)	-0.56	(0.42)
N	6935		6935		6935		6935	

Note: Specifications include year fixed effects, season fixed effects, product fixed effects and product fixed effects interacted with Christmas, Easter and Carnival. Standard errors are reported in parentheses. Symbols: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

References

Bayot, D. and Caminade, J. (2016). Popping the cork: Why the price of champagne falls during the holidays. *Mimeo.*

Berry, S., Levinsohn, J., and Pakes, A. (1995). Automobile prices in market equilibrium. *Econometrica: Journal of the Econometric Society, 63*(4):841-890.

Berry, S. T. (1994). Estimating discrete-choice models of product differentiation. *The RAND Journal of Economics, 25*(2), 242–262.

Bils, M. (1989). Pricing in a customer market. *The Quarterly Journal of Economics, 104*(4):699-718.

Björnerstedt, J., and Verboven, F. (2016). Does merger simulation work? Evidence from the Swedish analgesics market. *American Economic Journal: Applied Economics, 8*(3), 125–64.

Bonnet, C., and Réquillart, V. (2013). Tax incidence with strategic firms in the soft drink market. *Journal of Public Economics, 106*, 77–88.

Bundeskartellamt. (2014a). Beschluss im Verwaltungsverfahren gegen Edeka (Aktenzeichen: B2-58/09).

Bundeskartellamt. (2014b). Sektoruntersuchung Nachfragemacht im Lebensmitteleinzelhandel.

Chevalier, J. A., Kashyap, A. K., and Rossi, P. E. (2003). Why don't prices rise during periods of peak demand? Evidence from scanner data. *American Economic Review, 93*(1), 15–37.

Ciliberto, F., and Williams, J. W. (2014). Does multimarket contact facilitate tacit collusion? Inference on conduct parameters in the airline industry. *The RAND Journal of Economics, 45*(4), 764–791.

Cohen, M. A., and Cotterill, R. W. (2011). Assessing the impact of retailer store brand presence on manufacturer brands in an equilibrium framework. *The Journal of Industrial Economics, 59*(3), 372–395.

Costanigro, M., McCluskey, J. J., and Mittelhammer, R. C. (2007). Segmenting the wine market based on price: hedonic regression when different prices mean different products. *Journal of agricultural Economics, 58*(3), 454–466.

Davis, T. R., Ahmadi-Esfahani, F. Z., and Iranzo, S. (2008). Demand under product differentiation: an empirical analysis of the US wine market. *Australian Journal of Agricultural and Resource Economics, 52*(4), 401–417.

Draganska, M., and Klapper, D. (2011). Choice set heterogeneity and the role of advertising: An analysis with micro and macro data. *Journal of Marketing Research, 48*(4), 653–669.

Draganska, M., Klapper, D., and Villas-Boas, S. B. (2010). A larger slice or a larger pie? An empirical investigation of bargaining power in the distribution channel. *Marketing Science, 29*(1), 57–74.

Erdem, T., Keane, M. P., and Sun, B. (2008). The impact of advertising on consumer price sensitivity in experience goods markets. *Quantitative Marketing and Economics, 6*(2), 139–176.

Keane, M. P. (1997). Modeling heterogeneity and state dependence in consumer choice behavior. *Journal of Business & Economic Statistics, 15*(3), 310–327.

Kotschedoff, M. (2018). An empirical investigation of store brands and their role to mitigate brand manufacturer price increase. *Mimeo.*

Lal, R., and Matutes, C. (1994). Retail pricing and advertising strategies. *The Journal of Business, 67*(3), 345.

MacDonald, J. M. (2000). Demand, information, and competition: Why do food prices fall at seasonal demand peaks? *The Journal of Industrial Economics, 48*(1), 27–45.

McFadden, D. (1978). Modeling the choice of residential location. In F. Snickers, A. Karlquist, L. Lundquist, & J. Weibull (Editors), *Spatial Interactuin Theory and Residential Location* (p. 72–77).

Nevo, A., and Hatzitaskos, K. (2006). Why does the average price paid fall during high demand periods? *Mimeo.*

Perrone, H. (2016). Consumers' quality choices during demand peaks. *International Journal of Industrial Organization, 44*, 154–162.

Rhein, O. H., Bach, H. P., and Troost, G. (2010). *Sekt, Schaumwein, Perlwein* (3. ed.). Stuttgart: Ulmer.

Rotemberg, J. J., and Saloner, G. (1986). A supergame-theoretic model of price wars during booms. *The American Economic Review, 76*(3), 390–407.

Schafer, J. L. (1997). *Analysis of incomplete multivariate data.* Boca Raton: Chapman and Hall/CRC.

Shapiro, B. T. (2016). Estimating the cost of strategic entry delay in pharmaceuticals: The case of Ambien CR. *Quantitative Marketing and Economics, 14*(3), 201–231.

Verboven, F. (1996). International price discrimination in the european car market. *The RAND Journal of Economics, 27*(2), 240–268.

Villas-Boas, S. B. (2009). An empirical investigation of the welfare effects of banning wholesale price discrimination. *The RAND Journal of Economics, 40*(1), 20–46.

Warner, E. J., and Barsky, R. B. (1995). The timing and magnitude of retail store markdowns: evidence from weekends and holidays. *The Quarterly Journal of Economics, 110*(2), 321–352.