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Abstract

Due to the rapid development of private labels and their segmentation into quality levels the question arises how they have an effect on price rigidity. There is also much discussion about the impact of private label development on wholesale prices. Based on the roughly availability of appropriate data, questions in regard to the wholesale price are fairly unanswered. This paper fills this research gap by applying two approaches to analyze retail pricing behavior on the basis of weekly scanner data including the wholesale price of a chain distributing in Canada. The results of two case studies indicate higher price rigidities for private labels, especially for premium private labels in the case of salad dressings. Price variability is rather explained by price promotions than changes in the wholesale price. Long-term contracts and stable wholesale prices might be the result of increasing power by retailers due to rising private labels market shares.

Key words: Price rigidity, private labels, quality levels, wholesale price

1 Introduction

The rapid emergence of retail private labels (PL) over the past decades has created new and stiff competition for many established manufacturers of national grocery brands (NB). Traditionally, PLs have been seen as products with lower quality and generally less desirable than NBs. However, in recent years, PLs have changed dramatically. Apart from sizeable market shares (24 % in 2009 in Canada) in many staple food categories, retailers have successfully introduced new differentiated PL product lines to enter higher quality segments. In a survey of The Nielsen Company in 2010 42 % of the Canadians stated that PLs are a good alternative to NBs. Even 34 % think that the quality of the generic is relatively higher (The Nielsen Company 2011).

Previous economic literature has addressed various issues and dimensions related to the competitive impact of PLs including the economic significance to retail chains (Chintagunta et al. 2002), determinants accounting for PL success (Hoch and Banerji 1993), competitive interactions between PLs and NBs (Cotterill et al. 2000; Steiner 2004; Bontemps et al. 2008; Volpe 2010) and the use of PLs in exerting retail market power (Meza and Sudhir 2010; Morton and Zettelmeyer 2004). The economic literature has also taken great interest in retailer's strategic use of PLs to counter the prior dominance of NB manufacturers (Richards et al. 2010).

However, the agri-food industrial organization literature has paid limited attention to the new differentiated PL product lines and how they affect the retail pricing behavior (Bontemps et al. 2008). Considering the development of PLs over the years, a change in the strategic positioning of PLs can be observed. At the beginning retailers brought these "no names" into general food retailing in response to discount products (Jonas and Roosen 2005). Generic PLs provide the customer with a low-price alternative while the quality and packaging of generics is relatively standardized. In the Eighties, a new PL product group appeared on the market, the so called "pseudo brands", "me-too" products or "copycat brands". Retailers focus on large categories with strong brand leaders once they introduce copycat brands. The quality and the packaging are close to the brand leader products and retailers try to position them next to the brand leader in the shelf. All these strategies shall increase negotiating power against the manufacturer (Kumar and Steenkamp 2007). The most recent trend is the introduction of premium PLs. Objectives of the premium PLs are the provision of value-added products, a differentiation to other retailers, the increasing consumer loyalty and the attraction of new customers. In addition, margins are enhanced because the price is set close or higher than the brand leader while the wholesale price is lower (Kumar and Steenkamp 2007; Bergès-Sennou et al. 2004).

Existing empirical studies show that many food products in retailing are characterized by relatively long periods of unchanged prices, followed by recurring periods of lower prices (Herrmann and Möser 2006; Baumgartner et al. 2006; Hickey and Jacks 2011) despite the high degree of price instability of many agricultural commodity and markets for intermediary goods. This condition is called price rigidity. According to Hosken and Reiffen (2004) variations of retail prices are rather explained by price promotions than by changes in costs. A number of possible triggers for price rigidity have been discussed: Differences in strategic management decisions between retail formats (Owen and Trzepacz 2002), the use of psychological pricing points (Blinder et al. 1998; Levy et al. 2011), and the economic literature evolving around the concept of menu costs - the costs of changing retail shelf prices (Levy et al. 1997; Owen and Trzepacz 2002; Blinder et al. 1998).

Despite the above evidence, still, empirical studies on price rigidity including the wholesale price and the PLs, especially their different quality levels, are underrepresented or conducted in an insufficient way. The focus on vertically differentiated PLs and the deeper investigation of wholesale prices in this paper will fill this gap. The detailed case-study analysis of retail price rigidity reveals a number of interesting findings that support existing research, but also go beyond it.

The first objective of this paper is to quantify the impact of private labels on price rigidity in general and in particular the different types of private labels. Premium PLs constitute a successful weapon in the competition between NBs and PLs and have to be considered. The second one is to analyze the impact of the wholesale prices on price rigidity across products and categories. In the context of the increasing share of PLs bargaining power, PLs retail margins have been discussed as potential contributors to retailer strategic pricing and promotional behavior. Available UPC-level wholesale price (price paid by the retailer) data enables us to analyze these components in the strategic use of private labels and their potential impact on price rigidity.

The following section provides a review of the existing literature of PLs and price rigidity. Section 3 introduces the data, weekly store-level scanner data for a major North American retail chain. The methodological framework in Section 4 is two-fold, a linear regression approach to estimate the price rigidity and a second probability model is used to estimate the probability of a price adjustment. Section 5 covers the econometric results of the two models and provides interpretations of the results. Finally, conclusions and further work are given in Section 6.

2 Literature Review

Many authors computed a mean duration of unchanged prices following Powers and Powers (2001) to measure the price rigidity. Depending on the country, the category and the period, the price rigidity can differ from each other. Table 1 shows the different results for some studies. The studies which used data from North American retailers calculated a mean duration of unchanged prices of approximately 2.3 weeks. By contrast, researchers with data from European retailers computed in general higher mean durations. At this point, it is noticeable that the values can differ from one category to the other or from one brand to the other, respectively. Herrmann et al. (2005) investigated 20 brands in different categories and got results from 6.5 to 115.6 weeks. The results between Weber (2009) and Herrmann et al. (2009) for the category cheese and coffee show the different magnitudes depending on the category. All used the same data source, but for the category cheese the price rigidity is five times higher than for coffee. Different price rigidities for different product categories as well as for products were already observed by Verhelst and Van den Poel (2010). They also stated that the mean duration of unchanged prices is higher in the U.S. compared to European countries whereas it is ascribed to the higher sales frequency, indicating a more aggressive short-term pricing strategy in the US.

Table 1: Recent empirical evidence of price rigidity in retaling

Research	Period	Category	Mean duration	min-max
Powers and Powers (2001)	1986-1995	Lettuce	2.3 weeks	1.38-4.88 [a)]
Dutta et al. (2002)	1989-1991	Orange juice	-	1.63-3.77 [b)]
Eichenbaum et al. (2011)	2004-2006	200 categories	2.3 weeks	-
Herrmann et al. (2005)	1996-1999	20 brands	12.8 weeks	6.5-115.6 [b)]
Herrmann et al. (2009)	1996-1999	Coffee	5.2 weeks	2.0-13.1 [b)]
Weber (2009)	1996-1999	Cheese	27.4 weeks	-
Hellberg-Bahr et al. (2011)	2005-2009	Organic dairy goods	-	12.0-25.4 [b)]

Notes: [a)] Mean duration varies between stores; [b)] mean duration varies between products or brands, respectively.

One of the most important reasons why prices do not change is that price adjustment costs occur while prices change – the concept of menu costs (Blinder et al. 1998, Herrmann and Möser 2003, Weber 2009). Menu costs seem to be an important factor to explain price rigidity and are often the focus of studies of price rigidity, but there is not much evidence due to the impact of promotions which have a decreasing effect on price rigidity (Herrmann and Möser 2003; Eichenbaum et al. 2011; Weber 2007; Verhelst and Van den Poel 2010). In the study of Eichenbaum et al. prices change every three weeks. When sales are excluded, they change just every 4.5 months. Since menu costs do not differ between private labels and national brands and are difficult to measure, they will not gain much attention in the empirical model of this paper[1]. At this point, the promotional activity should be discussed because a different strategy can be observed for private labels and national brands. Retailers deviate with sales from the optimal price temporarily. Competition between the chains and the increasing foot traffic by sales induces retailers to offer price promotions. Customers will decide to visit the chain which offers the cheapest bunch of desired products, considering the transportation costs (Blattberg et al. 1995; Lal and Matutes 1994). In the context of different promotion strategies retailers choose one of the two strategies in general. There is the everyday low price (EDLP) or high-low (HiLo) price strategy. Under the EDLP strategy, the retailer sets prices low for extended periods of time and will offer less promotional sales or discounts. In contrast, with the HiLo pricing strategy, the retailer's prices are higher, and the retailer ends to offer more frequent discounts through periodic sales and promotions (Levy et al. 1998). Weber (2009) could show for German retailing that retailers with a HiLo strategy like supermarkets have a lower price rigidity. He also showed that PLs had significant fewer sales, but therefore more price jumps. Overall, PLs showed lower price rigidities. Despite arguments from the literature that PLs should not be put on sale due to the cannibalization of NBs or low promotional elas-

[1] The absolute price change might also be biased and is another reason why it should not be included into the model. Further explanation will be described in the data description.

ticities on the part of consumers, results from Volpe and Li (2012) show that PLs are promoted frequently in the U.S., but still less than NBs. Therefore the sales duration of PLs is higher than for NBs[2]. The sales frequency ranges from 25 to 50 %. The price variation is explained 50 to 60 % by sales. Hosken and Reiffen (2004) argue similarly and state that the variation is rather explained by price promotions than by changes in costs.

Another suggested influence on price rigidity by many studies are psychological pricing points (Herrmann et al. 2009; Levy et al. 2011; Kashyap 1995). 9-ending or 99-ending effects occur because consumers are expected to round down prices or either to apply a left-to-right comparison. Thus, an incentive exists for firms to utilize just-below prices ending at digits 9 or 99. Levy et al. could empirically show 9-ending prices were the most popular and were less likely to change compared to non-9-ending prices. Other empirical studies also showed the influence of factors which were less prominent. Some of their authors stated that greater stores indicate more frequent price changes while other argue that larger stores attract less price-sensitive consumers due to the greater variety or have greater absolute costs of antagonizing customers (Nakamura et al. 2011; Bonanno et al. 2009; Ellickson 2006; Powers and Powers 2001). A look at the management level also provides insights into the strategy of a chain. Nakamura et al. could show that differences in price rigidity can be found across chains instead of stores. Decisions are often made by the management of the chain and not by the management of the store.

Determining factors of price rigidity which are often discussed are input costs or the wholesale prices, respectively. Empirical results in regard to wholesale prices are found rarely because manufacturers and retailers often do not want to publish to which price they sell or buy, respectively the products. Often proxies are used to incorporate the input costs. Several authors used data from Dominick´s Finer Food, the second-largest supermarket chain in Chicago. They computed the wholesale price as a weighted average of the amount the retailer paid for the inventory, i.e. average acquisition costs (AAC) (Besanko et al. 2005; Dutta et al. 2002; Chevalier et al. 2003; Kano 2007). According to Peltzman (2000) the wholesale cost data do not correspond to the theoretical measurement, such as replacement cost or the last transaction price. The problem of such a measurement as a proxy is that a wholesale price cut today only gradually works itself into AAC as old, higher-priced inventory is sold off. However, there are hints in the empirical work of Kano (2007) and Dutta et al. (2002) that the retail price changes if the wholesale price, i.e. the proxy, changes. Blinder et al. (1998) continued the aspect of passing through costs in another way. They analyzed if prices reacted with a lag to costs. In their survey firms answered that they do expect cost increases, but they do not increase prices in most cases in advance due to the fear of adverse customer reactions and loss of market share because of a quicker price raise ahead of their competitors.

Previous economic literature has addressed various issues and dimensions related to the competitive impact of PLs. Retailers which offer NBs as well as PLs attain a special status because they are a customer and competitor of NBs at the same time. By carrying PLs store loyalty can be built and they can be used for differentiaton. The major reason for introducing PLs is the higher margin. In a survey retailers rated it as the most important reason for carrying a PL. On average, percentage margins of store PLs are significantly higher than of NBs. One reason for carrying PLs which is often discussed in the recent literature is the bargaining effect. With increasing market share of the PL the share of the NB decreases with the consequence that the manufacturer will lose its power (Morton and Zettelmeyer 2004; Steiner 2004; Hoch et al. 2000; Ailawadi and Harlam 2004; Kumar and Steenkamp 2007). Some studies

[2] Volpe and Li (2012) examine sales as defined by the store. Other authors define sales on the basis of the percentage change and/or the duration (Hosken and Reiffen 2004; Weber 2009; Herrmann and Möser 2006).

could empirically show lower wholesale prices after a PL introduction in the short and long term. While the empirical analysis did show evidence of wholesale price adjustment by the manufacturers in face of a potentially successful PL, it is certainly conceivable that manufacturers could find other ways than lowering wholesale prices to compensate the retailer for maintaining a certain price level on his PL and thereby not stealing too much of the manufacturer's share. Suggested ways by the authors of transferring money from the manufacturer to the retailer are slotting allowances, coop advertising allowances and free products (Narasimhan and Wilcox 1998; Meza and Sudhir 2010; Sayman et al. 2002).

Considering the development of PLs over the years, a change in the strategic positioning of PLs can be observed. Nowadays, three different types of PLs can be found at the POS: generics, copycat brands and premium PLs. They are positioned differently on basis of the price, quality and promotions. While copycat brands try to imitate the NB leader, premium PLs are a way to respond to the national brand´s ability to satisfy the heterogeneous preferences of the consumer. Objectives of the premium PLs are the provision of value-added products, a differentiation to other retailers, the increasing consumer loyalty and the attraction of new customers. In addition, margins are enhanced because the price is set close or higher than the brand leader while the wholesale price is lower. Premium PLs are always advertised as better products, but therefore there are just limited price promotions (Jonas and Roosen 2005; Kumar and Steenkamp 2007; Bergès-Sennou et al. 2004; Dhar and Hoch 1997). By carrying out a more detailed analysis about prices within the different types of PLs, Bontemps et al. (2008) could show a different extent of the impact on prices. The me-too product had the strongest influence on NB prices, while low-price PLs had a lower impact. Premium PLs could not exhibit a significant impact on prices of NBs. These results are consistent with the assumption that copycat brands were developed by retailers to compete directly with NB products. Others studied - including studies about price rigidity - in regard to the different types of PLs are scarce although there is no retailer who does not stock every type of PLs and is not aware of their development.

This paper contributes to the existing literature with the focus on vertically differentiated PLs. Using the price paid the retailer, i.e. the wholesale price, the direct costs of the retailer will be analyzed in a more appropriated way.

4 Model Development

Customers often purchase a whole basket of commodities with different products in a store. Because of the rivalry which retailers are exposed to, it is necessary to offer the bunch of products at a competitive price. Besides the optimal pricing of one product, the management of the retail chain faces the task to define the prices for the whole assortment under the consideration of the relationships between the individual products (Möser 2002). In the case of a dynamic pattern, variations of prices might be optimal due to changes in demand and changes in marginal costs (Herrmann and Möser 2003). One major argument which is missing in the price theory of the multiproduct firm is that the price does not change every time because of adjustment costs (Blinder et al. 1998). For grocery retailers such adjustment costs may be high once thousands of products are offered. Immediate reactions to all changes of input costs and demand would cause high decision and information costs as well as direct costs of printing new leaflets or price tag changing (Levy et al. 1997; Blinder et al. 1998). Price changes will be realized when the additional gains caused by higher prices or higher demand, respectively, exceed the price adjustment costs (Andersen 1994). Which determinants have an influence and to which degree will be measured by the empirical model.

In general, the price rigidity can be explained by several determinants:

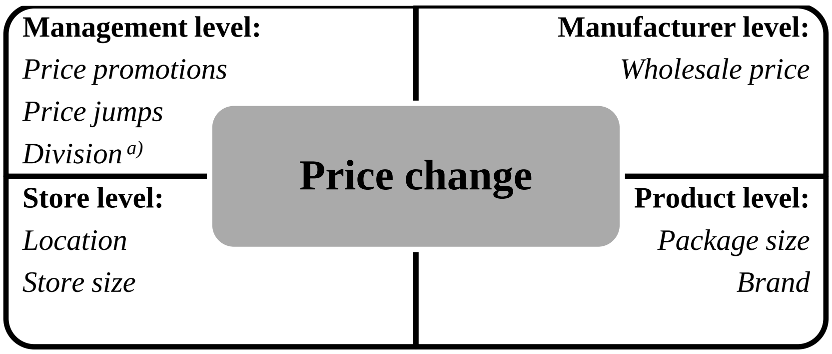
(1) Measurement of price rigidity = F {Determinants}.

Price rigidity can be measured in different ways. One way is to use the number and the frequency of price changes as Levy et al. (2008), Baumgartner et al. (2006) and Müller et al. (2007) did. The frequency is calculated as the relation of number of price changes to all observations of prices. Other authors computed a mean duration of unchanged prices *PR* following Powers and Powers (2001). It is the reciprocal of the frequency, i.e. it is calculated as all price observations *N* divided by the number of price changes $N_{\Delta P}$:

(2) $\mathrm{PR} = \frac{N}{N_{\Delta P}}$.

A more implicit way to show how rigid prices are, is the use the probability of a price change (Owen and Trzepacz 2002; Baumgartner et al. 2006; Kano 2007). The assumption in this case is that the higher the probability of a price change is the less rigid are the prices. Several determinants on four different levels were detected in this paper that might cause more or less price changes and again have an effect on price rigidity. Figure 1 illustrated the levels with their corresponding determinants. These factors will be used in the empirical models while it will be still focused on the papers objective to analyze the quality levels and the wholesale price in more detail.

Figure 1: Determinants of price changes



Note: [a] A division is a subset of a corporation that is logically and practically manageable. The geographical affiliation is the major criteria. The chain divides Canada into three divisions: Vancouver, Alberta and Winnipeg. Source: Own illustration.

Two different model approaches are applied which found both an implementation in the literature and use the measurements of price rigidity explained above, a linear regression model and a probit regression (Herrmann et al. 2009; Powers and Powers 2001; Kano 2007). They are used in this paper to support each other and to see differences. In addition, both approaches are necessary to test for relevant hypotheses. The dependent variable for the linear regression model is the price rigidity *PR*. There is one price rigidity for every product in every store. Due to the calculation for this measurement, there is no distinction between different periods. It is not the case for the probit model and the advantages of the panel data can be exploited.

Regression Model

The estimation approach is OLS and to deal with heteroscedasticity robust standard errors are used. Spatial autocorrelation is excluded because the price of a store does not influence the price in another store in the neighborhood within one chain. It is rather assumed that price setting is made on the division or management level and not from store to store (Nakamura et al. 2011).

A double-log functional form will be applied on basis of the R². In regard to the papers focus, the price rigidity is a function of following variables, illustrated in equation (2):

(3) $PR = F(PL^{G}, PL^{C}, PL^{P}, SP^{W}, Z)$,

where PL^G represents a dummy for the generic, PL^C a dummy for the copycat brand, PL^P a dummy for the premium PL, SP^W the share of changed wholesale prices in the whole period and Z a vector for the control variables.

The econometric model for price rigidity for the product j and the store h is specified as:

(4) $\text{Ln } PR_{jh} = \alpha_0 + \alpha_1 PL^{G}_{\ j} + \alpha_2 PL^{C}_{\ j} + \alpha_3 PL^{P}_{\ j} + \alpha_4 \ln SP^{W}_{\ jh} + \alpha_5 \ln PROMO_{jh} + \alpha_6 \ln JUMP_{jh} + \alpha_7 AB_h + \alpha_8 VAN_h + \alpha_9 RURAL_h + \alpha_{10} \ln PSIZE_j + \alpha_{11} \ln SSIZE_h + u_{jh}$,

where additional to the parameters in equation (3) PROMO represents the share of price promotions in the period, JUMP the share of price jumps, AB and VAN dummies for the management areas Alberta and Vancouver, respectively, RURAL a dummy for stores located in rural areas, PSIZE for the product size, SSIZE for the total selling area and u_{jh} for the error term.

Probit Model

There are two ways to measure the probability of a price change by using the cumulative standard normal distribution (probit) and the cumulative logistic distribution (logit). We follow the approach by Kano (2007) using a probit model. However, both models lead to similar results. There is no solid reason to prefer one over the other (Gujarati 2011). In the probability model the dependent variable Y is a binary, taking values of 1 or 0. There is a non-linear relationship between the probability of Y=1 and the explanatory variables X_i. In this case, it means:

(5) $\Delta P = \begin{cases} 1 & if \quad p_{jht} \neq p_{jh(t-1)} \\ 0 & if \quad p_{jht} = p_{jh(t-1)} \end{cases}.$

The assumption is that if a price change becomes more likely, the price rigidity will decrease more likely. Thus, comparisons among the models are still appropriate.

The population-average probit model is used to analyze a price change[3]. It allows for heteroscedasticity and autocorrelation which states a problem for the available data. The generalized estimating equations method is more appropriate when the objective is to make inference about group differences instead of individual change over time. The probability of a price change is a function of several variables, illustrated in equation (6):

(6) $Y\ (\Delta P=1) = f\ (PL^{G}, PL^{C}, PL^{P}, \Delta P^{W}, \Delta P^{W}_{\ t\text{-}i}, Z)$,

where ΔP represents a dummy for a price change, PL^G, PL^C and PL^P dummies as in equation (3), ΔP^W a dummy for a change in the wholesale price, $\Delta P^{W}_{\ t\text{-}i}$ a dummy for a lagged change in the wholesale price and Z for the control variables which were already used in equation (4).

[3] We also estimate parameters using a random-effects probit model. The results were quantitatively similar to those presented in this paper.

The econometric model for a price change of the product j, in the store h, at time t is specified as a normal, cumulative distribution function (7):

$$(7)\ P\ (\Delta P_{jht}=1) = \Phi\ (\beta_0 + \beta_1\ PL^{G}{}_{j} + \beta_2\ PL^{C}{}_{j} + \beta_3\ PL^{P}{}_{j} + \beta_4\ \Delta P^{W}{}_{jht} + \textstyle\sum_{i=1}^{3} \beta_{5i} \Delta P^{W}{}_{jh(t-i)} + \beta_6\ AB_h + \beta_7\ VAN_h + \beta_8\ RURAL_h + \beta_9\ PSIZE_j + \beta_{10}\ SSIZE_h).$$

The approach has as compared to the regression model the advantage that the impact of the wholesale price can be investigated in a more differentiated way. Otherwise, the impact of promotions and price jumps cannot be included into the model because a price promotion or a price jump, respectively can lead to a probability of 100 percentages that a price will change. These explanatory variables would not be exogenous any more[4].

In regard to the results of the existing literature discussed before four hypotheses can be set and expected signs for the coefficients of the equations (5) and (7) can be derived. First, higher margins and different pricing strategies lead to higher PR or a lower probability of a price change of PLs (Weber 2009; Volpe and Li 2012). With special emphasis to the different quality levels of PLs, price changes of these types will be analyzed in more detail. Empirical studies do not exist in this context, but due to the knowledge of promotion patterns and margins (Kumar and Steenkamp 2007; Ailawadi and Harlam 2004) it is assumed that the price rigidity for a generic PL has the highest degree, following the premium PL and then the copycat brand. The probability of a price change should increase from a generic to a me-too private label. The second hypothesis is derived on basis on the expectation that changes in input prices will lead to a change in retail price (Kano 2007, Dutta et al. 2002). The wholesale price is a part of the cost components of the retail price. To keep the margins constant, the retail price should be increased if a wholesale price increases. Likewise, wholesale price reductions should reduce the retail price if the retailer passes the cost saving through. But Hosken and Reiffen (2004) argued that price variations are rather explained by price promotions than by wholesale prices which leads to the third hypothesis. The last hypothesis is built onto the fear of adverse customer reactions and loss of market power (Blinder et al. 1998). Therefore retail prices are expected to respond in a delayed way to wholesale price changes. All hypotheses are summarized in Table 2, including the expected signs for the coefficients in the equations (4) and (7).

Table 2: Hypotheses and expected signs of coefficients

	Test of coefficients	
Hypothesis	*OLS*	*Probit*
H_1: Higher margins and different pricing strategies lead to higher PR or a lower probability of a price change of PLs whereas there are differences in the magnitude of the coefficients of the different types.	$\alpha_1 > \alpha_3 > \alpha_2$ and all > 0	$\beta_1 < \beta_3 < \beta_2$ and all < 0
H_2: Wholesale price changes have an impact on retail price changes.	$\alpha_4 < 0$	$\beta_4 > 0$
H_3: Price variation is rather explained by price promotions than by wholesale prices.	$\alpha_4 > \alpha_5$	
H_4: Retail prices respond in a delayed way to wholesale price changes.		$\beta_4 > \beta_{5i}$

[4] A price change does not have to be observed as a price promotion occurs because a promotion can last longer than one week (Volpe and Li 2012).

3 Data

Description of Data

The available data from a North American retailer consist of observations of weekly quantities, net revenues, gross revenues and wholesale prices for each UPC in each store from the first week in 2004 to the 22nd in 2007 whereas we focus on Canada with 70 stores. The wholesale price represents the price paid by the retailer for the product in week *t* and is unique information in the dataset compared to other studies. Besides that, information about the stores are given like the store size, the location of the store and to which management area the store belongs to. To compute the price for a unit (net price and gross price, respectively) the revenues were divided by the quantities. The gross price is the price before discounts. Therefore a discount can be measured by the difference of the net price and the gross price and a price jump can be detected by comparing the gross price of two following weeks. There have been several discussions about defining a price promotion (Volpe and Li 2012; Verhelst and Van den Poel 2010). Due to the possible distinction between a price promotion and a price jump, it does not state a problem for our data. The package size that is used in this analysis is not always available in the dataset. To get this missing information an inspection of the label in the store or a description of the manufacturer was necessary. Based on the UPC, errors of collecting the wrong data for one particular product are excluded. Villas-Boas (2007) used the same approach to deal with limited data.

There are missing observations for some weeks which might arise due to weeks when no item was sold or due to stock-outs. In this case, missing values were filled with the gross prices from the previous week because of the assumption that the probability for no sale is high if there is no price promotion in the week. A similar approach is used by Nakamuras et al. (2011) in a study of price dynamics. This approach leads to a complete series of observation so that the price change to last week can be calculated.

Despite the high quality of scanner data there is a potential source of measurement error associated with weekly price measures. Some items are sold at a discount to customers who have a loyalty card. Regular prices hold for loyalty card owners as well as for non-owners. The use of loyalty cards or so called "club cards" is widely spread in North American retail chains. European countries which follow the same system are, for instance, the United Kingdom and Austria. If there are changes over time in the fraction of customers who take advantage of this type of discounts, the procedure for computing weekly net prices will produce biased prices. It means that the computed price in a week with a discount can just be an average price of a product in that week. It does not have to display the price presented at the shelf in the store. However, it can be observed whether there was a price change or a discount, respectively. Just the absolute price change is biased. To cope with this error measurement a price change is defined as a real change if it is higher than 4.9 cents. Changes that are below this limit are treated as measurement errors or data errors. Because of this limitation and the knowledge that the majority of the Canadian populations uses the loyalty cards[5], the defined price change can be treated as appropriate.

Description of Selected Categories

Two case studies, bottled salad dressing and packaged side bacon, were chosen in regard to the papers focus of estimating rigidity among vertically differentiated PLs and NBs. Both

[5] Customers even do not have to carry the card for taking advantages out of it. If they cannot show the card, they have the opportunity to use their phone number.

categories differ considerably from each other and can show how their characteristics can have an effect on the results.

Bacon is a relatively popular good in Canada and most brands are made by Canadian manufacturers. It has as other products which need to be refrigerated a short shelf-life. Consumers evaluate bacon as a high quality product. Varieties of the products are narrowed down to the package size, to the thickness of the slices and to the addition of salt and compared to other categories the variety of brands keeps within bounds. The main ingredient is pork meat which price is subject to strong fluctuations on the commodity market. The category has twelve different products with four NBs and three different types of PLs. The market shares are relatively balanced. The leading NB accounts for 31.3 % which might be due to three different products. With a market share of 47.8 % the PLs represent an important part of the shelf.

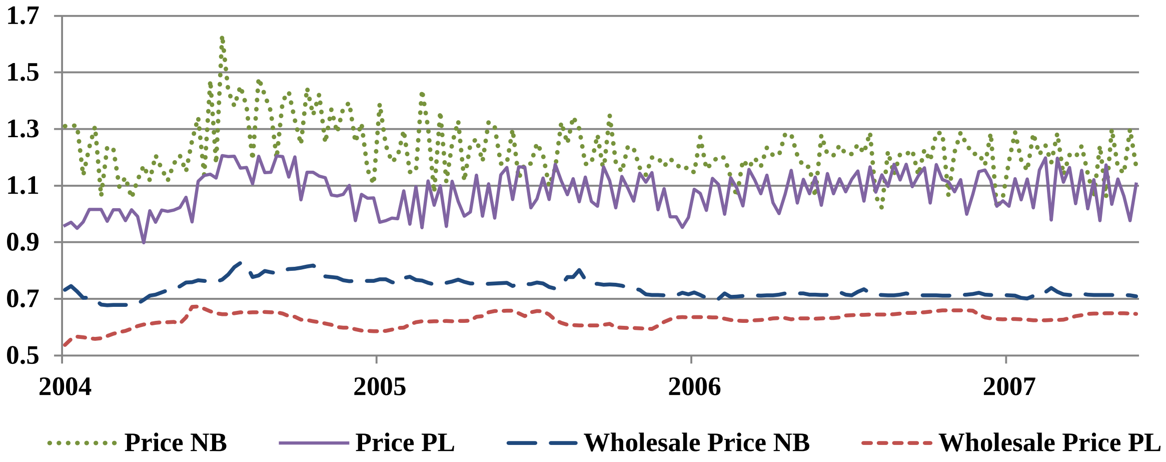
Salad dressings are classified as convenient products and constitute a fast solution for consumers who are short of time to prepare a meal. Compared to bacon they have a longer shelf-life. Salad dressings also show a longer list of ingredients which are usually not subject to strong fluctuations on the commodity market. However, due to many ingredients, fluctuations for one ingredient will not affect the costs as much as for bacon. Salad dressings exhibit an enormous range of flavors and many new product introductions. Compared to bacon there is one prominent and leading brand with a market share of 74.3 %. In total, the category offers thirteen brands whereas just four exceed a market share of 2 %. The PLs belong to them with an overall market share of 14.4 %. They constitute the opposite pole to the leading brand. The PLs and the leading NB are selected from the thirteen brands to concentrate on the most important market players and to show the unique characteristic of the category. All together, the selected brands account for 89 % of the market share and represent the category in a sufficient way. All selected brands account in sum for 115 products. Similar to Besanko et al. (2005) products of brands with the same package size are aggregated to facilitate the interpretation of the results, although the original data is available at the UPC level. Due to the strategy of pricing and selling these products show identical prices. An individual consideration would not provide any further contribution.

Summary Statistics and Description of Variables

To get an impression of the price variability, Figure 2 and 3 illustrate the development of the retail and wholesale prices for bacon and salad dressings, respectively. Surprisingly, the wholesale price in the case of salad dressings is rigid. On average, it does not change more than once in the sample period. The retail price of salad dressings keeps within bounds and does not show an upward or downward trend over time. The wholesale prices of bacon change more frequently, but still less than the retail prices. Beginning of 2004 the retail price for the NBs and the PLs showed an upward price trend which might be a result of the rising wholesale prices.

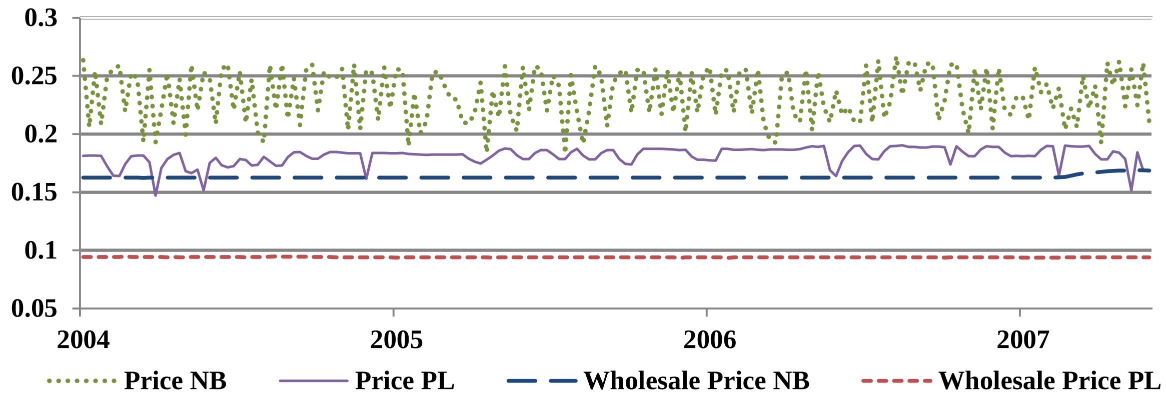
If the brands are analyzed in more detail, it can be observed that there is a distinct difference between the manufacturers. In the case of bacon, the wholesale price of a manufacturer of the NBs and the manufacturer of the copycat brands change their prices just roughly twice in the period of 178 weeks. This might indicate that long-term contracts exist depending on the manufacturer. However, the wholesale prices of all brands in both categories are much more rigid than the retail prices. It is a first indicator for the slight impact of the wholesale prices relatively to the price promotions.

Figure 2: Retail and wholesale prices (CAD/100g) of bacon by PLs and NBs



Source: Own computation.

Figure 3: Retail and wholesale prices (CAD/oz) of salad dressings by PLs and NBs



Source: Own computation.

Table 3 defines the variables used in the linear regression and probit model and provides the descriptive statistics. First of all, it can be stated that the price rigidity in both categories shows low values, whereas the deviation of the salad dressing is more than three times as high as for bacon. But it still fits into the results of existing North-American research. The high deviation of salad dressings is caused by the relatively high values of price rigidity for the copycat brand with 2.67 and for the premium PL with 5.62. It can also be observed that the promotion activity is high with an average value of 44.29 or 37.04 %, respectively.

It has to be mentioned for the empirical model that the package size and price jumps are not included in the case of bacon because of multicollinearity. The exclusion is also reasonable because the brands with differing package sizes from the standard package size show a low share of changes in wholesale prices. Mistakenly, the package size could be detected as the influence on the price rigidity whereas it is assumed that the real influence is the brand. The wholesale price in the case of bacon is also not included in the model because there is just a minimal variation like explained in the descriptive statistics. In addition, it has to be mentioned that there is no generic for the case of salad dressings.

Table 3: Description and summary statistics of the included variables

Variable	Definition	Bacon Mean	Bacon SD	Salad dressings Mean	Salad dressings SD
Dependant variable					
$PR^{a)}$	Mean duration of unchanged prices in weeks	1.72	0.41	2.26	1.42
$\Delta P^{b)}$	Dummy variable for price change	0.60	0.49	0.56	0.50
Independent variables					
BRAND	NB: Dummy variable for national brands (base category)	0.56	0.49	0.75	0.43
	PL^G: Dummy variable for generics	0.10	0.29	-	-
	PL^C: Dummy variable for copycat brands	0.17	0.37	0.12	0.33
	PL^P: Dummy variable for premium PL	0.18	0.37	0.12	0.33
$SP^{W\ a)}$	Share of changes in the wholesale price in all observations	15.84	9.94	0.50	0.53
$\Delta P^{W\ b)}$	Dummy variable for change in wholesale price	0.16	0.37	0.01	0.07
$\Delta P^{W}_{t-i}{}^{b)}$	Lagged dummy for change in wholesale price, i=1,2,3	0.16	0.37	0.01	0.07
Control variables					
$PROMO^{a)}$	Share of price promotions in all observations	44.29	13.03	37.04	14.24
$JUMP^{a)}$	Share of price jumps in all observations	7.70	4.43	8.64	3.91
DIVISION	WIN: Dummy for division Winnipeg (base category)	0.35	0.48	0.35	0.48
	AB: Dummy for division Alberta	0.31	0.46	0.32	0.46
	VAN: Dummy for division Vancouver	0.34	0.47	0.34	0.47
RURAL	Dummy for stores located in rural areas	0.39	0.49	0.39	0.49
PSIZE	Package size in gram or ounces, respectively	558.62	211.61	13.28	3.51
SSIZE	Total selling area of store in 100 square feet	273.64	87.50	271.57	88.00

Notes: [a)] Just used in the linear regression model, [b)] just used in the probit model.
Source: Own computation.

In Table 4 absolute and percentage margins are presented. Absolute margins show how much profit the retailer can gain with one unit, but this might not always be worth knowing. Lower prices can lead to more sales and thus, a product with a lower absolute margin can lead to an overall higher profit. Relative margins also include the varying package size and therefore, it constitutes a better measurement for comparison. As expected almost all PL products show higher relative margins. Contrary to the results of Kumar and Steenkamp (2007), the margin of the premium PL of salad dressings is lower than the margin of the copycat brand, but the assumption of the highest margins for premium PLs still holds for the case of bacon.

Table 4: Absolute and relative margins for both categories by brands

Bacon			Salad dressings		
Brands	Absolute margin (CAD)	Relative margin (%)	Brands	Absolute margin (CAD)	Relative margin (%)
National Brands					
NB 1	2.33	37.7	NB (16 oz)	0.80	25.0
NB 2	2.23	39.1	NB (8 oz)	0.80	34.0
NB 3	2.35	38.5			
NB 4	5.45	38.8			
Private Labels					
PL^G	1.39	37.4			
PL^C (250g)	1.39	41.6	PL^C	1.41	53.9
PL^C (1000g)	4.64	35.3	PL^P	1.39	43.5
PL^P	2.48	46.0			

Source: Own computation.

5 Results and Discussion

A contribution of this analysis is the influence of the different quality levels of the PLs on price rigidity. The effect is diverging for bacon. While the copycat brand and the generic compared to the four NBs have an increasing effect on the price rigidity, the premium private label has a decreasing effect. The case of bacon might be a special category. Bacon is in general a high quality product. The strategy to maintain prices of premium PLs constant to compete and to stand out against other brands might not apply because the direct competitors already distribute products with high quality. The differentiator high quality is not applicable to bacon. An introduction of a premium PL is reasonable in categories where a niche can be filled through this product (Kumar and Steenkamp 2010). The premium PL does not seem to fill such a niche. Contrary, to the recommendations or discoveries in the literature, the price setting for the investigated retail chain in the category bacon does not pertain, especially in regard to the results of the regression model. The probit model shows all the expected signs for the different private labels, but not in the assumed extent. Distinctions in the results of both models might be due to the different measurements to capture patterns of price variation.

The influence of the PLs, especially of the standard and premium PLs, are clearly presented in the case of salad dressings. Both models show the expected signs and magnitudes. If the product is a me-too product instead of the NB the price rigidity increases by 85.2 %, ceteris paribus and even by 149 % if it is the premium PL[6]. The results of the probit analysis support the findings of the regression approach. On average, the probability of a price change decreases by 38.6 percentage points if the product is a copycat brand instead of the NB and 58.3 percentage points for the premium PL. Both approaches present the assumed results. The price rigidity increases for PLs, whereby the premium PL has a greater effect.

At this point, it is interesting that the premium PLs in the category salad dressings do not reveal a higher margin than the me-too products, whether absolute nor on a percentage basis like stated by Kumar and Steenkamp (2007). Premium PLs do not have a higher margin to cushion wholesale price changes, whereby this would not matter because the descriptive analysis revealed that changes of the wholesale price for salad dressings do not play an important role. Apparently, price strategies have a great influence on the price setting in the category salad dressings. Already the relative frequent price jumps compared to changes in the wholesale prices indicate that prices are changed in a strategic instead of cost-reflecting way. The same case might be applied for the premium PLs. Stable and high prices might be perceived as a signal for high quality and reliance. In addition, the less frequent price changes could be a contrast to the frequent price changes of the NBs. It might be one weapon to compete with NBs.

Another contribution of this paper is the effect of changes in wholesale prices. Their impact on changes in retail prices was often conjectured, but due to the missing or insufficient data there was no answer or just an unsatisfied one. Especially in the case of bacon the consideration of changes in wholesale prices is reasonable because of the fluctuation of the market price of pork. The price rigidity decreases by 0.035 % if the share of changes in wholesale prices increases by one percent and supports the results of Kano (2007) and Dutta et al.

[6] The functional form of the conventional regression model is a double-log form. The dummy is not transformed since a dummy just takes values of 1 and 0 and 0 cannot be transformed into a logarithm. Usually the coefficients of the explanatory variables in semi-logarithmic equations can be interpreted as the relative change of the dependent variable with the marginal change of the independent variable. This interpretation is not appropriate for dummy variables. To obtain the correct results, the calculation of Halvorsen and Palmquist (1980), $100 \cdot g = 100 \cdot \{\text{antilog}(c) - 1\}$, has to be followed whereby g is the relative effect on Y, of the dependent variable, and c is the coefficient.

(2002). Interesting is not just that the changes of the wholesale price have an effect, but rather whether there is a direct or a delayed effect. The marginal effects of the probit analysis show that the probability of a price change increases significantly on average if the wholesale price is changed in the same week or in the previous week. But otherwise, on average the probability of a price change decreases if the wholesale price changed two or three weeks before. These results indicate that the price tends to change immediately or right after a change in the wholesale price. Blinder et al. (1998) assumed that firms which expect cost increases would increase prices in advance. Indeed, their survey could show that they try to refrain from that because of the fear of adverse customer reactions and the loss of market share. The hypothesis of this paper goes one step further. It is rather assumed that increases in the wholesale price will have an effect on the price in a delayed way. It is the same case for wholesale price decreases because it is also imaginable that decreases will not be passed through directly because retailers could try to take advantage of the cost decrease for a short time. In this analysis, there is no distinction between a price (wholesale price) increase and a price (wholesale price) decrease. But the results can clearly show that the retail price changes more likely within a week or after a week with a change in the wholesale price. Hence, it can be deduced that there is no or a modest lag, respectively. The statements of Blinder et al. (1998) can be seized at this point. It is imaginable that retailers do expect changes in costs and therefore, they can include this into their price decisions and are able to change their prices immediately. The higher probability for price changes if the wholesale price increased in the week before could also indicate that the cost changes are not passed through to the whole extent. Instead of, they might be allocated on two weeks, so that a price change does not seem obviously. This question cannot be answered definitely because the magnitude of a price change is not a part of this paper. But it might be a possible explanation for the results of the model.

Table 5: Estimation results

	Bacon		**Salad dressings**	
Variable	**Ln(PR)[a)]**	**ΔP=1[b)]**	**Ln(PR)[a)]**	**ΔP=1[b)]**
CONSTANT	-0.250 **		1.578 ***	
Variables used in both models				
PL^G	0.091 ***	-0.066 ***	-	-
PL^C	0.109 ***	-0.186 ***	0.616 ***	-0.386 ***
PL^P	-0.021 ***	-0.060 ***	0.913 ***	-0.583 ***
AB	-0.005	0.016 (*)	-0.037 ***	0.088 ***
VAN	-0.010 *	0.011	-0.035 ***	0.035 ***
RURAL	-0.015 ***	0.009	-0.010 (*)	-0.021 ***
SSIZE[c)]	0.017 **	-4.91^{-9}	0.022 ***	-2.82^{-6}
PSIZE[c)]	-	-	-0.719 ***	0.037 ***
Variables only used in the regression model				
Ln (SP^W)	-0.035 ***		-	
Ln (DEAL)	-0.490 ***		-0.358 ***	
Ln (JUMP)	-		-0.101 ***	
Variables only used in the probabilistic model				
ΔP^W		0.037 ***		-
ΔP^W_{t-1}		0.034 ***		-
ΔP^W_{t-2}		-0.024 ***		-
ΔP^W_{t-3}		-0.017 ***		-
R^2 [d)]	0.90	0.03	0.97	0.02

[a)] Coeffiencts of linear regression model, [b)] marginal effects of probit model, [c)] logarithm for linear regression, [d)] Pseudo-R² for the probit model; (*), *, **, ***, 90 %, 95 %, 99 %, 99.9 % significance level.
Source: Own computation.

Unlike the results of the regression model for bacon the wholesale price does not contribute anything significant to the explanation of price rigidity. On average, the descriptive analysis shows that there is a share of changes in wholesale prices by less than 1 %. In other words, the wholesale price does not change more than once in 178 weeks. Nevertheless, long-term changes in the retail price occur although the wholesale price does not change. This might indicate that changes in demand or in price strategy occurred instead of changes in costs.

The impact of the wholesale price cannot be transferred into all other categories. Thus, only transmissions to other categories with the same conditions, i.e. with a remarkable share of changes in wholesale prices, can be applied. Nevertheless, an unexpected result needs more attention. Wholesale prices are more rigid than expected, even for the case of bacon, and they change less frequent than the retail prices in both categories. The regression model shows likewise to Weber (2009) and Kano (2007) that the price rigidity for bacon and salad dressings decreases if the share of promotions increases relatively to the observations. If the share increases by one percent the price rigidity decreases by 0.49 % or 0.36 %, respectively. Under this perspective high price variations in retail prices are more assumed to be due to sales, as already stated in a study of Hosken and Reiffen (2004). The explanatory power decreases immensely if the price promotions are not a part of the empirical model. This is also one reason why the explanatory power of the probit models is at a low level.

Several of the control variables indicate relationships which should be briefly discussed because they support existing literature and provide discussion for further research. The result of the effect of stores, which belong to particular divisions, might be due to different strategies. If a store belongs to the division Alberta or Vancouver, respectively, compared to the division Winnipeg, the price rigidity increases. It can be definitely argued for the case of salad dressings. The impact is not strong, but it is reasonable since the price setting should not be completely different in one chain. The results show that decisions are made at this level instead of the store level and that price strategies might differ from one division to the other. Nakamura et al. (2011) could show that differences in price rigidity can be found across chains instead of stores. Decisions are often made by the management of the chain and not by the management of the store. The results in both cases indicate this relationship but they are not highly significant in the case for bacon and cannot be interpreted for certain. However, it is interesting to observe that not just chains differ in their pricing strategy as stated by Nakamura et al., there might be also a difference within the chain as long as they are subdivided into management areas. For a huge country like Canada such segmentation might be reasonable compared to European countries.

Several authors also explained the influence of the store size on retail prices (Nakamura et al. 2011; Bonanno et al. 2009; Ellickson 2006; Powers and Powers 2001). Our results indicate that with an increasing store size the price rigidity rises in both categories. For example the price rigidity for salad dressings decreases by 0.02 % if the store size increases by one percent. It seems to be just a small change, but given the fact that the store sizes accounts for 10,000 to roughly 65,000 square feet, great changes can be reached. An explanation for this result can be the different price strategies depending on the store size. While small stores have to compete with prices, larger stores have the advantage of variety. There might be no need to change prices to attract customers. Bonanno and Lopez (2009) and Ellickson (2006) found similar results. The store size is used as a proxy for store quality. They showed that larger stores attract less price-sensitive consumers.

The package size is another variable which can reveal interesting results. First of all, the package size could not be included into the model in the case of bacon due to multicollinearity. The exclusion is reasonable because the brands with differing package sizes from the standard package size show a low share of changes in wholesale prices. Mistakenly, the package size could be detected as the influence on the price rigidity whereas it is assumed that the real influence is the brand. It is possible that there are special contracts between the manufacturer and the retailer for these brands. To answer this question, more information about the ownership structure are necessary. It cannot be solved at this point and is beyond the research in this paper. But this problem does not occur for the case of salad dressings. Thus, the package size can be analyzed. If the package size, measured in ounces, increases by 1 %, the price rigidity decreases by 0.72 %, ceteris paribus. It means that products with smaller package sizes exhibit more steady prices. The results of the probabilistic model support these discoveries. On average, the probability of a price change increases by 3.7 percentage points with every ounce. One explanation for this result is the propensity of retailers to promote products with bigger package sizes and another one that products of the standard package size, in this case 16 oz, are exposed to higher competition. In the dissertation of Weber (200) about price rigidity in German retailing the package size is not taking into account. He argues that it is more plausible to consider absolute prices because consumers do not norm the package size for price comparison. Other characteristics like the type[7] play a more important role for decisions. From the view of the retailer, different package sizes affect the promotions, margins and price levels. Thus, it is reasonable to consider the package and the results emphasize it. Conspicuously at this point is that the PLs are just offered in one package size. Considering other categories in Canadian retailing and the analysis by Weber (2009), similar observations can be made. Apparently, retailers do not try to produce different package sizes for their PLs and do not try to distinguish between the offered PL products with the package size. This has the advantage of economies of scale for the production of PLs.

6 Conclusions and Further Work

First of all, it can be seen that the prices for the categories bacon and salad dressings change frequently. Depending on the category the magnitude of the price rigidity can differ. To obtain better comparisons another category with more rigid prices should be analyzed. It might be also interesting to choose non-food or nearfood categories, respectively, to analyze if there is a difference in price patterns among these classifications in retailing. Another aspect which has to be kept in mind is the use of loyalty cards. The use of loyalty cards is widely spread in North American retail chains. Recently, European countries like the United Kingdom and Austria follow the same system. If there are changes over time in the fraction of customers who take advantage of this type of discounts, the procedure for computing weekly prices would produce biased price changes. It does not have to display the price presented at the shelf in the store. However, it can be seen if there was a price change or a discount, respectively. Just the absolute price change is biased. These conditions need to gain attention, especially if the price rigidities of North American retail chains and European retail chains are compared. Apparently, the price rigidity is lower in North American countries and the calculated price rigidity in this paper follows these values. On the one hand, the North American price strategy might be different from the European as stated by Verhelst and Van den Poel (2010), but on the other hand it is imaginable that all researchers working with North American data have the same problem with the loyalty cards. This aspect should gain more attention in further research and the price and competitive strategies in different countries should be analyzed explicitly.

The results show that it is reasonable to investigate one category more closely, but otherwise to do it between categories. Categories should not be chosen randomly. In this study, two categories with different characteristic were picked to see the different price and PL strategies. It can be revealed that in the case of bacon the prices of the three different types of PLs do show

[7] Weber (2009) investigated the category hard and semi-hard cheese.

a different pattern from the expected one. In categories with a high standard of quality, like bacon, the advantages of a premium PL might not be used to the full potential. Usually premium PLs should be prominent in the category. The premium PL for bacon does not seem to fulfill this. A solution could be the introduction of a premium PL which stands out with attributes like health-consciousness or ecological awareness where a niche can be filled. The investigated retail chain already started to realize it and uses beside the investigated premium PL -a selection of products a step above the ordinary- others premium PL which fall into the category "better-for-you" and organic. These labels were introduced at the end or after the period that is given and should gain more attention when the data will be available.

Different from the expectations the wholesale price changes barely. Especially, in the case of salad dressings the wholesale price changes on average not more than once in the whole period. It also means that wholesale price do not decrease gradually. The bargaining effect as a result of the increasing market share of PL might be overrated or possibly, the bargaining effect is manifested in a different way. Referring to Narashimhan and Wilcox (1998) slotting allowances, coop advertising and free products are a way to transfer money from the manufacturer to the retailer. One aspect which was not considered so far is that the wholesale price might not change remarkably for salad dressings because retailers could negotiate long-term contracts. A wholesale price increase could occur before the investigated period and after the increase the wholesale price was kept constantly. Long-term wholesale prices might be the result of good negotiations which are due to the greater power in consequence of a successful establishment of PLs. Which case arises cannot be solved with this analysis. But it can already be stated that long-term contracts might occur because in the case of bacon clearly differing shares in changes in the wholesale price depending on the manufacturer could be observed, although the commodity price is subject to strong fluctuations. The information about the wholesale price is the strength of the data and other research question should be answered on the basis of these data. One conceivable question is if the wholesale market or the manufactures, respectively, capture the fluctuations of the commodity markets. Maybe the manufactures cannot pass through changes in costs because of the fear of losing markets shares or of dropping from the product range due to the market power of the retailers. It is the similar to the idea that retailers apprehend adverse customer reactions.

The availability of the wholesale price contributes to insights of the retail strategy and management which were not investigated before. Another contribution of this analysis is the consideration of vertically differentiated PLs. Different patterns among them can be observed, but they cannot be transmitted to all categories which raise the question about how reasonable an introduction of a premium PL is depending on the category.

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