Retail Sales: Do They Mean Reduced Expenditures? German Grocery Evidence

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Abstract

Retail pricing strategies incorporate promotions, sales, and rigidities. A number of models have been proposed in particular to explain the occurrence of sales. Focussing on the market for fresh foods the model by Varian and the loss leader argument seem to be intuitively best fitting to the conditions in the fresh food market. From these models we derive several hypotheses that are tested for a unique data set of the German fresh food retail market. The data set consists of weekly prices for ten food items in 131 grocery shops over the period from 1995 to 2000. Following Varian sales should lead to reduced expenditures, while the loss leader argument assumes that consumers are lured into the shop by promotional sales which are covered by higher prices for other products. The results indicate that expenditures decrease with the number of sales in the short run but this effect is outweighed by a dynamic price adjustment thereafter.

1. *Introduction*

All consumers are affected by pricing strategies in the retail sector. Though decreasing, the share of food and beverages consumption expenditures today accounts for 20 % of total private expenditures in Germany. This share of total expenditures also is typical of other European countries. In the U.S. the share is smaller, while in developing countries the share of food costs is typically much higher. Because of the improved access to detailed data, theoretical and empirical studies of retail pricing have become increasingly feasible. Of particular interest is the question of whether retail sales play a constructive role in a competitive economy, signalling needs of retailers to reduce inventories, or of the food chain to increase sales to clear unanticipated supplies. Alternative hypotheses include strategic goals such as loss-leader theories. In any case, these theories have been examined empirically only on a limited basis in U.S. retail markets. An important constraint on empirical enquiry has been the identification of "sale" status of prices. In this paper, we introduce a price-based indicator of "sale" status of prices and examine the relationship between "sales" and retail price levels. In particular, we examine intertemporal relationship between "sales" and consumer expenditures, as well as the relationship of "sales" across product categories. To do so, we employ a unique data set for German grocery stores.

The paper is structured as follows. First, we briefly summarize available theoretical and empirical results that consider the role of retail sales. Next, we consider the German grocery sample, presenting descriptive statistics for weekly German food retail price time series for ten fresh food products in 131 grocery stores over the period from 1995 to 2000. In the final section, we present our indicator of sale status, and present results of an empirical model of the role of sales as a determinant of the level of consumer expenditures. We find that while retail sales are not correlated across products within a store, are not correlated over time, and are not correlated across stores, retail sales appear to be part of an intertemporal pricing strategy that begins with a contemporaneous reduction in consumer expenditures that is followed by increases. These results are not consistent with cross product loss-leader strategies in a static sense, but nevertheless suggest that retail sales play a strategic role, perhaps providing information, though are financed by price increases that follow later in time which might be interpreted as a dynamic loss leader strategy.

2. *Review of the theory on retail sales*

Within the retail pricing literature, considerable attention has been paid to the explanation of sales. Hosken and Reiffen (2001) defined sales as "temporary (significant) reductions in the price of an item that are unrelated to cost changes". In this section we briefly summarize the existing theories on sales or promotional retail pricing and assess their implications for retail pricing for fresh foods. Different promotional strategies can be applied to implement sales including shelf price reductions, coupons ('free standing inserts' (FSI) or electronic), mail rebates, or price packs, see Banks and Moorthy (1999). They classified models of sales as those related to changes in fundamentals (e.g. changing demand and cost conditions), price discrimination, and strategic price competition.[2] Conslisk et al. (1984) develop a monopoly model of intertemporal pricing. They distinguish between consumers with high and low reservation prices, all agents are fully informed and risk neutral. Under these conditions sales occur periodically to induce purchases by consumers with high reservation prices. Sobel (1984) extends the model to multiple sellers and finds that in equilibrium sales occur periodically at the same time across sellers. Inventory-based theories of sales considered by Blinder (1982), Reagan (1982), or Blattberg et al. (1981) assume that costs of inventory holding of goods vary across retailers and across consumers. If a significant share of consumers has low inventory costs, then retailers can minimize their inventory costs by regularly putting products on sale, transferring the inventory function and cost to consumers. Lazear (1986) introduced uncertainty about the final demand as might be the case for fashion goods. He shows that retailers generally start with higher prices reducing them through sales as the season progresses to discriminate across consumer valuations of fashion. Pesendorfer (2000) presents a dynamic model of demand accumulation. In every period low and high valuation consumers enter the market. In addition, low valuation consumers are either store loyal or shoppers.[3] Pesendorfer shows that sales are a function of the time with a price path where an extended period of high prices is followed by a short period of low prices.[4] Hosken and Reiffen (2001) extend the approach of Sobel by considering two goods, a durable and a perishable item. They show that price changes for the durable good exceed the changes in prices of the perishable good and that the price changes are negatively correlated.[5] Other motivations for sales are given when goods are newly introduced (Bass, 1980 or Kalish, 1983), when consumers need incentives to spread their buying across time (Gerstner, 1986), or when firms want to forward sell products (Salop and Stiglitz, 1982). Salop and Stiglitz (1977) analyze the impact of search costs on the price equilibrium. They differentiate consumers with high versus low search costs and suggest there are informed and uniformed consumers. The uniformed select the retail shop at random, the informed always search for the lowest price store(s). Under particular parameter conditions a two price equilibrium exists, in which some retailers charge low prices and others high prices.[6] In a similar specification, Narasimhan (1984) models price discrimination between consumers with higher and lower transaction costs by employing coupons as promotional instrument. To receive the sale's price consumers need time. If we assume different opportunity costs and demand elasticities across consumers, then it is shown to be optimal to discriminate across these groups by using coupons. For impulse goods Lal and Matutes (1994) or earlier Hess and Gerstner (1987) show that a loss leader pricing strategy might be a rational for retailers. The loss

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2 We do not consider entirely static approaches, such as the model by Bliss (1988), because we are primarily interested in the dynamic behaviour of prices, in particular sales or promotional prices. Static models can explain the occurrence of different or even negative markups (loss leader) for respective goods. However, an essential feature of sales in our definition is the temporary character of sales' offers. For an overview of most of the models presented here see also Blattberg and Neslin (1990).

3 Shoppers are fully informed and purchase the good at the store that offers the good at the lowest price.

4 Pesendorfer simplifies the Sobel model by letting his consumers not behaving strategically, but he extends the model by letting some low valuation consumers to be store loyal (Hosken and Reiffen (2001).

5 However, it seems to be hard to define which goods are to be considered perishable and which durable. Hosken and Reiffen (2001) consider peanut butter to be a durable good, while margarine is a perishable item.

6 Varian (1980) criticizes that consumers likely learn to know the low price stores in time and thereby become informed. Thus, the derived two price equilibrium ought to converge to a single price equilibrium in time.

leader good is used to lure customers into the shop. If significant costs exist for changing stores to purchase good, a customer may find it rational to buy other goods at the store despite higher prices for those goods. In this way, potential losses associated with using a loss leader are compensated and the strategy is rational for the store. Varian (1980) presents a dynamic model of retail competition with informed and uninformed consumers. Uniformed consumers randomly choose shops; the informed always visit the lowest price store. Because of high fixed costs, average costs of retailers are decreasing. For these conditions Varian shows that an equilibrium strategy is to decide prices randomly based on a U-shaped distribution function. Thus, high as well as low (sales) prices are chosen most often. Because of specific conditions in food retailing most models presented so far can *a priori* be excluded to explain sales for these products. The products analyzed in this study are fresh foods (fresh meats, fresh vegetables, and fresh fruits) which cannot be stored over long time intervals (perishable goods). Thus, the inventory-based models cannot explain the potential occurrence of sales for these products. Fresh foods are bought by consumers at a high frequency (e.g. weekly), and thereby, consumers will eventually learn about the low price stores. The specification of the Salop and Stiglitz (1977) and Lazear (1986) models are inappropriate for this category of goods. The arguments concerning the introduction of new goods and incentives to spread demand across time are also not relevant in the market for fresh foods, at least for the products under study. Fresh meats, vegetables, and fruits are relatively (standardized) homogenous products. The informed and uninformed consumer model of Varian (1980), however, is supported by survey studies in this field. Results show that consumers know only to a limited extent the prices of foods in shops they just visited (see e.g. Gabor and Granger, 1961). Also, the loss leader argument cannot be rejected *a priori.* From the Varian model, the following hypothesis can be derived:[7] (a) Prices stem from a continuous distribution, (b) the distribution of prices is U-shaped, (c) sales occur randomly in time, (d) sales occur randomly between shops, (e) sales lead to lower expenditures for foods.[8]

3. Data[9]

The data used for this study are from the "Zentrale Markt- und Preisberichtstelle" (ZMP) located in Bonn, Germany. Price data is collected for 56 fresh food products by "Melder" (price reporter). For our study, ten out of the 56 food products sampled by ZMP were selected to create a sample composed of a full panel. That is, products were selected to ensure that prices were available over the entire period of observation for each store. Specialized fruit and vegetable as well as butcher shops were excluded from the sample due to incomplete data. Food products

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7 The loss leader model leads to the opposite hypothesis as the Varian model regarding the impact of sales on expenditures. If loss leaders are used to lure customers into the shop, total expenditures ought to be not negatively correlated with the number of sales.

8 Empirical evidence relevant to this study is limited. Villas-Boas (1995) tested the distribution of prices for the coffee and saltine cracker markets in the US (Kansas City) based on the hypothesis derived from the Varian model. His results support in about 50 % of the analyzed price series for saltine crackers and coffee that the estimated distribution predicted by the Varian model has to be rejected. Pesendorfer (2000) analyzed the market for ketchup in Springfield Missouri (US). He finds the data to indicate the predicted path by the model. The duration variables are significant and indicate the predicted sign. Prices and sales exhibit only little correlation across chains, but are significant for the same chain between different brands. Hosken and Reiffen (2001) find their main hypothesis to be supported by data for retail prices of peanut butter and margarine in Sioux Falls (Missouri) and Springfield (South Dakota) in various supermarket chains. Price changes for the perishable good (margarine) are significantly smaller than for the durable good (peanut butter) and price changes are negatively correlated.

9 Prices throughout the paper are quoted in German pennies (Pfennige). One penny is equal to one hundredth of one German Mark (Deutsche Mark, DM). German Marks were the valid currency in Germany up to the end of 2001. Since January 2002 the currency has changed to Euro (€). One Euro is equal to 1.9558 German Mark. SSM, BSM, CSM, DC indicate small, big, and combined supermarkets and discounter respectively.

only offered seasonally, such as cherries, and items that are only reported on a monthly basis, such as milk products, were also excluded. The remaining products included 4 meats, 3 fruits and 3 vegetables. For these 10 food products, we selected those stores that carry each of these items at all times. As a criterion for continuous price reporting, we required availability of price observations for each product in more than 92 % of all weeks from May 1995 to December 2000 (n = 296). For the missing observations, we set the price of the product in the store equal to its price in the previous week. This entire selection process reduced the number of observations from around 250,000 for each product to 38,776, a panel corresponding to 131 food stores over a period of 296 weeks. For the individual stores, information on the corresponding zip code (exact regional location), the type of the store (see above for definition), the name of the store, and the company that owns the store are also available. Our final sample of products consists of fresh beef (braised beef quality without bones), liver sausage (from calves, thin cut, packed in gold skin), fresh pork steak ("Schnitzel" without bones), fresh turkey breast steak (without skin and bones), apples (Golden Delicious, size 70 to 80 mm in cross section), pears (table pears of different sort), citrons (regular quality), lettuce (ice salad), carrots (without foliage), onions (regular quality of typical sort). Prices are reported in German pennies per kilogram, except for lettice and citrons (lemons) for which prices are reported in pennies per piece. The stores in our final sample are summarized in Table 1 by store type and company symbol. The real names of the companies have been suppressed and replaced by alphabetical letters to preserve confidentiality.[10] <Insert Table 1 about here> The data set consists of a complete panel of retail prices for ten basic food items in 131 retail stores that have been collected continuously on a weekly basis from 1995 to 2000. In Figure 1 average prices over all stores (m = 131) are shown for the entire period of observation to indicate the common price dynamics. <Insert Figure 1 about here> The average prices change from week to week, and the volatility around the deterministic components are much bigger for meat products than for fruits and vegetables. To what extent is the price structure at particular retail stores represented by these averages? In perfect markets, the law of one price would imply that the properties of the average series would be reflected in the properties of individual prices. In Table 2 average prices over the entire period of observation and three measures of variation are presented. The figures in the first row for each product in Table 2 show that average prices vary significantly between store types and between retailer chains. <Insert Table 2 about here> For each of the ten product markets, we observe significant differences in average prices across store types. Pork, for instance, is on average about 3.6 German Marks or 25 % cheaper at CSM or DC compared to SSM. Although the absolute differences decline for products of lower value, such as fruits and vegetables, relative deviations between store types occur to be at similar levels for most products. In sum, CSM and DC store types report the lowest price level compared to SSM and BSM store types. For meat products, CSM and DC are the cheapest store types, while fruits and vegetable prices are always the lowest at DC followed by CSM. SSM are the most expensive venue for meat products, and BSM report the highest average price level in fruits and vegetables. Within store type variation is substantial on a product basis and differences in average price between clusters composed of all stores (types and retail companies) are statistically significant, in general.[11] In 80 % of all cases the average price for the cluster is was found to be significantly different from the average price over all stores. As for store types, we observe large differences in average price levels of the various retail chains. Chain E and F are found to be the cheapest supplier for nearly all products. Chain D is (with the exception of citrons) always the most expensive chain. The result for the retailer companies E and F might partly be related to the fact that E and F include a high percentage of CSM; however, as almost half of the stores of chain D do also

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10 Because of the small number of observations in some cases we have to be cautious with some conclusions. For instance, with respect to DI and retail chains D and F.

11 Total variation is measured by the standard deviation of all observations in the respective cluster.

belong to CSM, the latter conclusion has to be interpreted with caution. These differences in most cases are statistically significant. Even though the grouping of retail stores leads to significant differences in average price levels between groups, the variation within each group still is substantial (often at the same level as for the total sample). The second row of Table 2 reports the standard deviation of prices. For instance, the standard deviation of beef prices for the store types is between 239 and 444 German pennies per kg, the overall standard deviation is 299 German pennies per kg. Thus, the clustering by store types does not substantially reduce the within group variation, meaning prices seem to vary as much within cluster as they do in the entire sample. The reduction in variation by clustering in the case of beef is 11 %. For the other products the cluster effect is between 2 % and 11 %. The reduction is higher for meat products compared to fruits and vegetables. Interestingly, the clustering by retailer companies indicates an even lower reduction in the within group variation even though the number of clusters is increased by 2. In relative terms the standard deviation is between 20 to 30 % of the corresponding average price level for all products. Even though some variation in this relative measure can be observed, no systematic relationship with respect to either the type of the store, the retailer chain, or the product type was found in the sample.

4. Empirical results

To begin, a measure of retail sales is defined. Given that available data contains no indication of whether prices are sale prices, we define an indicator of "sale" status of a price when the current price level is a significant, though temporary reductions in past price level. It would be of interest to require such changes to be independent of cost changes; however, cost information is not available in our sample.[12] As a criterion for identifying a significant price reduction, we set a standard of downward price changes that exceed 20 %.[13] As an indicator of whether the price change is related to cost changes we define "sale" prices as those that deviate from price dynamics that are common across products by more than 20 %. To empirically identify prices that are consistent with this definition of sales prices, the following procedure was implemented. First unweighted average prices are calculated for each food item (see Figure 1). For most products, these series indicate a high correlation with a wholesale price series that reflects underlying cost dynamics.[14] Thus, each food price time series is compared to an average price series adjusted for the deviation between its own and the mean of the individual time series. Whenever the price of the individual time series is 20 % below the adjusted average series, then this price is to be considered as a sale's price. This procedure is used to differentiate sales prices from those associated with persistent, low price strategies. Clearly, our approach is compromised when sales between shops are highly synchronized for a particular food product.[15] Nonetheless, our approach avoids errors associated with use of shop announcement of sales, given that such announcements are often associated with reduced prices.

Based on our criterion for defining sales, Figure 2 presents the share of products that are on put sale in each week for all shops and for SSM and BSM only. On average over the entire

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12 Hosken and Reiffen (2001) circumvent the problem by implicitly judging every downward price change as a sale and every upward price change as the return to the normal price.

13 We have also tested the robustness of results by varying this margin, for instance using also a 10 % and a 30 % threshold. The general conclusions are similar for these variations, detailed results can be obtained from the authors.

14 Another interpretation is that this measure indicates a sale when a shop offers the product for a price that is significantly lower than the price at competing shops. Store specific differences, for instance, in service or convenience are considered by adjusting the average prices to the store specific mean price.

15 Considering the low correlation between prices, between price changes, and between sales, we do not see this to be a problem fort he actual data set (see Loy and Weiss, 2003). This is confirmed by the results from the study by Pesendorfer (2000).

period about 17 % of the 10 food items under study are put on sale, which roughly means 2 out of ten products. This share does not vary substantially over time. Further, sales are focused temporarily in single or particular weeks, but appear to be spread almost equally across time. Even though the aggregate series across all store types shows some slight temporal autocorrelation, it is likely insignificant from an economic point of view. The uniform distribution of sales across time also suggests that at this level of aggregation we do not find synchronisation of promotional measures between shops.[16] This feature also occurs for store type aggregates (see the graphs for SSM and BSM in Figure 2). In addition, these store type aggregate series are not found to be significantly correlated across store type. Only SSM and BSM, and BSM and CSM store types are found to some correlation (0.15). When the indicator of sales is compared across different product categories, no systematic differences are found. An exception is that for fruits and vegetables some correlation of sales across store type is found. On average sales occur a little more frequent in BSM and CSM store types. In conclusion, our indicator of sales suggests that sales are not coordinated across stores or correlated across time. Instead, we find that a significant number of sales occur each week. The number of sales does not differ across products and differs only slightly across store types. <Insert Figure 2 about here> Next, we examine the impact of sales on the expenditures of consumers. Of interest is whether sales reduce consumer expenditures. To proceed, we compute average per capita expenditures for the basket of food products examined in the sample. Because price changes for high value goods are larger in magnitude, we distinguish sales for meats from those for fruits and vegetables. Further, we consider the wholesale price paid for the product to affect the retail price and thereby the expenditures.[17] To construct the average per capita expenditures or the retail price index, we use the average per capita consumption data for Germany for the product categories under study.[18] For each store, the weighted retail price index is a calculated as: $p_t^I = \sum_{i=1}^{9} p_t^i q^i$.[19] The same operation is employed to calculate a store level wholesale price index that is interpreted as a measure of costs faced by the store for the product. Because of seasonal variations in the prices of fruits we also incorporate monthly seasonal dummies in the model specification. To summarize, we hypothesize the following model: $p_t^{RTI} = \alpha_0 + \alpha_1 p_t^{WPI} + \alpha_2 S_t^M + \alpha_3 S_t^{F\&V} + \sum \beta_j D_t^j + \varepsilon_t$. The left-hand side variable is the retail price index. The right-hand side variables by order of appearance are the wholesale price index, the number of sales for meats, the number of sales for fruits and vegetables, and a set of seasonal monthly dummies. We assume these variables to be exogenous determinants of the retail price. As price changes and very likely thereby sales have a much higher impact in the case of meats compared to fruits and vegetables, we did not aggregate the number of sales over all products. We estimate this model for independently for each store type (SSM, BSM, CSM, DC).[20] To

[16] The standard deviation of the share of sales can be employed to measure the extent of synchronisation. An increase of the standard deviation indicates a higher synchronization. However, if we compare the measure for different aggregates (groups of stores) we have to consider the number of observations between aggregates. As the measure has a tendency to decline with the number of observations.

[17] As we assume the quantities to be fixed we expect a direct impact on the expenditures. In this view we could also define our measure of expenditures as a particular type of price index.

[18] While for items such as lettuce this measure might be very close to the actual quantities bought of that item, other products such as beef are consumed through many other items but fresh beef of steak quality. For instance, fresh beef of other qualities, packed beef, etc.

[19] We use here only 9 of the ten food items as for sausages neither an average per capita consumption measure nor a wholesale price could be found.

[20] We expect at least for the level of the price index (expenditures) differences between the store types, as DC are generally much cheaper than e.g. BSM. To test for these or other potential deviations in the

proceed, we consider the time series properties. In all cases, the price indices are nonstationary of first order while the sales indicator series are stationary. Based on these results, we examine cointegration and estimate an error correction model (ECM) specification to test the impact of the number of sales. Alternatively, we could use the Johansen (1995) procedure. However, as we are primarily interested in the impact of the number of sales, a stationary series, the associated parameters can be consistently estimated and tested in the ECM model, stated as follows:

$$dp_t^{RTI} = \alpha_0 + \gamma_1 p_{t-1}^{RTI} + \alpha_1 p_{t-1}^{WPI} + \sum \gamma_{m+2} dp_{t-m-1}^{RTI} + \alpha_{m+2} dp_{t-m}^{WPI} + \sum \theta_k S_{t-k}^{M} + \psi_k S_{t-k}^{F\&V} + \sum \beta_j D_t^j + \varepsilon_t$$

This specification is estimated for each store type aggregate series. Thus, average prices and average number of sales for each store type are used. The wholesale price index is the same across store type. The dynamic specification (number of lags) is determined by extending the lag until the residual series is interpretable as white noise. We start with one lag and increase the number of lags symmetrically for all variables until autocorrelation is rejected at the 95 % significance level. Other specification tests, such as ARCH, heteroscedasticity, normality and functional form tests led to rejection of the null hypothesis suggesting that estimated residuals are consistent with white noise processes (see Table 3). Finally, we examined the existence of a short-run dynamic impact of sales by employing a Wald test. R-squares of the models range from 0.64 to 0.73. The number of sales has a significant negative impact on the per capita expenditures in each store type. However, this contemporaneous effect of the sale on expenditure is found to be partly or completely offset by lagged positive effects, suggesting that following a sale, expenditures increase. In the case of meats in BSM and DC the expenditure reduction by sales was not entirely offset; however the effect of sales was significantly reduced. Sales in meats have the biggest impact which ranges from 3.6 for BSM to 1.69 German Mark for DC. Most of this reduction in expenditures is set off by price increases in the weeks following the occurrence of sales. Thus, the long-term impact ranges from 11 to 60 pennies. A significant impact is resulted only for BSM and DC. Sales for fruits and vegetables have a far lower impact which is not significant for all store types. Recall that the absence of correlation in the sales series across products suggested that cross-product price strategies are not followed (e.g. loss leader strategies where a sale product is discounted while other product prices are increased). However, results do indicate that intertemporal, product specific strategies are used such that price discounts are followed by price increases. <Insert Table 4 about here>

5. Conclusions

Various models have been proposed in the literature to explain the use of promotional measures such as simple sales prices. However, most approaches do not fit to the specific conditions in the market for fresh foods. The most promising concepts are the Varian model and the loss leader hypotheses. For these theories, we test the essential hypotheses for a unique data set for the German food retail market in the period from 1995 to 2000. The data consist of weekly retail prices for ten fresh food items (meats, fruits, and vegetables) in 131 grocery stores. We find that pricing strategies indicate a low level of coordination between stores. Sales are an important promotional measure that indicates the competitive market structure in this market as predicted by the Varian model. However, the static impact of sales is often offset by dynamic price increases. Thus, customers who are attracted by store sales prices and choose the store also in the periods following the sales suffer from increased prices.

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parameters, a panel estimation would be preferable. Because of time series properties and the extended time component (296 weeks), the panel estimation and testing is not a standard routine. Thus, we start with an unrestricted dynamic single equation approach for each store type that considers the non-stationarity of the data.

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Figures and Tables

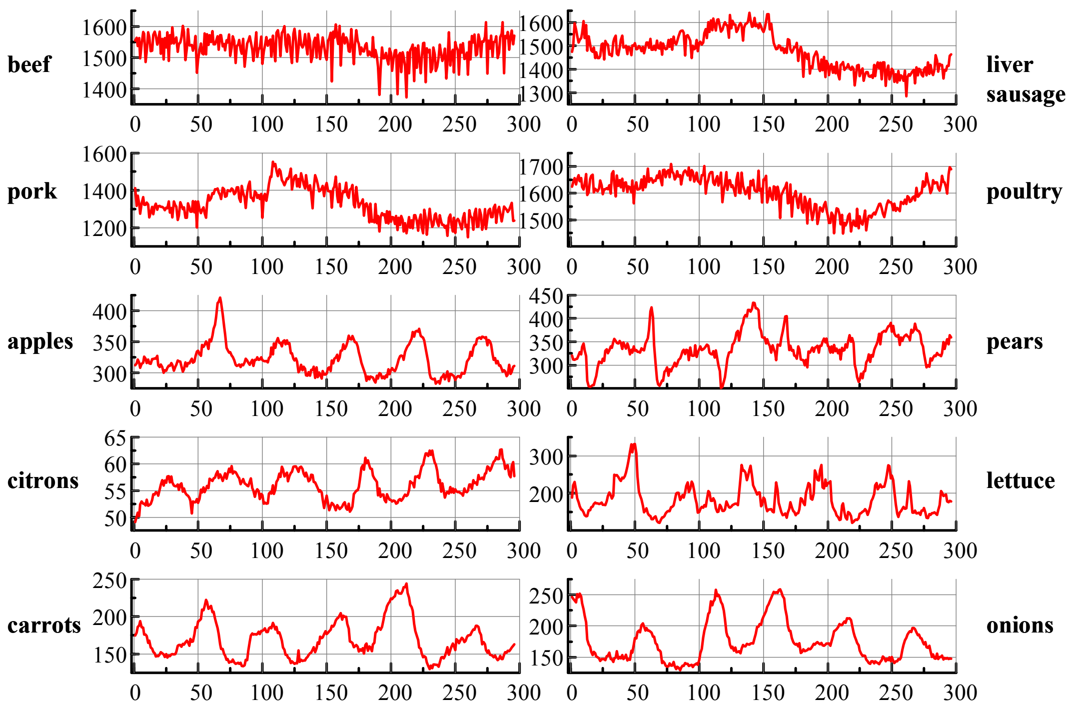
Tab. 1: Selection of store types and retailer companies in the sample

	Total	Retailer company A	B	C	D	E	F	Other
SSM	16	5	7	2	1	0	0	1
BSM	43	12	5	11	3	4	0	8
CSM	68	7	4	12	5	20	6	14
DC	4	0	2	0	2	0	0	0
Total	131	24	18	25	11	24	6	23

Notes: SSM: Small supermarkets, BSM: Big supermarkets, CSM: Combined supermarkets, DC: Discounter. A to F: Different retailer companies, such as Edeka or Spar group.

Source: Data by ZMP, 2001.

Fig. 1: Weekly average food retail prices in Germany from 1995 to 2000



Legend: All prices in German pennies per kg, except the prices of lettuce and citrons which are quoted in German pennies per piece.

Source: Data by ZMP, 2001.

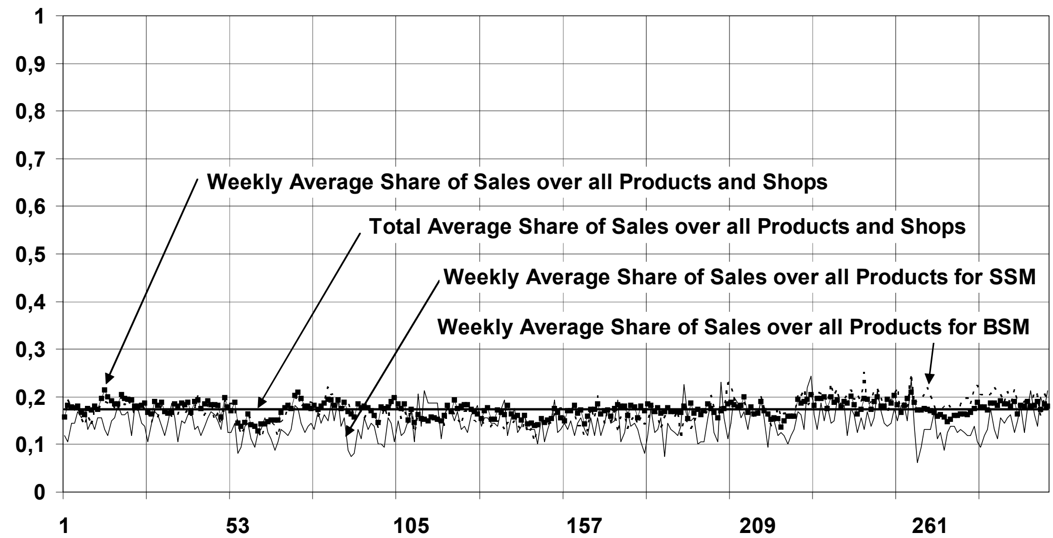
Tab. 2: Average and variation of food retail prices in Germany

			Store type				Retailer company					
		All	SSM	BSM	CSM	DC	A	B	C	D	E	F
Beef	**Mean**	1531	1662	1634	1439	1482	1581	1582	1513	1726	1421	1333
	Stdv.	299	239	285	277	444	276	317	238	289	291	206
Liver sausage	**Mean**	1477	1684	1564	1376	1428	1505	1584	1574	1443	1293	1212
	Stdv.	456	427	416	458	480	484	426	411	467	428	393
Pork	**Mean**	1323	1529	1437	1211	1171	1366	1419	1303	1504	1150	950
	Stdv.	387	372	358	365	399	401	370	349	421	321	230
Poultry	**Mean**	1602	1700	1679	1539	1435	1601	1644	1628	1710	1516	1441
	Stdv.	306	305	281	298	364	320	307	302	292	284	238
Apples	**Mean**	322	309	341	315	297	305	326	333	347	315	299
	Stdv.	67	66	68	64	56	68	71	63	69	57	44
Pears	**Mean**	335	329	351	327	309	326	341	331	354	329	322
	Stdv.	74	71	77	73	58	75	70	72	77	71	68
Citrons	**Mean**	56	55	59	55	36	58	55	56	52	55	57
	Stdv.	17	14	19	16	7	19	17	18	13	16	14
Lettuce	**Mean**	183	181	194	179	162	183	186	179	194	181	167
	Stdv.	59	54	61	58	46	60	57	56	62	56	57
Carrots	**Mean**	169	174	180	163	141	168	171	172	182	165	152
	Stdv.	51	45	55	49	42	56	52	50	58	43	44
Onions	**Mean**	176	179	195	165	137	174	183	179	197	164	129
	Stdv.	64	65	63	61	57	64	67	58	60	58	58

Legend: All prices in German pennies per kg, except the prices of lettuce and citrons which are quoted in German pennies per piece.

Source: Data by ZMP, 2001.

Fig. 2: Total and weekly share of sales over all products



Legend: Share of products (total of 10 food items) that are on sale based on the definition in the text.

Source: Data by ZMP, 2001.

Tab. 3: Estimation results for the relationship between the retail price index (per capita expenditures) and the number of sales

Endogenous n=289	Price Index SSM Coefficient	t-value	Price Index BSM Coefficient	t-value	Price Index CSM Coefficient	t-value	Price Index DC Coefficient	t-value
dPRT_1	-0,40	*-4,22*	-0,53	*-7,31*	-0,68	*-10,50*	-0,51	*-6,38*
dPRT_2	-0,43	*-4,84*	-0,45	*-6,24*	-0,62	*-8,86*	-0,30	*-3,85*
dPRT_3	-0,15	*-1,97*	-0,28	*-4,35*	-0,44	*-6,71*	-0,34	*-4,70*
dPRT_4	0,01	*0,16*	-0,07	*-1,55*	-0,11	*-2,40*	-0,14	*-2,59*
Constant	1087,11	*4,56*	560,65	*3,27*	164,31	*1,69*	696,70	*4,10*
PRT_1	-0,47	*-4,95*	-0,25	*-4,26*	-0,18	*-3,99*	-0,39	*-4,99*
PWS_1	0,32	*4,17*	0,22	*4,23*	0,26	*3,63*	0,27	*3,57*
dPWS	0,22	*0,75*	-0,14	*-0,76*	0,17	*0,96*	-0,02	*-0,06*
dPWS_1	-0,53	*-1,68*	-0,19	*-0,94*	-0,25	*-1,22*	0,10	*0,29*
dPWS_2	0,15	*0,48*	-0,23	*-1,16*	0,06	*0,30*	-0,26	*-0,73*
dPWS_3	-0,75	*-2,41*	0,11	*0,56*	0,03	*0,16*	-0,35	*-0,97*
dPWS_4	0,41	*1,33*	-0,01	*-0,07*	0,05	*0,26*	-0,31	*-0,88*
SM	-306,58	*-11,60*	-359,72	*-14,20*	-323,33	*-12,50*	-168,77	*-10,00*
SM_1	105,09	*3,19*	96,79	*2,90*	89,93	*2,80*	12,44	*0,63*
SM_2	27,69	*0,84*	39,93	*1,17*	37,52	*1,17*	5,90	*0,30*
SM_3	60,65	*1,85*	50,15	*1,48*	68,61	*2,14*	-18,72	*-0,94*
SM_4	4,78	*0,15*	49,11	*1,43*	94,20	*2,93*	28,56	*1,46*
SF&V	-35,95	*-1,92*	-42,25	*-2,13*	-1,17	*-0,05*	-11,74	*-0,97*
SF&V_1	36,99	*1,84*	-12,43	*-0,61*	-30,30	*-1,27*	-10,15	*-0,82*
SF&V_2	-5,58	*-0,28*	10,61	*0,51*	41,21	*1,71*	-16,96	*-1,38*
SF&V_3	-2,61	*-0,13*	-18,53	*-0,90*	-31,31	*-1,30*	13,17	*1,09*
SF&V_4	6,66	*0,35*	37,18	*1,91*	31,73	*1,44*	6,88	*0,57*
R^2	0,73	-	0,71	-	0,73	-	0,64	-
DW	2,01	-	1,99	-	2,08	-	2,05	-
AR2: F(2,254)=	0,65	*[0,52]*	1,81	*[0,17]*	2,95	*[0,05]*	2,33	*[0,10]*
ARCH1: F(1,254)=	2,11	*[0,15]*	0,00	*[0,99]*	1,00	*[0,32]*	0,17	*[0,68]*
Normality: Chi^2(2)=	2,40	*[0,30]*	5,36	*[0,07]*	9,71	*[0,01]***	31,93	*[0,00]***
Heterosk.: F(53,202)=	0,84	*[0,77]*	0,90	*[0,67]*	0,77	*[0,87]*	1,08	*[0,35]*
Reset: F(1,255)=	0,57	*[0,45]*	2,10	*[0,15]*	0,80	*[0,37]*	0,07	*[0,79]*
ΣSM=0: Chi^2(1)=	2,86	*[0,09]*	6,17	*[0,01]**	0,47	*[0,50]*	15,43	*[0,00]***
ΣSF&V=0: Chi^2(1)=	0,00	*[0,99]*	0,94	*[0,33]*	0,19	*[0,66]*	1,12	*[0,29]*

Legend: Calculations are run with Ox 3.0 and PcGive 10.0 (Doornik and Hendry, 2001). Estimates for the seasonal components are not documented here.

Source: Data by ZMP, 2001.