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Price Variability or Rigidity in the Food-retailing Sector? Theoretical Analysis and Evidence from German Scanner Data*

by

Roland Herrmann** and Anke Möser**

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Abstract

In many industrialized countries, the grocery-retailing sector exhibits a strong and increasing market concentration. Hence, it is important to understand retail pricing for many questions related to market power in the marketing chain and to agricultural and food policies. We analyze intertemporal pricing of grocery retailers in Germany with a large set of scanner data for processed foods. In theory, food prices could be rather variable, e.g. due to fluctuating commodity prices in a competitive world, or rather rigid, e.g. due to price adjustment costs. We elaborate that retail sales are crucial and raise food price variability at the points of sale. Despite this, prices are rather rigid and often do not change for many weeks. Moreover, pricing strategies for identical brands vary strongly across retailers. Retailers seem to have differential pricing strategies and, thus, market power. This casts substantial doubt on the assumption of a competitive price transmission in the marketing channel underlying most analyses in agricultural economics.

Keywords: Grocery retailing sector, pricing patterns, sales, price rigidity, scanner data.

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** Prof. Dr. Roland Herrmann and Dr. Anke Möser, Institute of Agricultural Policy and Market Research, University of Giessen, Senckenbergstr. 3, D-35390 Giessen, Germany.
Roland.Herrmann@agrar.uni-giessen.de

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1 INTRODUCTION

Within the marketing chain for food products, large grocery retailers play an important and increasing role. In the U.S., e.g., a major structural change took place in the 1990s with a wave of mergers, acquisitions and new entries in particular by the discount retailer Wal-Mart (FRANKLIN, 2001). Although the national market share of the four leading U.S. retailers appears to be relatively low with 28 %, it is much higher at the regional level with an average of about 70 % for the 100 largest metropolitan areas. In Europe, concentration in the food-retailing sector is typically higher at the national level than in the U.S. In the mid-1990s, the market shares for the largest five food retailers amounted to 75 % in Germany and to 67 % in France and the United Kingdom (MCCORRISTON, 2002). In general, these concentration ratios have increased over time.

Given this background, it is often argued that the market power of large chains of grocery retailers has strongly increased as opposed to food manufacturers. Consequently, buyer power of food retailers is a major issue of antitrust policy in the EU and the member states. Likewise, the retailers' pricing strategies are observed by antitrust authorities with great interest under the existing policies against cartels and price discrimination. Moreover, merger control is important in the food-retailing sector as it is in many other sectors (BUCCIROSSI, MARETTE and SCHIAVINA, 2002).

Despite the importance of grocery retailers' market behaviour for market performance and the great interest of antitrust policy in this behaviour, detailed analyses of retailers' pricing behaviour by agricultural economists appeared only recently. There is a dominance of two other branches of the literature in this field. On the one hand, there is an ongoing interest of marketing research in the optimal product line pricing of multiproduct firms like grocery retailers (LITTLE and SHAPIRO, 1980; REIBSTEIN and GATIGNON, 1984; SOBEL, 1984; SIMON, 1992). It is derived there that varying sales with lead products are a major component of successful pricing policy.¹ The existence and variation of specials suggest that price variability is prominent in grocery retailing. On the other hand, comprehensive price analyses for foods and other consumer goods have been a core element of the microeco-

¹

Of course, this implies that there is a strong reaction of consumer demand to varying prices at the point of sale. This has been shown in a number of empirical demand studies mostly on the basis of scanner data (CAPPS, 1989; HOCH et al., 1995; SCHÄFER, 1997; MÖSER, 2002). In most cases, price elasticities of food demand above unity in absolute terms were computed.

conomic foundation of macroeconomics (CARLTON, 1986; BLINDER et al., 1998; KÖHLER, 1996). Keynesian hypotheses of price rigidity, e.g. due to adjustment costs or coordination failure, are stressed. Several empirical studies, based on surveys or econometrics, confirm the importance of price rigidity (BLINDER et al., 1998; LEVY et al., 1997; LACH and TSIDDON, 1996; SLADE, 1998).

Given the existence of plausible hypotheses for both variable and rigid prices, we will analyze here whether consumer prices of processed foods are variable or rigid and how this evidence can be explained. A rich set of German scanner data is exploited for a selection of national food brands.

The paper is organized as follows. The theoretical basis for variable as opposed to rigid food prices is illustrated first. Then, the data set is described and the empirical findings are presented. In the last section, results are summarized, economic conclusions are drawn, and suggestions for future research are given.

2 THEORETICAL ANALYSIS

Major theoretical approaches to explain variable or rigid food prices are (i) the theory of pricing in multiproduct firms and (ii) theories of price rigidity. Both approaches are briefly surveyed and their relevance for our question is discussed in this section.

2.1 Price Theory of the Multiproduct Firm – Theoretical Arguments for Potentially Variable Prices

The theory of pricing in a multiproduct firm typically explains optimal levels of prices in a comparative static framework. Interpreted dynamically with changes in marginal costs and demand, it can serve, however, mainly as an explanation for variable prices over time.

What is the optimum pricing rule of a profit-maximizing multiproduct firm that offers i ($=1, \dots, n$) goods? The prices (p) of all goods have to be considered in the demand (q) for each of i goods:

$$q_i = q_i(p_1, \dots, p_n). \quad (1)$$

Profits (π) of the multiproduct firm are defined as

$$\pi = p_1 q_1 + \dots + p_n q_n - C_1(q_1) - \dots - C_n(q_n) \rightarrow \text{Max!}, \quad (2)$$

where C denotes costs. By introducing (1) into (2), the first-order condition for the profit maximizing price of one of the goods, say j , can be derived:

$$\frac{\partial \pi}{\partial p_j} = q_j + \left(p_j - \frac{\partial C_j}{\partial q_j} \right) \cdot \frac{\partial q_j}{\partial p_j} + \sum_{\substack{i=1 \\ j \neq i}}^n \left(p_i - \frac{\partial C_i}{\partial q_i} \right) \frac{\partial q_i}{\partial p_j} = 0 \quad (3)$$

By rearranging (3), we get the optimal prices of the individual product j as a function of elasticities:

$$p_j^* = \frac{\varepsilon_{jj}}{(1 + \varepsilon_{jj})} \cdot C_j' - \sum_{\substack{i=1 \\ j \neq i}}^n (p_i - C_i') \cdot \frac{\varepsilon_{ij} q_i}{(1 + \varepsilon_{jj}) q_j} \quad (4)$$

C_j' stands for marginal costs, ε_{jj} for the own price elasticity of demand for product j , and ε_{ij} is the cross-price elasticity of demand for product i with regard to the price of product j . Apparently, all cross-price elasticities of demand and the own price elasticities of demand as well as marginal costs of all products affect the optimal pricing strategy of the multiproduct firm (SELTEN, 1970, p. 48; LITTLE and SHAPIRO, 1980; REIBSTEIN and GATIGNON, 1984).

A special case of equation (4) is the optimal price of the single-product monopoly:

$$p_j^* = \left(\varepsilon_{jj} / (1 + \varepsilon_{jj}) \right) \cdot C_j'. \quad (5)$$

No substitutive or complementary relationships to other goods do exist under equation (5). Strong differences between (4) and (5) may occur for a product if the cross-price elasticities of demand are not zero. Complementary (substitutive) relationships to other products

drive the optimal price downward (upward) compared to the single-product monopoly. In the first case, e.g. it may be attractive for grocery retailers to offer so-called “loss leaders” even below marginal costs. Loss leaders are products that are strongly complementary in demand with other products and when priced attractively, provide incentives for one-stop shopping at the respective store. However, such low-price strategies below marginal costs are not in all European countries legal.²

Equation (4) is an optimal pricing rule for a certain point of time, i.e. static. However, if the coefficients of (4) were known for each point of time, a dynamic pattern of price formation could be derived. In a dynamic interpretation of (4), it is clear that variations of prices might be optimal due to (i) changes in demand and (ii) changes in marginal costs. Changes in demand would affect the difference between price and marginal costs in (4) and/or the price elasticities. Changes in marginal costs would affect C' directly.

There are some determinants of food prices which are particularly important as causes of price changes. On the demand side, three determinants seem most relevant. First, the demand function shifts within a year due to seasonal influences. Second, marketing activities by competitors shift the demand curve for own products to the left and put pressure on suppliers to react by measures of price and quality competition. Most important strategies are periodic and changing retail sales (HOSKEN and REIFFEN, 2001). Third, a large number of product innovations in the food industry (CONNOR and SCHIEK, 1997) changes demand for “old” products over time and leads to changing optimal prices over time.

On the cost side, changing input prices will often occur and induce changing marginal costs. A second important factor is caused by market power in the marketing chain. With an increasing concentration in the food-retailing sector, retailers are often in a position to demand slotting allowances or product subsidies from food manufacturers. Typically, the subsidies are infrequent and irregular, reduce marginal costs and give rise to optimal price changes according to equation (4).

We can summarize that changes in demand and marginal costs will change optimal prices in a situation of monopolistic competition. Therefore, these changes in market conditions favour variable prices in food retailing over time.

² According to German competition law, e.g., it is prohibited to set retail prices continuously below a product's input price. Such prices, called “Untereinstandspreise”, are only allowed in the short run during sales.

2.2 Macroeconomic Theories of Price Rigidity

The price theory of the multiproduct firm as shown above has ignored major arguments that are stressed in the macroeconomic theories of price rigidity (BLINDER et al., 1998). One of these major arguments is that price changes cause adjustment costs. For grocery retailers, such adjustment costs may be high as 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 the direct costs of printing new leaflets or repricing at the shelf. These costs are known as menu costs.

The optimal decision rule for individual products has been derived formally by SHESHINSKI and WEISS (1977). Price changes will be realised when the additional gains are higher than price adjustment costs. Analytically, price adjustment costs would enter into equation (3) for the multiproduct firm.

It is very clear that price adjustment costs do exist. Controversial is the functional form. Proponents of the menu-cost approach argue that adjustment costs are fixed, i.e. independent of the degree of price adjustment (MANKIW, 1985). An opposite hypothesis was formulated by ROTEMBERG (1982) and is known as the theory of convex price adjustment. ROTEMBERG argues that high price increases damage the reputation of a firm, antagonize consumers and induce the convex functional form of price adjustment. It is important for a quantitative analysis that the menu-cost hypothesis would be supported by rather long periods of rigid prices with few and large price changes. Gradual and small price changes would be consistent with the theory of convex price adjustment. Empirical studies have recently provided some support for the menu-cost hypothesis in the retailing sector (LACH and TSIDDON, 1996; LEVY et al., 1997; SLADE, 1998).

3 THE SCANNER DATA

The quantitative analysis is based on a commercially available scanner data set provided by MADAKOM GmbH (MADAKOM, 1999a). It captures scanner data from the German food-retailing sector for 144 weeks, i.e. the period from September 30, 1996, to June 28, 1999. Four types of retailing firms were selected for this study: (i) large consumer markets (1,500 to 5,000 m²/sales area); (ii) small consumer markets (800 to 1,499 m² area); (iii) supermarkets (400 to 799 m²) and (iv) discounters. A further selection criterion was that data were available for 100 consecutive weeks. 38 stores remained in the sample after applying this criterion as well as the rule that the regional distribution of stores should approximately picture the structure of the German food-retailing sector. Data for seven retailing companies were included, and the selection of products covers breakfast products in the broadest sense.

The individual articles could be identified with their EAN codes³ and comprehensive information was available on the items. This information includes the quantity sold, the product price, the name of the product and the package size. Information on promotion activities at the point of sale were available as well as a variable accounting for price discounts. Sales are measured as those prices which remain for four weeks or less by at least five percent below the normal price. After more than four weeks, such low prices are counted as normal price (MADAKOM, 1999b). It has to be borne in mind that the panel data represent a pure retailers' panel and, thus, sociodemographic variables of consumers are not included.

4 EMPIRICAL EVIDENCE

The theoretical analysis has shown alternative approaches that might explain either flexible or sticky prices. Branches of the literature that stress the high variability of food prices

³ EAN codes contain 13 or 8 numbers which are printed on the product and they contain an identification of the manufacturer and the details of the product.

have typically relied on the empirical measurement of instability in economic time series. Therefore, we will present first the price variability of 20 national brands of breakfast products at the point of sale on the basis of the scanner data set described above. Theories of price rigidity have been typically confronted in empirical studies with special indicators of stickiness. Price rigidity will be measured here in the second empirical part for four selected brands in more detail. It will be shown in both parts how pricing strategies of grocery retailers affect the results.

4.1 The Variability of Grocery-Retailers' Prices and the Special Importance of Sales

Table 1 shows the empirical results on price variability for the 20 food brands across stores and over time for six grocery-retailing firms. Additional background information is provided in Appendix 1 where mean prices in the various retail chains are summarized.

If we look at Appendix 1 first, it is interesting to note that mean prices for the products clearly vary across the retail chains. Apparently, the law of one price does not hold for identical products across stores. On average, grocery retailers *B* and *C* are the cheapest suppliers and retailer *F* the most expensive one. In particular for individual brands, cross-store price differences are high. Dallmayr Prodomo, Rama, and Müllermilch Schoko, three leading brands on the coffee, margarine and flavoured milk markets respectively, are cases in point. In each of these cases, the average price charged by the retailing chain *B* is about 10 % below that of retailing chain *A*.

Table 1 reveals that the instability of prices at the point of sale is rather low compared with the magnitude of price instability known from agricultural commodity markets. The trend-corrected coefficients of variation rank between zero and 7.99 % and the unweighted mean is 3.05 %. Again, there are some differences between the six grocery-retailing firms. It is striking that the top-three include the grocery retailers with the lowest price level, i.e. chains *B* and *C*, as well as the chain with the highest price level (*F*). Apparently, a higher variability of store prices over time may be associated with a low-price as well as a high-price strategy.

Exactly these three grocery retailers, which reveal the highest price variability over time, are clearly leading in terms of the number of price actions. If we consider an unweighted

mean of the price actions for those 18 brands distributed in all chains, the mean number of sales per brand in the period of analysis is highest for retailer *B* (96.1), followed by *F* (49.2) and *C* (43.8). This strongly suggests that the impact of price specials is important for the variability of store prices over time.

We tested this hypothesis, i.e. retail sales drive price variability, more formally. When the results for the 18 brands are pooled, the following regression result occurs:

$$\hat{v}^* = 2.4781^{***} + 0.0168^{***} PA \quad (6)$$

(12.04) (4.87)

($\bar{R}^2 = 0.18$; $F = 23.70^{***}$; $n = 108$)

The variables are defined as in Table 1 and the statistical indicators as in Table 2.

Table 1: Variability of Consumer Prices and Number of Specials for 20 Brands of Breakfast Products in Six Grocery-Retailing Firms in Germany, Weekly Prices, 1996-99^{a)}

Products	Grocery-Retailing Firms											
	A		B		C		D		E		F	
	v*	PA	v*	PA	v*	PA	v*	PA	v*	PA	v*	PA
Bärenmarke "Feine 12", 170g	1.62	1	1.46	5	0.50	4	n.d. ^{b)}	n.d. ^{b)}	2.05	0	1.46	11
Bärenmarke Kaffeeraum 8%, 170g	2.27	8	2.39	86	4.10	57	6.96	43	2.87	0	2.57	67
Coppenrath & Wiese Unsere Goldstücke 9 St. (450g)	1.16	5	2.66	39	3.17	90	3.83	30	1.05	0	4.52	41
Dallmayr Prodomo, 500g	5.12	27	7.38	282	6.85	81	6.11	62	7.99	23	5.68	97
Danone Actimel Drink Classic, 4x100g	2.63	2	3.64	68	5.25	52	3.01	12	5.10	15	3.54	33
Golden Toast Butter Toast, 500g	7.58	41	2.63	36	6.16	64	1.21	7	6.72	13	4.93	120
Golden Toast Sonntagsbrötchen, 8 St.	2.57	11	1.51	4	3.05	25	0.50	0	2.92	5	4.79	26
Jacobs Café Zauber Cappuccino, 200g plus 10g Milkschokolade	0.90	4	3.16	103	2.92	47	3.58	64	2.14	18	2.41	51
Kellogg's Cornflakes, 375g	4.53	21	3.31	51	5.04	23	3.46	44	3.85	14	6.27	77
Kerrygold Original Irische Butter, 250g	1.81	8	3.85	134	4.46	64	1.32	19	1.30	7	2.62	27
Landliebe Landmilch 3,8%	n.d. ^{b)}	-	1.74	7	2.51	59	0.57	3	n.d. ^{b)}	-	1.21	0
Lieken Urkorn Das Vollkorn-Saftige, 500g	5.09	15	3.60	92	2.32	10	0.62	5	0.51	2	2.74	34
Müllermilch Schoko, 500ml	3.01	21	3.60	103	5.27	67	3.42	55	2.11	21	4.17	51
Nestlé Cini Minis, 375g	0.81	5	3.21	113	2.99	50	2.06	30	3.18	5	1.77	37
Nestlé Nesquik für ein Knusperfrühstück 375g	0.83	5	3.04	110	2.59	49	0.34	2	3.19	6	1.84	32

Table 1: Variability of Consumer Prices and Number of Specials for 20 Brands of Breakfast Products in Six Grocery-Retailing Firms in Germany, Weekly Prices, 1996-99^{a)} (cont.)

Products	Grocery-Retailing Firms											
	A		B		C		D		E		F	
	v*	PA	v*	PA	v*	PA	v*	PA	v*	PA	v*	PA
Nutella, 400g	3.36	14	3.18	160	1.63	12	1.69	38	0.98	0	2.28	40
Rama, 500g	4.50	36	4.55	221	5.04	44	2.43	74	1.50	0	3.23	77
Schwartau Extra Erdbeer-Konfitüre Extra, 450g	2.14	3	1.90	74	2.67	26	1.83	11	1.91	0	1.95	32
Teekanne Teefix, 43,75g	1.31	2	2.65	16	2.75	0	5.36	21	6.96	8	2.12	19
Wasa Schoko Wikinger, 150g	0.91	2	1.55	37	2.18	28	1.34	2	0.00	0	2.03	24
Unweighted mean ^{c)} :	2.81	12.8	3.21	96.1	3.80	43.8	2.72	28.8	3.02	7.61	3.30	49.2

a) v* indicates the coefficient of variation, trend-corrected according to the proposal of CUDDY/DELLA VALLE (1978) and PA stands for the number of price actions in the respective firm. The product sample, the sample period and the included stores are explained in the text.

b) Not distributed.

c) Only those 18 products included which are distributed in all chains.

Source: Authors' computations.

Equation (6) shows that the price variability increased significantly with the number of retail sales. For the cross-section of the 18 brands and six retailing firms, an additional price action caused an increase in the trend-corrected coefficient of variation by 0.017 percentage points. Separate results for the six grocery retailers reveal, however, that the marginal impact of sales on price variability varied strongly across firms. Table 2 summarizes regression coefficients for the different grocery retailers. They rank between 0.016 and 0.179.

Table 2: Marginal Changes in the Trend-corrected Coefficients of Price Variation Due to an Additional Retail Sale^{a)}

Grocery-Retailing Firms	Coefficients	Grocery-Retailing Firms	Coefficients
A	0.1406*** (7.57)	D	0.0479* (2.94)
B	0.0159*** (6.69)	E	0.1788** (3.05)
C	0.0358** (2.96)	F	0.0317** (3.17)

a) An equation like (6) was estimated for the six grocery-retailing firms and the regression coefficients are shown. *** (**, *) indicates the 99.9 %- (99 %-, 95 %-)level of statistical significance and values in parentheses are *t*-values.

Source: Authors' computations.

If we introduce differential effects of price actions on price variability by slope dummies in the regression model, the statistical fit can be clearly improved:

$$\begin{aligned}
 \hat{v}^* = & 1.5631^{***} + 0.0409^{***} \cdot PA + 0.0760^{***} \cdot \text{DUMMY } A \cdot PA \\
 & (7.52) \quad (7.96) \quad (4.03) \\
 & -0.0241^{***} \cdot \text{DUMMY } B \cdot PA + 0.1439^{***} \cdot \text{DUMMY } E \cdot PA \\
 & (-4.84) \quad (4.73) \\
 & (\bar{R}^2 = 0.45; \quad F = 23.06^{***}; \quad n = 108)
 \end{aligned} \tag{7}$$

DUMMY A (DUMMY B, DUMMY E) are dummy variables for the grocery-retailing firms A (B, E) with 1 for the respective firm and 0 otherwise. Equation (7) indicates that the marginal impact of an additional price action on price variability in the reference group,

i.e. firms *C*, *D* and *F*, is a positive one of 0.04 percentage points. The marginal impact is, however, significantly larger in firms *E* and *A*, the chains with a comparatively low number of retail sales. It is significantly smaller in firm *B*, where the number of retail sales is higher than in all other grocery-retailing firms.

4.2 Price Rigidity and the Size of Grocery-Retailers' Price Changes

In this part, price rigidity will be measured and analysed in more detailed for four food brands: Dallmayr Prodomo, 500g; Kellogg's Cornflakes, 375g; Schwartau Extra Erdbeerkonfitüre, 450g; Wasa Schoko Wikinger, 150g. Again, the scanner data set for various outlets of the six grocery-retailing firms in the period 1996-99 is exploited.

Following Powers and Powers (2001), price rigidity is measured as the mean duration of unchanged prices:

$$PRIG = w / w_{PCH} \tag{8}$$

w stands for the number of weekly price observations, w_{PCH} is the number of weeks with price changes.

In a competitive world, where the law of one price holds we would expect a similar price rigidity across stores for one brand⁴. We would expect that changes in marginal costs would affect store prices in similar ways. We would also expect a similar pattern of price rigidity and price changes across brands in all grocery-retailing firms.

Table 3 indicates that these expectations are not at all fulfilled. Price rigidity for all four brands exhibits enormous differences for the six retail chains. For the coffee brand, Dallmayr Prodomo, the mean duration of unchanged prices varies between an average of 2.7 weeks (chain *B*) and 18 weeks (chain *E*). For Kellogg's Cornflakes, it ranges between 7.4 weeks (chain *F*) and 36.6 weeks (chain *A*) and, for Schwartau Erdbeerkonfitüre, even between 4.2 (chain *C*) and 139.3 weeks (chain *E*). For Wasa

⁴ Only differences in transportation and transaction costs, for which we do not have information, could cause deviations from this pattern.

Schoko Wikinger, prices changed every 10 weeks in chain C but chain E did never alter the price.

Table 3: Evidence on Price Rigidity and the Size of Price Changes in Food Stores, Four Brands, Weekly Prices, 1996-99^{a)}

Products	Average Price Rigidity (<i>PRIG</i>) in Six Grocery-Retailing Firms ^{b)}					
	A	B	C	D	E	F
Dallmayr Prodomo, 500g	16.3	2.7	7.2	11.1	18.0	9.3
Kellogg's Cornflakes, 375g	36.6	17.9	17.7	33.6	34.0	7.4
Schwartau Extra Erdbeer-Konfitüre, 450g	19.9	4.5	4.2	18.7	139.3	8.2
Wasa Schoko Wikinger, 150g	123.3	23.1	10.2	82.6	- ^{c)}	17.8
Products	Average Price Changes in Six Grocery-Retailing Firms (DM) ^{b)}					
	A	B	C	D	E	F
Dallmayr Prodomo, 500g	1.16 (1.13)	1.10 (1.29)	1.02 (1.23)	0.91 (1.16)	0.51 (0.94)	1.15 (1.25)
Kellogg's Cornflakes, 375g	0.29 (0.30)	0.51 (0.53)	0.18 (0.18)	0.47 (0.89)	0.23 (0.10)	0.47 (0.48)
Schwartau Extra Erdbeer-Konfitüre, 450g	0.12 (0.11)	0.15 (0.16)	0.15 (0.15)	0.21 (0.12)	- ^{d)} (0.20)	0.19 (0.20)
Wasa Schoko Wikinger, 150g	0.17 (0.07)	0.24 (0.29)	0.25 (0.30)	0.20 (0.13)	- ^{e)} - ^{c)}	0.32 (0.36)

a) The sample period and the included stores are explained in the text. The number of observations differs across the grocery-retailing firms and products.

b) Price rigidity is measured as in equation (8) in the text. The average price changes are measured as absolute changes in DM, separately calculated for price decreases and price increases (the latter ones in parentheses).

c) Not computed as no price changes were observed.

d) Not computed as no price decreases were observed.

e) Not computed as no price increases were observed.

Source: Authors' computations.

If we regard median price rigidity for all four brands in individual grocery-retailing firms, major differences are again visible. Whereas firm *C* changes every 11 weeks a price, chain *E* alters the store prices only every 87 weeks. Overall, this is a confirmation of a great importance of price rigidity at the retail level. Moreover, these enormous differences in price rigidity suggest a strong potential for individual pricing and market power in grocery retailing.

Median price rigidity across grocery retailers is clearly highest for Schoko Wikinger (23.1 weeks), followed by Kellogg's Cornflakes (25.8 weeks), Schwartau Extra Erdbeerkonfitüre (13.5 weeks) and Dallmayr Prodomo (10.2 weeks). Interestingly, this implies that price rigidity is highest for the brand with the lowest number of retail sales and lowest for the brand with the highest number of sales. The importance of a brand for sales seems to be negatively associated with its price rigidity.

Additional computations in Table 3 show the average price decreases and increases of the four brands' prices. Again, these vary strongly by retail chain and brand. The menu-cost hypothesis suggests that the size of price changes becomes higher with a growing price rigidity. When this hypothesis is tested with the pooled data of Table 3 and *PRIG* is differentiated by price increases and decreases, this hypothesis is not confirmed⁵. A higher price rigidity leads to a lower size of price changes. The interpretation has, however, to consider retail sales and the result does not mean that the menu-cost hypothesis is not valid. As price actions do drastically reduce the brand's price, consequential returns to normal price levels will also be high. Different from the analysis of Powers and Powers for lettuce, where sales were not very important, changes in the normal price and changes in the price due to retail sale will have to be differentiated. Tests of the menu-cost hypothesis will have to refer to changes in the normal price.

⁵

A regression equation based on Table 3 and more differentiated price rigidity data yields:

$$PRCHA = 0.5861^{***} - 0.2194 \cdot 10^{-2} ** PRIG \quad (\bar{R}^2 = 0.12; F = 7.44 **)$$

(7.90) (-2.73)

All statistical indicators are used as before and *PRCHA* is the average size of price changes in the individual retailing firms.

5 CONCLUSIONS

Pricing strategies in the food-retailing sector have been widely ignored in the agricultural economics literature for many years. Given the high concentration level in the grocery-retailing sector of industrialized countries, this is not justified. It was the objective of this paper to analyse the dynamic pattern of prices in the food-retailing sector theoretically and empirically. In particular, it was tested whether food prices are variable – like many commodity prices – or relatively rigid – like many sales prices of the manufacturing sector. The following results are striking:

1. With competitive pricing, store prices would be variable under the influence of changes in demand and marginal costs. The empirical analysis of a large scanner data set for 20 food brands in six German grocery-retailing firms revealed that weekly price variability is rather low compared with price variability of agricultural commodities. It increased strongly with the number of retail sales for the respective brand.
2. Consistent with the first result is that price rigidity is in general rather high at the retail level. There are brands where the median duration of unchanged prices is as high as 53 weeks. Again, the number of price actions for brands leads to a lower price rigidity.
3. Price variability as well as price rigidity varies strongly across grocery-retailing firms. Differences are so strong that no consistent pricing pattern for all retail chains can be discovered. This is an indication of market power and the potential to set prices independently of the competitors' behaviour. On a perfectly competitive market, similar price patterns would occur under ceteris-paribus conditions as input costs would affect all retailers in the same way.
4. Retail sales are important for price rigidity and, thus, the frequency of price changes. Price rigidity itself affects the absolute price changes. Therefore, retail sales have to be incorporated when price strategies suggested by macroeconomic hypotheses of price rigidity are tested.

As price strategies of the grocery-retailing firms seem to be heterogeneous and not uniformly linked to changes in input costs, this fact has to be introduced much more in

price-transmission analysis in future research. Studies in agricultural economics often start from a price-transmission coefficient based on perfect competition and the share of input costs in the production value. This may lead to substantial forecasting errors when policy impacts on the marketing chain are analysed or impacts of changing world prices on consumers.

6 LITERATURE

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Appendix 1: Mean Price Level of 20 Brands of Breakfast Products in Six Grocery-Retailing Firms in Germany, 1996-99a)

Products	Grocery-Retailing Firms					
	A	B	C	D	E	F
Bärenmarke "Feine 12", 170g	1.33	1.36	1.31	n.d. ^{b)}	1.28	1.47
Bärenmarke Kaffeeraum 8%, 170g	1.13	1.14	1.04	1.26	1.00	1.29
Coppenrath & Wiese Unsere Goldstücke 9 St. (450g)	2.47	2.31	2.39	2.42	2.48	2.54
Dallmayr Prodomo, 500g	9.99	9.09	9.31	9.54	9.82	9.55
Danone Actimel Drink Classic, 4x100g	2.61	2.63	2.59	2.42	2.55	2.62
Golden Toast Butter Toast, 500g	2.30	1.99	1.90	1.97	1.99	2.13
Golden Toast Sonntagsbrötchen, 8 St.	2.94	2.84	2.85	2.91	2.89	2.84
Jacobs Café Zauber Cappuccino, 200g plus 10g Milkschokolade	6.92	7.25	7.51	7.01	7.68	7.44
Kellogg's Cornflakes, 375g	3.41	3.60	3.29	3.39	3.39	3.34
Kerrygold Original Irische Butter, 250g	2.54	2.43	2.40	2.42	2.43	2.66
Landliebe Landmilch 3,8%	n.d. ^{b)}	1.68	1.68	1.67	n.d. ^{b)}	1.82
Lieken Urkorn Das Vollkorn-Saftige, 500g	2.14	2.36	2.42	2.40	2.24	2.47
Müllermilch Schoko, 500ml	1.41	1.28	1.15	1.07	1.09	1.38
Nestlé Cini Minis, 375g	4.73	4.70	4.72	4.84	4.87	4.78
Nestlé Nesquik für ein Knusperfrühstück 375g	4.72	4.70	4.64	4.86	4.87	4.77
Nutella, 400g	2.77	2.65	2.61	2.63	2.55	2.79
Rama, 500g	1.95	1.77	1.82	1.83	1.86	1.85
Schwartau Extra Erdbeer-Konfitüre Extra, 450g	2.97	2.97	2.96	2.95	2.98	3.00
Teekanne Teefix, 43,75g	3.88	3.72	3.62	3.81	3.37	3.64
Wasa Schoko Wikinger, 150g	2.77	2.77	2.89	2.82	2.73	2.78
Unweighted mean ^{c)} :	3.43	3.34	3.34	3.36	3.38	3.44

a) The product sample, the sample period and the included stores are explained in the text. All prices are average prices across stores of the individual retailers and over time where all "normal" and discount prices are included.

b) Not distributed.

c) Only those 18 products included which are distributed in all chains.

Source: Authors' computations.