Expectations and retail profit margins

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Abstract

In this study expectations and prediction errors are introduced in the context of retail price setting. A new model and a new data set are used to examine whether prediction errors influence retail price setting, whether prediction errors cause only limited price changes to maintain price stability and whether there are differences in influences according to whether prediction errors are positive or negative. The model is an extended version of a full costs pricing model and the averaged data are for a large number of shop types in German retailing for a long series of successive years.

Keywords

Germany, models, pricing, profit margins

Introduction

The purpose of the current study is to present a model explaining retail price setting by expectations and prediction errors. To estimate the model we use an extensive data set for German retailing. Extensive means that a long time series (thirty-four years) of a wide range of German shop types (twenty-four) is available. Special attention will be paid to two questions. First are there differences in influences on retail price setting between expected values of explanatory variables like costs, business cycle, etc., and deviations of actual from expected values? Second, are there differences in influences between positive and negative deviations? The first question relates to the meaning of prediction errors for retail price setting and the importance of price stability in retailing, while the second question relates to asymmetric reactions of retailers.

The introduction of expectations in the context of retail pricing requires a modelling of retail profit margins in which expected values and deviations of actual from expected values can replace the actual values of the explanatory variables. This requires an analysis on the level of the average shop because the issue goes beyond the level of the analysis of individual products in individual shops. The literature on retailing offers many useful ideas and concepts on the level of individual products/shops but few explanatory mathematical models on the level of shop types/margins. A general complaint of students of retailing is the lack of studies attempting to explain retail margins. Nooteboom (1985) states that explaining retail margins forms an important and relatively neglected topic of research, and Betancourt and Gautschi (1990: 1) remark that 'surprisingly enough, there is a paucity of studies seeking to explain retail margins'. This little interest is remarkable because an abundance of studies explaining manufacturing profit margins is available (see Cubbin (1988) and Schmalensee (1989) for a survey of empirical studies in this area). The paucity of studies explaining retail profit margins may be explained by the small part retailing plays in Western economies, the difference in nature between retailing and manufacturing and the small average size of retail firms.

Nevertheless, there is a relatively small group of studies attempting to explain retail pricing on the level of shop types. This group consists, among others, of Bliss (1988), Bode, Koerts and Thurik (1986, 1988, 1990), Marion (1989), Marvel (1989) and the already mentioned studies of Betancourt and Gautschi (1990) and Nooteboom (1985).[1] According to Nooteboom (1985: 647), the average full costs pricing model he presents 'explains differences in percentage margin between different shop types as well as the development in time per type of shop'. Empirical evidence is given not only for retailing but also for manufacturing and the hotel and catering sector. The model is used by Nooteboom and Thurik (1985) to analyse Dutch retail margins during recession and growth and by Nooteboom, Kleijweg and Thurik (1988) to examine the influence of normal costs and demand effects on the Dutch retail price setting. Van der Hoeven and Thurik (1987) use the model to explain profit margins in the Dutch hotel and catering sector, while Thurik and Van der Hoeven (1989) use it to explain Dutch manufacturing profit margins with a discrimination between small and large firms. The Research Institute for Small and Medium-Sized Business (EIM) in the Netherlands uses the model to forecast the implications of policy decisions for various sectors of the Dutch economy. We shall build a new model based on the average full costs pricing model of Nooteboom (1985).

To give a broad basis to our analysis of retail price setting, data are required for many different shop types. Moreover, the distinction between expected values and deviations of actual from expected values requires considerably long time series. That is, a thorough analysis of both cross-sectional and time serial effects requires a data set containing data for both a reasonably complete spectrum of shop types across retailing and a relatively long series of successive years. Fortunately, we can use a data set that contains averaged data for twenty-four shop types in German retailing for the period 1953–86 (yielding a total of 816 observations).

The structure of the paper is as follows. The next section deals with the average full costs pricing model of Nooteboom, followed by the presentation of a new model that is used to introduce expectations and to answer the two questions raised above. The modelling of expectations and the data are then described before empirical results are presented and discussed. Finally, there is a summary.

A full costs profit margin model

The average percentage gross margin is defined as the difference between sales and purchasing value of sales, expressed as a percentage of sales. The model presented in Nooteboom (1985) explains the average percentage gross margin as an average percentage profit mark-up on average operating costs, which exclude a reward for shopkeepers' labour,[2] as a percentage of sales. The mark-up consists of four elements (Nooteboom 1985: 651–2):

scale effect: the average percentage profit mark-up is inversely related to the average sales size of a shop, because a higher average sales size allows a lower percentage of sales to achieve a given minimum reward for shopkeepers' labour.

shop type effect: a more varied range of products and a higher service level require a higher percentage profit mark-up to achieve a given return on investment. This is an argument from the supply side. There is a parallel argument from the demand side: customers, who want to buy quality products, end up with retailers who offer quality and have a certain amount of expertise. This dependence of the customers on the retailers provides the room for a higher percentage profit mark-up.

life cycle effect: during the penetration phase there is the risk of novelty; during the phase of saturation this risk lessens; during the phase of decline the profit mark-up shrinks due to heavy competition of new types of trade.

business cycle effect: the size of the profit mark-up depends on the growth rate of consumer spending (in volume). Price competition is assumed to become more intense in a contracting market because retailers attempt to sustain sales volume.

To take these effects into account, Nooteboom proposes the inverse of average sales, the income elasticity, the change of market share and the change of consumer spending, respectively. He suggests the following specification:

$$M_{it} = \alpha_0 + \alpha_1 K_{it} + \alpha_2 \frac{P_t}{Q_{it}} + \alpha_3 3E_{it} + \alpha_4 CM_{it} + \alpha_5 CS_{it} + u_{it}, \qquad (1)$$

where

i = index of the shop type;

t = index of the year;
M = average percentage gross margin;
K = average percentage operating costs (excluding a reward for shopkeepers' labour);
P = consumer price index;
Q = average sales per shop;
E = income elasticity of products and services offered;
CM = change of market share;
CS = percentage change of consumer spending (in volume);
u = stochastic error.

If the average percentage gross margin is exactly a percentage profit mark-up on average percentage operating costs, α_0 and α_1 should be zero and one, respectively. However, in Nooteboom, Kleijweg and Thurik (1988) α_0 was found to be significantly different from zero. The coefficients α_2, α_3, α_4 and α_5 should all be positive because all corresponding elements of the mark-up are assumed to have a positive influence on the percentage profit mark-up. The coefficient α_2 represents a net profit level independent of the characteristics of the shop type.[3] Nooteboom (1985) and Nooteboom, Kleijweg and Thurik (1988) report estimates for α_2 close to the legal minimum wages for employees.

Attention has to be paid to the variable K. In the literature two types of pricing models are presented. One type of model relates net profit margins to a function of some economic factors. The other type of model relates gross profit margins to a function of both these economic factors and operating costs. Equation (1) is clearly an example of the second type. Since the coefficient α_1 is not restricted to unity, we can determine the extent to which costs are passed on. Using the variable K as an explanatory variable a definition of costs has to be chosen. Waterson (1984) gives three possible definitions: marginal costs, normal costs and full costs (including fixed costs). Marginal costs are hard to measure by researchers and hard to observe by entrepreneurs. Nooteboom, Kleijweg and Thurik (1988) have used normal costs. In the present study we use expected costs which are in essence similar to normal costs. In Equation (1) the variable K represents full costs. If the coefficient α_1 is equal to one, the model can be rewritten as a model which explains net profit margins.

Using the variable P/Q, we can test whether there is a mechanism by which smaller, independent shops tend to be systematically pressed out of the market (Nooteboom 1986). Assume that costs are given by the relationship[4]

$$\textit{costs} = \beta_0 + \beta_1 \textit{ sales size}. \tag{2}$$

and that the relationship between gross profits and sales size is

$$\textit{gross profits} = \beta_2 \textit{ sales size}, \tag{3}$$

where β_0 is assumed to be greater than zero and β_2 (reflecting the profit margin = gross profits/sales size) is assumed to be greater than β_1. This implies that net profits are positive beyond some critical sales size. Moreover, beyond this critical size net profits increase in proportion to the sales size. This will push up average sales size. If the coefficient of P/Q is positive, this increase of the average sales size exerts a downward pressure on the profit mark-up. This means that β_2 decreases and that the critical sales size increases; this reinforces the ousting of small shops.

The variable *CM* has been dropped from our analysis, because we have no data on the shop type level. The average stock level as a percentage of sales[5] is used in the present study as an indicator of the shop type effect instead of the income elasticity for two reasons. First, the income elasticity, *E*, is difficult to measure because of the complicated and changing assortment composition of shop types. Second, Nooteboom and Thurik (1985) show that the stock level explains retail profit margins better than the income elasticity.[6]

The rationale for the use of the stock level is twofold. First, a high stock level often accompanies a deeper or wider range of products and a greater ability to satisfy customer demand and hence accompanies a higher service level. Second, a high stock level means an increase of uncertainty for the retailer. This uncertainty is determined by unexpected price changes dictated by the market and unforeseen, disappointing low sales levels leaving the goods unsold. The retailer requires a premium to compensate for this uncertainty.

The new model

The present study aims at introducing expectations in the context of retail price setting to answer the question of whether there are differences in influences between expected values and deviations of actual from expected values and the question of whether there are differences in influences between positive and negative deviations. To answer the former question we need to consider the meaning of price stability and deviations of actual from expected values, while the latter question relates to asymmetric reactions of retailers.

Deviations of actual from expected values are quite important in monetary and financial economics. For instance, Barro (1977) shows that unexpected money growth influences US unemployment. The question that we have to address is whether unexpected changes are also important for retail price setting. Unexpected changes will be unimportant for retailers if their expectations are such that the prediction errors do not contain any useful information. However, is it realistic to assume that retailers' prediction errors have no impact on retail price setting, while unexpected changes in money growth can even influence national unemployment?

Deviations of actual from expected values will be unimportant for our modelling if retailers have the power to control their percentage operating costs, stock level and changes of consumer spending. It is however unrealistic to assume that retailers' firm size is large enough to have the market power to control sales and consumer spending. Since costs of labour and space are fixed, unexpected decreases of sales may lead to unexpected increases of percentage costs. Moreover, if it is difficult to adapt the size of stock, unexpected decreases of sales may also lead to unexpected increases of the stock level. Of course, retailers may try to compensate unexpected decreases of sales through advertising or by promoting their goods but this will lead to unexpected increases of percentage costs. We shall therefore assume that the uncertainty of consumer spending and sales makes deviations of actual from expected values relevant not only for changes of consumer spending but also for percentage costs and the stock level. Accepting the meaning of deviations for retail price setting, we need to consider to what extent deviations are passed on or, more generally, the way retailers set their prices.

We may believe that retailers can adjust their prices most of the time, but this contradicts the importance of price stability.[7] Although some consumers may not be interested in prices, many consumers will appreciate price stability. People often complain about increasing prices. Price stability is also of interest for retailers for at least three reasons. First, retailers can lose their customers due to price fluctuations because these fluctuations will motivate customers to compare prices and quality of various retailers. Second, price changes cause switching costs and retailers may try to minimize these costs. Although automating price display boards reduce switching costs in the food sector, switching costs will still be a barrier in many other retail sectors. Third, consumers tend to be less price sensitive when prices are less variable (see Bawa, Landwehr and Krishna (1989), for instance). Therefore, we assume that retailers try to maintain price stability by setting prices based upon their expectations of costs, stock level and changes of consumer spending at the beginning of each new period,[8] and by adjusting these prices not fully to deviations of reality from expectations. Since deviations may be regarded as temporary, it may not be worth giving up attempts to maintain price stability.

There is another reason to expect differences in influences between expected values and deviations. This reason relates to our choice of explanatory variables. The stock level has been introduced as an indicator of the shop type effect. However, the stock level also contains a business cycle effect. As mentioned above, the stock level may increase because of a stagnation of sales resulting from a contracting market. The two effects on profit margins are separated by using the expected stock level and the deviation of actual from expected stock level, and are assumed to have opposite signs. The cross-section component of the stock level serving as an indicator of the shop type effect will be represented by the expected stock level. An upward pressure of the expected stock level on retail prices is assumed. The time series component of the stock level representing the business cycle effect will be captured by the deviation of actual from expected stock level. A positive (negative) deviation is assumed to have a downward (upward) pressure on retail prices because a positive (negative) deviation indicates a contracting (growing) market.

To answer the question of whether there are differences in influences between positive and negative deviations of actual from expected values, we allow for asymmetric reactions to deviations. For costs, asymmetric reactions may result from the different consequences for retailers' income. Positive deviations threaten retailers' income, while negative deviations provide retailers the opportunity to increase their income by not allowing customers to benefit from the cost reduction. It is not straightforward that retailers react in the same way to a decrease as to an increase of income. For changes of consumer spending and the stock level the distinction between positive and negative deviations is suggested by Nooteboom and Thurik (1985). Their results indicate that the effect of consumer spending is different according to whether spending grows or declines. Changes of consumer spending, deviations of actual from expected stock level, unexpected changes of consumer spending are all indicators of the possibly asymmetric business cycle effect.

To examine the differences in effects suggested, we propose the following specification:

$$\begin{aligned} M_{it} = \beta_0 &+ \beta_1 K^{ex}_{it} + \beta_2 (K - K^{ex})^+_{it} + \beta_3 (K - K^{ex})^-_{it} \\ &+ \beta_4 ST^{ex}_{it} + \beta_5 (ST - ST^{ex})^+_{it} + \beta_6 (ST - ST^{ex})^-_{it} \\ &+ \beta_7 CS^{ex}_{it} + \beta_8 (CS - CS^{ex})^+_{it} + \beta_9 (CS - CS^{ex})^-_{it} \\ &+ \beta_{10} P_t/Q_{it} + u_{it}, \end{aligned} \tag{4}$$

where

K^{ex}	= expected operating costs;
ST^{ex}	= expected stock level;
CS^{ex}	= expected percentage change of consumer spending (in volume);
$(K - K^{ex})^+$	$= K - K^{ex}$ if $K \geq K^{ex}$ and 0 otherwise;
$(K - K^{ex})^-$	$= K - K^{ex}$ if $K \leq K^{ex}$ and 0 otherwise;
$(ST - ST^{ex})^+$	$= ST - ST^{ex}$ if $ST \geq ST^{ex}$ and 0 otherwise;
$(ST - ST^{ex})^-$	$= ST - ST^{ex}$ if $ST \leq ST^{ex}$ and 0 otherwise;
$(CS - CS^{ex})^+$	$= CS - CS^{ex}$ if $CS \geq CS^{ex}$ and 0 otherwise;
$(CS - CS^{ex})^-$	$= CS - CS^{ex}$ if $CS \leq CS^{ex}$ and 0 otherwise.

All costs and stock variables are expressed as a percentage of annual sales. If price stability is important and, therefore, prices are not fully adjusted to unexpected changes of costs and consumer spending, then β_2 and β_3 will be smaller than β_1 and β_8 and β_9 will be smaller than β_7. Because of the differences in effects β_4 is assumed to be positive and β_5 and β_6 are assumed to be negative.

Expectations

This section presents three equations that are used to determine the expected costs, stock level and changes of consumer spending. Expected costs and stock level are assumed to be related to expected changes of consumer spending, two lags of the actual values and a linear time trend. Actual costs and stock level will be affected by both expected and unexpected changes of consumer spending. Expected costs and stock level are not affected by unexpected changes of consumer spending because a retailer determining his expectations of costs and stock level accounts for economic developments as far as he is able to foresee them. For this reason a determination of expected costs and stock level requires the elimination of fluctuations of costs and stock level caused by unexpected developments. Lagged values of costs and stock level are included because they may contain useful information. We confine ourselves to two lags. To compensate for the omission of higher order lags a linear time trend is included. All this finds concrete shape in a procedure that starts with the estimation of the coefficients of the following equations:

$$K_{it} = \psi_0 + \sum_{q=1}^{2} \psi_{1q} K_{i,t-q} + \psi_2 CS^{ex}_{it} + \psi_3 (CS - CS^{ex})_{it} + \psi_4 TR_t + f_{it}, \tag{5}$$

and

$$ST_{it} = \phi_0 + \sum_{q=1}^{2} \phi_{1q} ST_{i,t-q} + \phi_2 CS^{ex}_{it} + \phi_3 (CS - CS^{ex})_{it} + \phi_4 TR_t + g_{it}, \tag{6}$$

where

$(CS - CS^{ex})$	= deviation of actual from expected percentage change of consumer spending (in volume);
TR	= linear time trend;
f, g	= stochastic errors.

To eliminate fluctuations caused by unexpected changes of consumer spending, expected costs and stock level are determined by the relations:[9]

$$K^{ex}_{it} = \hat{\psi}_0 + \sum_{q=1}^{2} \hat{\psi}_{1q} K_{i,t-q} + \hat{\psi}_2 CS^{ex}_{it} + \hat{\psi}_4 TR_t \tag{7}$$

and

$$ST^{ex}_{it} = \hat{\phi}_0 + \sum_{q=1}^{2} \hat{\phi}_{1q} ST_{i,t-q} + \hat{\phi}_2 CS^{ex}_{it} + \hat{\phi}_4 TR_t. \tag{8}$$

Using the variables CS^{ex} and $(CS - CS^{ex})$, we need a model predicting changes of consumer spending. Hall (1978) and Hansen and Singleton (1983) argue that lagged changes of consumer spending explain future changes. Harvey (1988) proposes the use of the yield spread, i.e. the spread between the long- and short-term interest rate. The predictive power of the yield spread is explained by the intention of people to increase their savings when expecting a future recession. This increase of savings will reduce interest rates of long-term bonds which mature when the recession occurs and people like to have some additional income relative to interest rates of short-term bonds. So, a slightly positive or negative spread indicates pessimism about future changes of consumer spending. Both lagged changes of consumer spending and a yield spread are included in our model:[10]

$$CS_{it} = \gamma_0 + \sum_{q=1}^{2} \gamma_{1q} CS_{i,t-q} + \gamma_2 SPR_t + e_{it}, \tag{9}$$

where

SPR = yield spread;
e = stochastic error.

Expected changes of consumer spending, CS^{ex}, are defined as the predicted values of Equation (9). The residuals are used as unexpected changes of consumer spending ($CS - CS^{ex}$). The estimates of the coefficients of the prediction equations are presented below.

The data

Our data description consists of three elements: the data-sources and the shop types, the regression results which are used to determine expected values, and some data characteristics such as cross-sectional differences, the development in time and the correlation between the variables.

The data sources

The German data are obtained for the period 1953–86 (thirty-four years) for twenty-four shop types, yielding a total of 816 observations. Our main data-sources are Seÿffert *et al.* (1962), Sundhoff *et al.* (1970, 1980), Sundhoff and Klein-Blenkers (1980 through 1987). The German price indices, which are used to compute P/Q and CS, and the interest rates, which are used to determine the expected changes of consumer spending, are taken from the International Financial Statistics of the IMF (yearbook 1979, 1983 and 1987). The data on consumer spending in Germany are based on the consumer expenditure of resident households, which is taken from the National Accounts of the OECD. The consumer expenditure of the OECD is available for several product categories but these categories do not coincide with the assortment compositions of the shop types. To obtain data on the shop type level, weighted values of the OECD categories have been assigned to the shop types. The German shop types are presented in Table 1. The shop types practically span the entire spectrum of retail shop

Table 1 A survey of the West German shop types used

Shop type	*Number of firms in the sample for 1986*	*Average sales per firm for 1986 in 1000 DM*
furniture-store	282	5594
iron tools	105	5245
clothes for men, women and children	173	4431
clothes for men and children	90	3150
tools and kitchen utensils	233	2908
clothes mixed assortment	195	2606
lighting and electra	28	2290
bookshop	421	2244
floor-covering and wallpaper	89	2183
clothes for women and children	246	2116
shoe-shop	522	2053
sports shop	96	1888
glass, china and ceramics	167	1655
groceries	1201	1544
photographer's shop	77	1528
tobacco-shop	59	1498
leather- and fancy-goods shop	62	1384
cycle-shop	36	1297
bed-clothes	51	1253
jeweller's shop	240	1227
linen/underwear, knitted goods	11	1170
house and kitchen utensils	53	1071
chemist's shop	146	736
drapery-shop	13	507
total	4596	51578
average	192	2149

types in Germany. The number of firms used to calculate the averages per shop types and average sales per firm are given in Table 1.

The determination of the expectations

The expected and unexpected changes of consumer spending, CS^{ex} and $(CS - CS^{ex})$, are defined as the predicted values and the residuals of equation (9), respectively. Estimating[11] the coefficients of this equation, we get[12]

$$CS_{it} = \underset{(0.264)}{1.593} + \underset{(0.033)}{0.570}CS_{i,t-1} - \underset{(0.034)}{0.130}CS_{i,t-2} + \underset{(9.010)}{37.672}SPR_t + \hat{e}_{it} \quad \bar{R}^2 = 0.292 \tag{10}$$

The yield spread has the expected positive influence on changes of consumer spending. To determine expected costs and stock level, we use the variables CS^{ex} and $(CS - CS^{ex})$ and estimate the coefficients of equations (5) and (6). The results are as follows:

$$K_{it} = \underset{(0.227)}{2.079} + \underset{(0.035)}{0.912}K_{i,t-1} + \underset{(0.035)}{0.087}K_{i,t-2} - \underset{(0.026)}{0.189}CS^{ex}_{it} - \underset{(0.013)}{0.124}(CS - CS^{ex})_{it} - \underset{(0.007)}{0.042}TR_t + \hat{f}_{it} \quad \bar{R}^2 = 0.979 \tag{11}$$

and

$$ST_{it} = \underset{(0.511)}{2.278} + \underset{(0.035)}{0.794}ST_{i,t-1} + \underset{(0.036)}{0.222}ST_{i,t-2} - \underset{(0.063)}{0.247}CS^{ex}_{it} - \underset{(0.033)}{0.107}(CS - CS^{ex})_{it} - \underset{(0.015)}{0.0517}TR_t + \hat{g}_{it} \quad \bar{R}^2 = 0.972 \tag{12}$$

Equation (11) indicates that the two consumer spending variables have a negative influence on costs. This negative influence can be explained by the fact that costs are defined as a percentage of sales. When consumer spending increases, sales increase more than operating costs because some operating costs are fixed within certain intervals of sales (e.g. costs related to labour and space).[13] That is, unit costs are anticyclical. The negative coefficient of *TR* in equation (11) indicates that, *ceteris paribus*, the growth of costs decreases.

Equation (12) indicates that the consumer spending variables also have a negative influence on the stock level. Unexpected changes of consumer spending take the retailer by surprise and therefore reduce his stock (relative to sales). Surprisingly, expected changes of consumer spending do not lead to an increase of the stock to suppress a decline of the stock level and hence a decline of the service level. It seems that the retailer's ability to adapt his stock is limited. The negative coefficient of *TR* in equation (12) indicates that, *ceteris paribus*, the growth of stock level also decreases gradually. The growth of stock level seems to decrease despite the continued growth of the number and variety of goods.

The variables

In this subsection some characteristics of the data are described. In Table 2 the sample means and standard deviations of the main variables, M, K^{ex}, ST^{ex}, P/Q and CS^{ex}, are presented for the years 1953 and 1986. The standard deviations indicate considerable differences between shop types. Comparing the means for 1953 and 1986, we see that the margins, expected costs, expected stock level (or service level) have increased. The difference between the margin and expected costs, and expected changes of consumer spending have decreased. The high expected changes of consumer spending for 1953 reflect the high economic growth during the first decennium after the Second World War. The increase of firm size is reflected by the decrease of P/Q.

The correlation coefficients between the variables of equation (4) are

Table 2 An impression of the differences between the shop types in 1953 and 1986

	Mean		*Stand.dev.*	
Variable	*1953*	*1986*	*1953*	*1986*
M	24.95	37.83	6.13	7.37
K^{ex}	19.03	34.68	4.62	6.85
ST^{ex}	24.10	47.47	8.35	21.37
CS^{ex}	7.22	2.59	0.95	0.44
P/Q	0.12	0.09	0.09	0.06

given in Table 3. There seems to be no great danger of multicollinearity since most correlation coefficients are low. Only three correlation coefficients are high. The high correlation between M on the one hand and K^{ex} and ST^{ex} on the other hand is desirable. The high correlation between K^{ex} and ST^{ex} is explicable because an important component of costs is caused by keeping stock.

Empirical results

The coefficients of equation (4) have been estimated to determine the influences of expected values and deviations of actual from expected values on margins. The estimator of the coefficients corrects for heteroskedasticity, while the estimator of the standard errors corrects for heteroskedasticity and autocorrelation.[14] The results are as follows:

$$
\begin{array}{llllllll}
M_{it} = & 4.461 & + & 0.899K^{ex}_{it} & + & 1.014(K-K^{ex})^{+}_{it} & + & 0.462(K-K^{ex})^{-}_{it} & + \\
 & (1.087) & & (0.041) & & (0.135) & & (0.149) & \\
 & & & 0.082ST^{ex}_{it} & - & 0.093(ST-ST^{ex})^{+}_{it} & + & 0.016(ST-ST^{ex})^{-}_{it} & + \\
 & & & (0.019) & & (0.057) & & (0.058) & \\
 & & & 0.302CS^{ex}_{it} & - & 0.007(CS-CS^{ex})^{+}_{it} & + & 0.120(CS-CS^{ex})^{-}_{it} & + \\
 & & & (0.059) & & (0.035) & & (0.047) & \\
 & & & 5.256P_t/Q_{it} & + & \hat{u}_{it}. & & & \\
 & & & (3.612) & & & & \bar{R}^2 = 0.997 &
\end{array}
\qquad (13)
$$

Table 3 The correlation between the variables of equation (4)[a]

	M	K^{ex}	$(K-K^{ex})$	ST^{ex}	$(ST-ST^{ex})$	P/Q	CS^{ex}
K^{ex}	0.94						
$(K-K^{ex})$	0.15	0.05					
ST^{ex}	0.71	0.65	0.07				
$(ST-ST^{ex})$	0.07	0.05	0.34	0.01			
P/Q	−0.24	−0.31	−0.12	−0.05	−0.01		
CS^{ex}	−0.33	−0.43	0.00	−0.26	0.00	0.09	
$(CS-CS^{ex})$	−0.16	−0.15	−0.34	−0.09	−0.13	0.07	0.00

[a] A distinction between positive and negative deviations is not made: so the variables $(K-K^{ex})$, $(ST-ST^{ex})$ and $(CS-CS^{ex})$ are defined as the deviations of actual from expected values.

First we shall discuss the results with regard to costs. From a statistical point of view we see that:

1) the coefficient of K^{ex} is significantly (5% level)[15] smaller than one;
2) the coefficient of $(K - K^{ex})^+$ is not significantly different from one nor from the coefficient of K^{ex};
3) the coefficient of $(K - K^{ex})^-$ is significantly smaller than one and significantly different from the coefficient of K^{ex};
4) the coefficient of $(K - K^{ex})^+$ is significantly different from the coefficient of $(K - K^{ex})^-$.

These findings provide answers to the two questions raised in the introduction. First, the reaction of the retailer to expected costs differs from his reaction to (negative) deviations of actual from expected costs. Second, the reaction to deviations of actual from expected costs is asymmetric and, therefore, a distinction between positive and negative deviations is useful.

In addition to these answers the results provide further insights into retail price setting. The retailer takes risks by not fully passing on expected costs. He takes the chance of an unexpected reduction of costs to enlarge the number of customers. Furthermore, if actual costs are higher than expected, the deviation is fully passed on. Given the risks the retailer already takes, it is not surprising that attempts to maintain price stability are not important when actual costs are higher than expected. Not fully passing on the positive deviation would mean a reduction of his income in addition to the reduction which results from not fully passing on expected costs. It is interesting that the retailer is not compensated for not fully passing on expected costs when costs are higher than expected: the positive deviation can be passed on but nothing more than that. Negative deviations do seem to provide some compensation. When actual costs are lower than expected the retailer tries to maintain price stability. This is attractive because it leads to an increase of retailer's income.

The statistical results with regard to the stock level can also be summarized in four points:

1) the coefficient of ST^{ex} is significantly different from zero;
2) the coefficient of $(ST - ST^{ex})^+$ is not significantly different from zero but is significantly different from the coefficient of ST^{ex};
3) the coefficient of $(ST - ST^{ex})^-$ is not significantly different from zero nor from the coefficient of ST^{ex};
4) the coefficient of $(ST - ST^{ex})^+$ is not significantly different from the coefficient of $(ST - ST^{ex})^-$.

We can answer in the affirmative to the first question. The influence of the expected stock level on retail margins differs from that of the (positive) deviation of actual from expected stock level. This difference is explained by the fact that the variable ST^{ex} on the one hand and the variables $(ST - ST^{ex})^+$ and $(ST - ST^{ex})^-$ on the other hand are indicators of different effects.

We have to answer in the negative to the second question. The reaction of the retailer to deviations of actual from expected stock level is not asymmetric.

Apart from these answers the results provide insights into the influences of the separate variables. The variable ST^{ex}, which measures the shop type effect, has the expected positive influence on retail margins. A higher expected stock level means a higher service level, which results in higher margins. The business cycle effect indicated by the deviations of actual from expected stock level has no significant influence on margins.

For the change of consumer spending we see that:

1) the coefficient of CS^{ex} is significantly different from zero;
2) the coefficient of $(CS - CS^{ex})^+$ is not significantly different from zero but it is significantly different from the coefficient of CS^{ex};
3) the coefficient of $(CS - CS^{ex})^-$ is significantly different from both zero and the coefficient of CS^{ex};
4) the coefficient of $(CS - CS^{ex})^+$ is significantly different from the coefficient of $(CS - CS^{ex})^-$ at a 6% significance level.

We can answer in the affirmative to both questions. With respect to the first question the results imply that there is a difference in influences between expected and unexpected changes of consumer spending. Compared with the strong reaction to expected changes of consumer spending, the reaction to unexpected changes is relatively weak. That is, the results indicate attempts to maintain price stability. Retailers may assume that unexpected changes of consumer spending have a temporary character: it is not worth making switching costs and taking the risks of losing customers due to price adjustments. With regard to the second question the results indicate that the reaction to unexpected changes of consumer spending is asymmetric. Considering the influence of the separate variables we see that expected changes of consumer spending and negative unexpected changes of consumer spending have a significant, positive influence on margins.

Finally, we discuss the coefficients of the variable P/Q and the intercept. The coefficient of P/Q gives an indication of the profit level which is independent of the characteristics of the shop type. This profit level is about 5,000 DM at 1976 prices. The insignificant coefficient of P/Q questions whether the mechanism which is responsible for the ousting of smallness is applicable in the German case. The coefficient of the intercept indicates that there is a statistically significant remainder in the form of a constant term. The significant intercept indicates a positive relation between net profits and firm size. So, firms will try to increase their size. However, the insignificant coefficient of P/Q indicates that this increase will not lead to a significant decrease of the margins and thereby not to an increase of the critical firm size.

Summary and conclusions

In this study the meaning of expectations in retail price setting is examined. The average full costs pricing model presented by Nooteboom (1985) is extended to examine whether there are differences in influences on retail margins between expected values and the deviations of actual from expected values and between positive and negative deviations. The extended model is more complicated than the original model and only a data set as extensive as the one we use allows an appropriate analysis. The more complex analysis is, however, worth the effort. The analysis provides interesting insights into the meaning of prediction errors or deviations of actual from expected values for retail price setting and the importance of price stability.

Since positive and negative deviations of actual from expected costs, positive deviations of actual from expected stock level and negative unexpected changes of consumer spending contribute significantly to the explanation of retail profit margins, we conclude that deviations of actual from expected values are indeed relevant for retail prices. Differences in influences on retail margins between expected values and deviations are found for costs, stock level and changes of consumer spending. Negative deviations of actual from expected costs and both positive and negative unexpected changes of consumer spending have smaller influences than the expected values, that is, evidence is provided on retailers' desire to maintain price stability. The difference in influence between the expected stock level and the positive deviation of actual from expected stock level confirms that the two variables reflect a shop type effect and a business cycle effect, respectively. For costs and changes of consumer spending, reactions to positive deviations seem to differ significantly from reactions to negative deviations. We can therefore conclude that the two questions raised in the introduction to this study can be answered in the affirmative.

In addition to the results with regard to expectations, we obtain some interesting estimates for the intercept and the variable P/Q. The results confirm incentives of firms to increase their size in order to increase net profits but question the ousting of smallness by the mechanism mentioned in Nooteboom (1986).

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Appendix: estimation

Using time serial and cross-sectional data, the stochastic residuals are often assumed to be heteroskedastic and autocorrelated. The residual u_{it} of Equation (4) is assumed to be generated by the relation:

$$u_{it} = \rho u_{i,t-1} + \eta_{it}, \tag{14}$$

where $E[\eta_{it}u_{i,t-1}] = 0, E[\eta_{it}] = 0, E[\eta_{it}^2] = \sigma_i^2$ and $E[\eta_{it}\eta_{js}] = 0$ for $t \neq s$ and/or $i \neq j$. The covariance matrix for $u = (u_{11}, \ldots, u_{1T}, \ldots, u_{N1}, \ldots, u_{NT})$[16] is given by

$$E[uu'] = \Phi = \Sigma Y, \tag{15}$$

where

$$\Sigma = \begin{bmatrix} I_T \otimes \sigma_1^2 & & 0 \\ & \cdot & \\ 0 & & I_T \otimes \sigma_N^2 \end{bmatrix} \tag{16}$$

and

$$Y = I_N \otimes \frac{1}{1-\rho^2} \begin{bmatrix} 1 & \rho & \ldots & \rho^{T-1} \\ \rho & 1 & \ldots & \rho^{T-2} \\ \vdots & \vdots & \cdot & \vdots \\ \rho^{T-1} & \rho^{T-2} & \ldots & 1 \end{bmatrix} \tag{17}$$

Let β denote the vector of coefficients of Equation (4). Efficient estimates of β are given by the generalized least squares estimator correcting for heteroskedasticity and autocorrelation:

$$\hat{\beta} = (X'\Phi^{-1}X)^{-1}X'\Phi^{-1}y, \tag{18}$$

where X and y are the matrix of explanatory variables and the vector of margins, respectively:

However, Hayashi and Sims (1983) point at the danger of a correction for autocorrelation when the model includes deviations of actual from expected values. This correction leads to inconsistent estimates when at least one of the coefficients ϕ_k ($k = 1, 2, 3$) of the relation

$$\hat{u}_{it} = \rho\hat{u}_{i,t-1} + \phi_1 \hat{f}_{i,t-1} + \phi_2\hat{g}_{i,t-1} + \phi_3\hat{e}_{i,t-1} + \nu_{it} \tag{19}$$

is significantly different from zero. $\hat{u}_{it}$ denotes the least squares residuals of Equation (4), while $\hat{f}_{it}$, $\hat{g}_{it}$ and $\hat{e}_{it}$ denote the least squares residuals of the Equations (5), (6) and (9), respectively. In the present study the coefficients ϕ_2 and ϕ_3 are significantly different from zero.[17] So, we are forced to use the generalized least squares estimator of β which corrects only for heteroskedasticity,

$$\beta = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}y = (X'P'PX)^{-1}X'P'Py, \tag{20}$$

where $P'P = .\Sigma^{-1}$. The covariance matrix for $\bar{\beta}$ is

$$(X'P'PX)^{-1}. \tag{21}$$

but the matrix

$$(X'P'PX)^{-1}X'P'\Upsilon PX(X'P'PX)^{-1} \tag{22}$$

Using Equations (20) and (22), we get estimates of β that are corrected only for heteroskedasticity and standard errors that are corrected for both heteroskedasticity and autocorrelation.

Since the matrices Σ, P and Υ depend upon the unknown variances σ_i^2 and the unknown coefficient ρ, they have to be replaced by the matrices Σ, $\hat{P}$ and $\hat{\Upsilon}$, which depend upon the estimates of the variances σ_i^2 and the coefficient ρ. These estimates are determined by the following two step procedure:

1) determine $\hat{\rho}$ by applying least squares to the equation[18]

$$\hat{u}_{it} = \rho\hat{u}_{i,t-1} + \eta_{it}; \tag{23}$$

2) determine the estimates of the variances[19]

$$\sigma_i^2 = \frac{\hat{\eta}_i'\hat{\eta}_i}{T}\ (i = 1, 2, \ldots, N). \tag{24}$$

Notes

1 In Bliss (1988) a theory of retail price setting is presented. In Bode, Koerts and Thurik (1986, 1988, 1990) different aspects of retail pricing are studied, like the influence of market disequilibria and the differences in percentage gross margins among individual stores in the retail trade. Betancourt and Gautschi (1990) use different models to detect the factors which determine US retail margins. Nooteboom (1985) presents a model which explains the average percentage gross margin per type of shop as a profit mark-up on average percentage operating costs. See Marvel (1989) and Marion (1989) for references to studies of the relation between concentration and price in the retail trade.

2 The reward for shopkeepers' labour is treated as a part of the residual net profit.
3 See Den Hertog and Thurik (1991).
4 There is abundant theoretical and empirical evidence for this linear inhomogeneous relationship between costs and sales size. See Nooteboom (1982) and Frenk, Thurik and Bout (1991).
5 In the remainder of this paper the term stock level will be used when denoting the average stock level as a percentage of sales.
6 Data of sixteen Dutch shop types for the period 1976–82 were used in this study.
7 From a different point of view, Maccini (1981) argues for limited price changes. He states that short-run prices adjust quickly to long-run prices but the latter are determined by expected normal variables which respond slowly to changes in their determinants.
8 We do not argue that deviations of actual from expected values are a matter of experience. Of course a retailer starting in business will find it more difficult to predict costs, stock level, etc. But even retailers with experience may find it difficult to predict the market situation and influences at the beginning of each new period.
9 ψ_k and ϕ_k denote coefficient estimates.
10 The yield spread, which is proposed by Harvey, has been simplified because a very sophisticated analysis of the relation between the yield spread and changes of consumer spending is beyond the scope of this study. In our study the yield spread $SPR = ln([1+R]/[1+r])$ is used with R denoting the nominal long-term interest rate (mortgage bond yield) and r denoting the nominal short-term interest rate (money market rate).
11 Ordinary least squares can be used to estimate the coefficients of the three prediction equations because we are primarily interested in the coefficient estimates and less in the significance of them. Even if the residuals are heteroskedastic and autocorrelated, the estimates will be consistent. See Judge *et al.* (1988).
12 Standard errors are given between brackets throughout this paper. Let $\hat{c}_{it}$, $\hat{g}_{it}$, etc. denote residuals.
13 This is a well-known phenomenon in retailing. See Thurik and Kleijweg (1986).
14 See the appendix for a discussion of the estimators.
15 We shall use a 5% significance level throughout this paper unless otherwise specified.
16 N and T denote the number of shop types and years, respectively.
17 The estimates coefficient ρ, $\hat{\phi}_1$, $\hat{\phi}_2$ and $\hat{\phi}_3$ are, respectively, 0.836, −0.041, −0.097, −0.039, with the standard errors 0.019, 0.038, 0.015, 0.012.
18 In the present study $\hat{\rho} = 0.823$ with standard error 0.021.
19 The median of the estimates is equal to 3.949.

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