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PRICE-SETTING AND PRICE-ADJUSTMENT BEHAVIOR FOR FAST-MOVING CONSUMER GOODS

MATTHIAS FENGLER AND JOACHIM WINTER*

1. Introduction

When analyzing aggregate dynamics, economists traditionally assume that prices adjust instantaneously in response to changes of economic conditions. In that case, relative prices, i.e., the ratios of prices of different goods, act as a signal of the relative scarcity of goods. Flexible prices are a crucial condition for an efficient allocation of resources in an economy. In reality, however, the simplifying assumption that prices are flexible need not hold: wages are stipulated in long-term contracts, and prices of many consumption goods and services change only infrequently.¹ If prices do not adjust fully and instantaneously in response to changes of economic conditions, one speaks of *price rigidities* (see Carlton, 1986). Based on casual empiricism, one might expect that many prices are rigid.²

In this paper, we present new empirical evidence that helps to understand price-setting behavior in retail markets and its aggregate implications. Using data from the GfK Consumer Panel 1995 (a large-scale household survey conducted by the *Gesellschaft für Konsumforschung*, Nürnberg), we investigate the dynamics and dispersion of prices for fast-moving consumer goods. We focus on one frequently purchased consumption good that exhibited substantial price dynamics during 1995, ground coffee. Our empirical

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1 We treat wages as prices and services as goods.

2 One might ask whether by this strict definition there are *any* flexible prices at all. Under certain circumstances one can justify that in financial markets prices of stocks are fully flexible, i.e., that they adjust instantaneously in response to changes in economic conditions (e.g., to new information on expected profits of a company). However, it is beyond the scope of this paper to discuss this question.

results show that psychological pricing points affect both static price setting and adjustment to cost shocks significantly. We interpret our findings as evidence for substantial rigidity of prices in German retail.

The remainder of this paper is structured as follows. In the next section, we present some basic concepts used in the analysis of price setting and price adjustment behavior, and we review the central questions of current empirical research in this area. In section 3, we discuss whether price data obtained from the GfK Consumer Panel are suitable to answer these empirical questions. We then focus on one explanation for price rigidities, psychological pricing points in section 4. We sketch other empirical issues that can be explored with data from the GfK Consumer Panel in section 5. Section 6 provides a summary of our results.

2. Theoretical and empirical analysis of price setting and price adjustment behavior

For economists, the phenomenon of rigid prices is associated with several important questions. First, it is necessary to document whether and to what extent observable prices are rigid. Once the existence of price rigidities is established, the reasons why prices do not adjust fully and instantaneously need to be explored, and finally, the aggregate effects of rigid prices need to be examined. These issues have been, and they continue to be, areas of active research in macroeconomics over the last decades (see Blanchard, 1990).

Rigid prices play a major role in Keynesian models of aggregate economics. Whereas in frictionless economies, it is difficult to justify active policy measures, frictions (such as rigid prices) open the possibility for policy makers to influence the economy's aggregate performance positively. In the earlier Keynesian literature, most theoretical models of aggregate economics invoked rigid prices by assumption; this was often motivated by long-term employment contracts or the inertia of prices of goods and services. However, just *assuming* rigid prices seems to be unsatisfactory from a methodological point of view and, even worse, turned out to be inconsistent with economic theory. It is obvious that firms could increase profits if they adjusted prices to their optimal level more often. Without any further arguments, rigid prices cannot be derived by optimizing behavior of economic agents. This was one of the main criticisms of traditional Keynesian models, and the existence and importance of price rigidities became one of the battlefields of the Keynesians and the neoclassic school.

Having realized the importance of price rigidities, especially in the aggregate economic analysis from the Keynesian perspective, it is not surprising that in the 80s, economists

developed a large number of models that try to derive price rigidities consistently from a microeconomic optimization framework. This change of focus also revealed a drawback of earlier empirical research in Keynesian economics, the lack of disaggregated micro data (see Danziger, 1987). While on the theoretical side, this research program has come to an end, there is still only little convincing empirical evidence on price rigidities. Only recently, some advances using disaggregated price data have been made.³

At this point, another drawback of traditional macroeconomic analysis (not only of the Keynesian approach) emerged – the missing link between the microeconomic activities of individual agents (firms and households) and the dynamics of those economic aggregates macroeconomists are actually interested in, i.e., the *aggregation problem*. With respect to price rigidities, for example, it is not clear whether and how the inflexibility of prices at the micro level influences the dynamics of the aggregate price level, i.e., inflation (e.g., Caplin and Spulber, 1987). These issues have not yet been fully resolved, neither theoretically nor empirically, and they are an active area of current research in macroeconomics (see Bryan and Cecchetti, 1999, for a recent review of this literature).

In this paper, we discuss how the price data obtained from the GfK Consumer Panel can be used to approach some of the empirical questions raised above. We identified four issues which could be addressed, although by the nature of the data, the analysis is restricted to price setting and price adjustment for fast-moving consumption goods:

- the empirical relevance of psychological pricing points,
- the empirical relevance of (fixed) costs of price adjustment,
- the aggregate impact of micro-level price rigidities,
- the interaction of micro-level price dynamics, price dispersion, the aggregate price level and inflation.

In the remainder of this paper, we focus on the first issue, that is the empirical relevance of psychological pricing points for individual price setting, and we discuss whether they can explain price rigidities. The other topics are sketched only briefly; a more thorough discussion of the theoretical literature and additional empirical results can be found in Fengler (2000).

³ Köhler and Winter (1993) provide an extensive summary of this literature. Major contributions include Rotemberg (1982), Cecchetti (1986), Kashyap (1995), Blinder et al. (1996), Slade (1998, 1999) and, for Germany, Köhler (1996).

3. Obtaining micro-level price data from the GfK Consumer Panel

In this paper, we use price data based on individual transactions that were obtained from the 1995 wave of the GfK Consumer Panel. This data set was designed for household demand analysis from a marketing perspective. For many issues in applied household analysis, however, researchers face the problem that the socio-demographic and socio-economic characteristics of the panel households (e.g., income and employment status) are recorded only once a year. Although the consumption data are sampled with high frequency, the corresponding household information exhibits little variation over time. Within-household event studies are hardly possible because events such as changes of household composition or income cannot be related to changes to consumption patterns observed in the transactions data. However, long-term issues of demand behavior, such as the role of households' attitudes, can be analyzed quite well as long as between-household comparisons are sufficient.

In this paper, we focus exclusively on the price data available in the GfK Consumer Panel and ignore all other information such as household characteristics. For every transaction (i.e., the purchase of an individual product), the data set provides very detailed information such as product classification, brand, size, type of retailer, and last but not least, its purchase value. We can therefore extract daily price data for a vast number of fast-moving consumption goods covering the year 1995. From this perspective, the GfK Consumer Panel constitutes a unique source of high-frequency, micro-level price data.

For the analysis of price adjustment, there is one important drawback which stems from the fact that the data are recorded on a transaction basis from the household perspective. Transaction prices can only be traced to four different types of retailers, but not to a *specific* retailer (such as a specific grocery store), and we cannot construct consistent time series of prices quoted by unique retailer. Specifically, price changes are not directly observable. Therefore, our analysis is restricted to the dynamics of the whole *distribution* of prices over time.⁴ Since these distributions of prices are available daily on the level of individual products (the lowest level of aggregation possible), we can still address some of the empirical questions posed in section 2 from the perspective of German retail markets, such as the relevance of psychological pricing points. We return to the other issue below in section 5.

4 The only way to construct a time series of individual prices is to identify those households which purchase a given product with high frequency at the same type of retailer and then to impose the assumption that this is indeed the same retailer all the time; see Fengler (2000).

4. Empirical results on psychological pricing points

Prices that account for the subjective price perception of consumers are very popular among retailers of consumption goods (see Monroe, 1983, and Wiswede, 1995). To explain the wide-spread use of such prices, it is usually argued that consumers react only little in response to price changes within a certain price range, but react strongly when the limits of these price ranges are violated in either direction. These limits, the so-called pricing points, are typically associated with even prices (such as 1 DM, 5 DM, 100 DM etc.). Actual prices are set just below these limits. Therefore, especially with fast-moving consumption goods, we observe odd prices (e.g., prices of 49 Pf. or 99 Pf., 4.99 DM or 89 DM) very frequently, but rarely even prices. In the remainder of this paper, we refer to these prices as *psychological pricing points*; a related term used in the literature is *focal point pricing*. For Germany and other countries, the relevance of focal prices has been documented extensively, and we report additional evidence below.⁵

Whereas the existence of pricing points is generally accepted, the traditional motivation for them is subject to controversial debate. In field experiments, Diller and Brielmaier, 1996, do not find any evidence that switching from odd to even prices results in significant demand reactions of consumers (which would be an implication of the traditional model). Therefore, the psychological motivation for focal prices is questionable, and Diller and Brielmaier conclude “that psychological pricing points are presumably rooted more deeply in the brains of researchers and managers than in those of consumers” (1996: 709, our translation). In her survey study, Köhler (1996) finds that psychological pricing points are not relevant for price-setting in the manufacturing sector. Similar results have been obtained by Blinder et al. (1998) who conducted a survey among U.S. companies. It is therefore still an open question why psychological pricing points are so important, and more theoretical research is needed (see Wedel and Leeflang, 1998, for a recent theoretical contribution).

Since psychological pricing points can be documented empirically, economists should be interested in their aggregate impact. When those economic variables which determine prices change continuously, actual prices will be adjusted either too early or too late in most cases and therefore deviate from optimal prices most of the time which implies price rigidities. Therefore, in addition to confirming that retailers prefer psychological pricing

5 We do not attempt to summarize this vast literature. Recent evidence for Germany is provided by Dahlhäuser (1996), Diller and Brielmaier (1996), Müller-Hagedorn and Zielke (1998) and Gedenk and Sattler (1998). For a recent study based on American price data see Huston and Kamdur (1996).

points when *setting* prices, we also need to investigate price *adjustment*, that is how prices are adapted after changes in the economic environment.

The GfK Consumer Panel does not only provide the opportunity to document the empirical relevance of psychological pricing points for a large number of fast-moving consumption goods, but because of its time dimension, we can also investigate the effect of psychological pricing points on price adjustment. We now present preliminary empirical evidence on these issues; for further details, see Fengler and Winter (2000b). We concentrate on three products (ground coffee, milk, and butter); see tables 1 and 2a to 2c.

Table 1: *Distribution of prices for three fast-moving consumption goods*

	Number of observations	Mean	Standard deviation	Min	Max
Ground coffee, vacuum packed, 500g	14247	8,21	1,00	5,98	14,98
Milk, 1l	4926	1,02	0,09	0,49	1,98
Butter, 250g	33732	1,74	0,16	0,89	3,69

Source: GfK Consumer Panel 1995 (coffee: commodity group 12, article ID 24199; milk: commodity group 08, article ID 15109; butter: commodity group 22, article ID 43990); own calculations.

With respect to coffee, 86 percent of the 14,247 purchases registered in the GfK Consumer Panel 1995 may be classified as being subject to psychological focal pricing. Besides the “classic” pricing points ending in 49 Pf., 98Pf. or 99 Pf., we also treat prices such as 6.66 DM, 7.77 DM and 8.88 DM as “psychological”. For example, 7.77 DM is observed in approximately 10 percent of all purchases.⁶ Moreover, the distribution exhibits a large dispersion (spread and variance). The smallest price observed is 5.98 DM, the most expensive is 14.98 DM. This is partially due to extensive quality and product discrimination in the coffee market, but also to the dynamics of coffee prices in 1995; we return to this issue below.

⁶ The fractions of prices below 6.00 DM and over 10.00 DM are not reported since they are negligible.

Table 2a: Psychological pricing points for ground coffee

Price	Number of obs.	Relative frequency	Rank
Ground coffee, vacuum packed, 500g			
6,49	59	0,00	
6,66	158	0,01	
6,98	187	0,01	
6,99	1410	0,10	4
7,49	911	0,06	6
7,77	1429	0,10	3
7,98	295	0,02	8
7,99	3834	0,27	1
8,49	681	0,05	7
8,88	51	0,00	
8,98	191	0,01	
8,99	1827	0,13	2
9,49	153	0,01	
9,98	107	0,01	
9,99	911	0,06	5
<i>Other</i>	2043	0,14	
Sum	14247	1,00	

Source: GfK Consumer Panel 1995 (coffee: commodity group 12, article ID 24199); own calculations.

Table 2b: Psychological pricing points for milk

Price	Number of obs.	Relative frequency	Rank
Milk, 1l			
0,89	125	0,03	4
0,99	3504	0,71	1
1,09	844	0,17	2
1,19	232	0,05	3
Other	221	0,04	
Sum	4926	1,00	

Source: GfK Consumer Panel 1995 (milk: commodity group 08, article ID 15109); own calculations.

Table 2c: Psychological pricing points for ground butter

Price	Number of obs.	Relative frequency	Rank
Butter, 250g			
1,49	1226	0,04	6
1,59	2241	0,07	3
1,69	15195	0,45	1
1,79	7139	0,21	2
1,89	2036	0,06	5
1,99	2043	0,06	4
Other	3852	0,11	
Sum	33732	1,00	

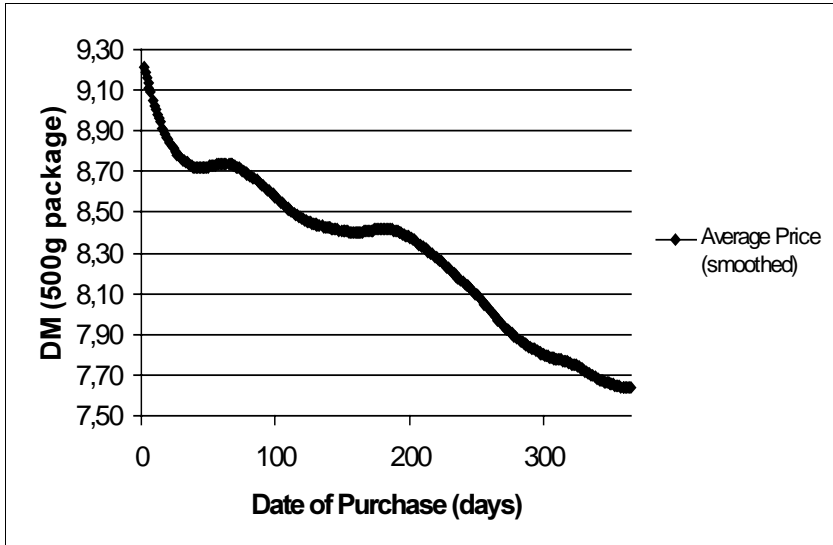
Source: GfK Consumer Panel 1995 (butter: commodity group 22, article ID 43990); own calculations.

Prices of milk exhibit less spread, but psychological pricing points dominate even more. Approximately 96 percent of all purchases show only four different prices, and 71 percent belong to only one price (99 Pf.). In contrast to coffee, the average price of milk remained constant over the entire year. With regard to butter, there were also only little changes in the average price over the year, but price dispersion is higher which might be due to quality and price differentiation. Again, we confirm the dominance of psychological pricing points (about 89 percent of observed purchases).

These results establish, once again, the importance of psychological pricing points and focal pricing in the German retail market (in this case for three grocery products of daily use). However, they only refer to the distribution of prices over the entire year. This static approach might mask actual price dynamics. In our dynamic analysis, we concentrate on one of the products presented above, precisely: on ground coffee. We choose this product because the average retail price exhibited an almost dramatic decline during 1995 (see figure 1), and because production costs are rather well known – the price of green coffee is determined on the world market, and it is essentially the same for all German coffee roasters.⁷

⁷ Almost all ground coffee sold in Germany is also roasted in Germany; the proportion of imported coffee is negligible (see Feuerstein, 1999).

Figure 1: Retail Coffee Prices



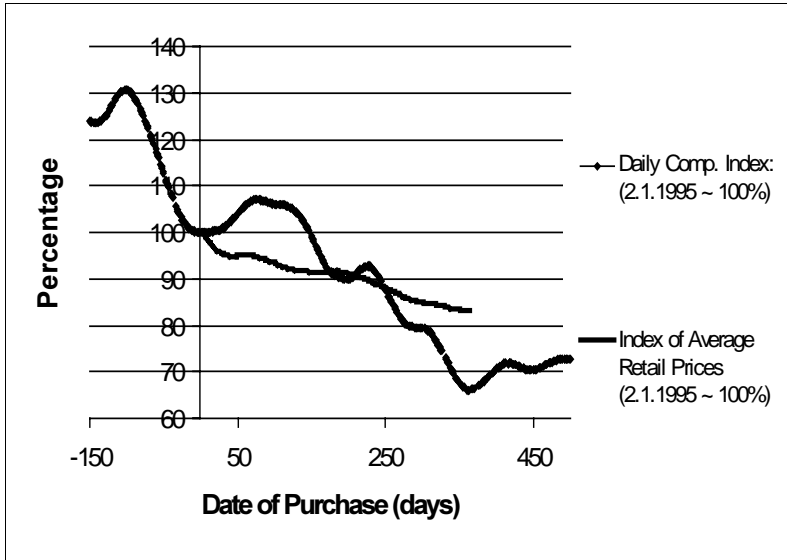
Source: GfK Consumer Panel 1995 (commodity group 12, product ID 24199); own calculations.

The strong decline in retail prices can be related to the decline of green coffee prices that occurred over the course of 1995. In figure 2, we present scaled indices of the average retail price and green of world-market.⁸ Note that the price of green coffee is displayed beginning in 1994, almost 150 days before the first retail price observation in our data, and well into 1996. The initial high prices are due to a shortage of green coffee following a frost in Brazil in 1994. This shortage was overcome continuously in 1995. From figure 1, we conclude that retail prices of roasted coffee track green coffee prices and that they are determined by the supply side. Feuerstein (1999) comes to the same conclusion in an econometric analysis of the German coffee market.⁹ For our analysis, it is important that the variation of retail coffee prices in the long run is determined exogenously because in this case we can make valid inferences on price adjustment behavior using observed retail prices.

⁸ The world market price of green coffee is available on a daily basis; we should like to thank P. Dubois, of the International Coffee Organization (ICO), London, for providing these data.

⁹ The study of Feuerstein (1999) provides a detailed analysis of the German coffee market, especially of the role of green coffee prices for price setting in a tight oligopoly.

Figure 2: Green Coffee Prices and Retail Coffee Prices

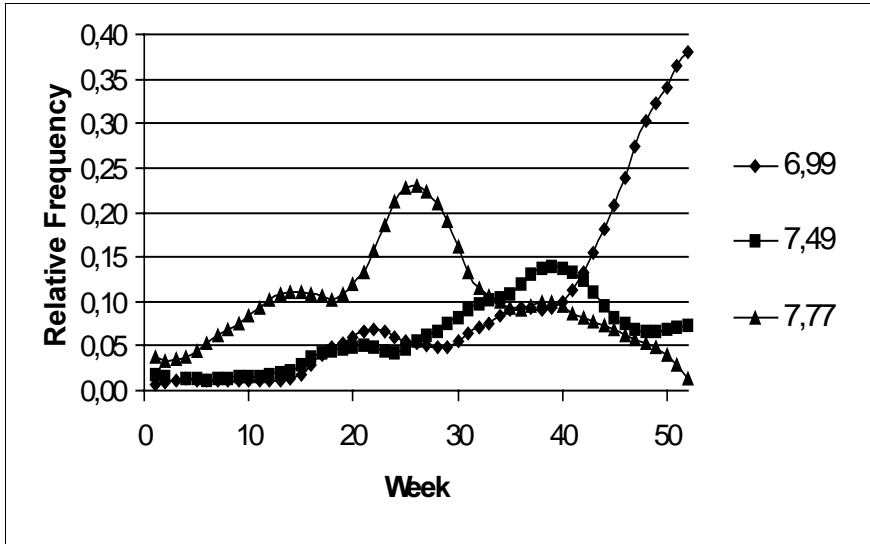


Source: International Coffee Organization, London; GfK Consumer Panel 1995 (commodity group 12, product ID 24199); own calculations.

For the analysis of price adjustment behavior, it is interesting to see how the long run drop of average retail prices is reflected in changes of the *distribution* of retail prices. To this end, we collapse our daily retail price data into an empirical distribution of weekly prices¹⁰ and determine their relative frequency. Using a kernel density procedure, we smooth the relative frequency of the most important (psychological) prices. For convenience of presentation, we divide the coffee market into three segments (lower, middle, and upper segment) that are presented separately (fig. 3, 4, and 5).

¹⁰ Fengler (2000: 61-62) discusses the assumptions under which this procedure is valid.

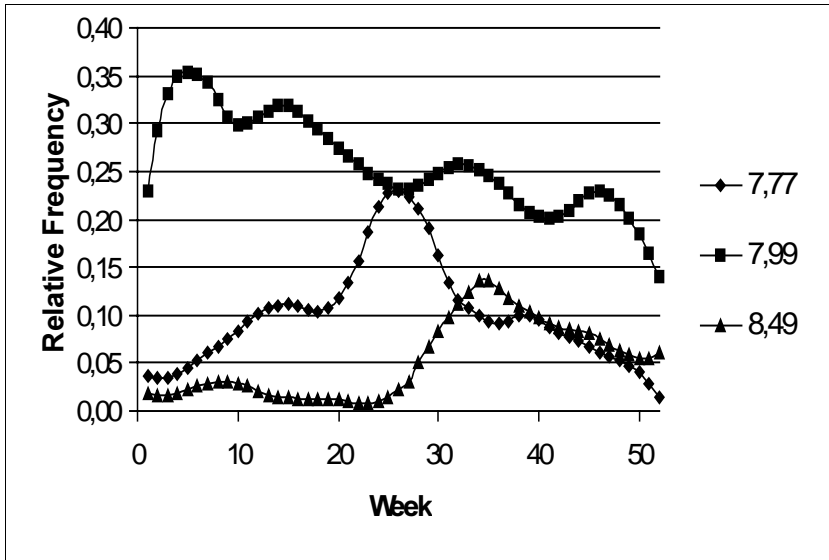
Figure 3: Fractions of Psychological Prices During the Year: Lower Price Segment



Source: GfK Consumer Panel 1995 (commodity group 12, product ID 24199); own calculations.

By inspecting the dynamics of the relative frequencies, it is evident that the slow and smooth decline of the average retail prices masks the sometimes rather abrupt movements of individual prices. These movements do not occur in a balanced fashion over the year, but are limited to a small interval of a couple of weeks during which the relative frequencies of prices change dramatically. Consider first figure 3 for the lower price segment. At the beginning of the year, the smallest prices, 6.99 DM and 7.49 DM, are negligible. With time passing, their relative frequency is rising slowly, until – beginning in the 40th week – the price of 6.99 DM, with a fraction of 35% of all quotations, clearly dominates the price segment (and also the whole market; see fig. 4 and 5). This fast upward move is accompanied by declining frequencies of the prices 7.49 DM and 7.77 DM which are the nearest focal prices. Whereas one might expect that during a price decline, the lowest price becomes more significant, the dynamics of the other prices are ambiguous. The rise in significance of the price of 7.77 DM in the first months of the year (see fig 4) is probably a result of the shrinking importance of the 7.99 DM price.

Figure 4: Fractions of Psychological Prices During the Year: Middle Price Segment

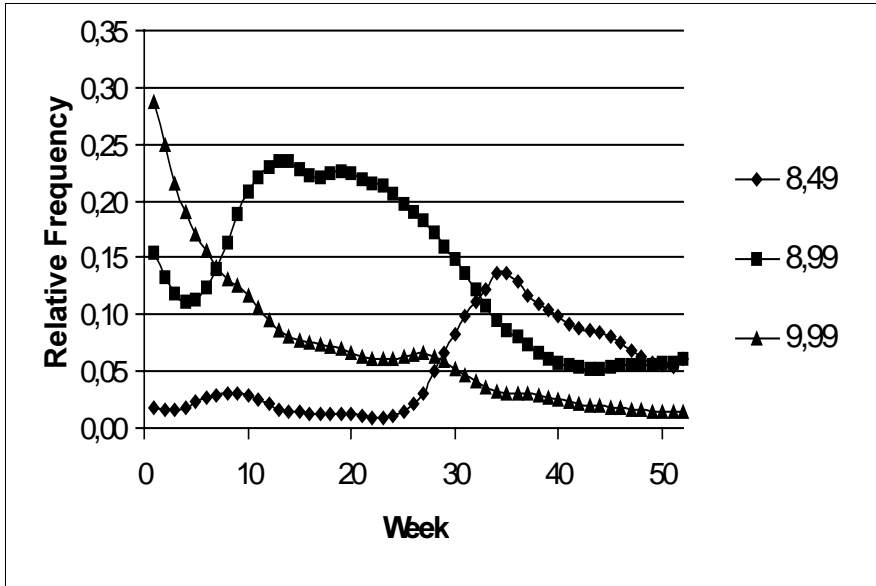


Source: GfK Consumer Panel 1995 (commodity group 12, product ID 24199); own calculations.

Finally, we inspect the upper segment (figure 5). Here, the frequency of the 9.99 DM prices is dropping rather fast, while at the same time the next lower focal price 8.99 DM establishes itself as the dominant price in the upper segment. The declining importance of both prices beginning in week 27 results again in a sharp upward movement in the frequency of 8.49 DM prices which until then had been insignificant.

These empirical observations allow two conclusions: First, psychological prices are very important in German retail markets for fast-moving consumer goods; this replicates the findings of earlier studies. Second, our analysis reveals how complex the dynamics of individual prices is, even if the adjustment of *average* prices to a cost shock looks smooth. Our conclusion from these empirical findings is that retail prices are rigid to an extent which is relevant from an aggregate point of view. We should stress, once again, that assessing the aggregate consequences of price rigidities more adequately would require a structural model of aggregation.

Figure 5: Fractions of Psychological Prices During the Year: Upper Price Segment



Source: GfK Consumer Panel 1995 (commodity group 12, product ID 24199); own calculations.

Finally, let us point out that by the nature of the data, the prices observed refer to actual purchases, meaning that the actual distribution of prices offered by retailers might deviate from the distribution observed in the data set. This will especially be the case when consumers prefer products with psychological pricing points. It would be interesting to investigate this selection problem more formally, but we lack the appropriate data. In any case, our results provide evidence for the importance of psychological prices from a consumer's point of view: The large proportion of these "psychological" prices among all possible prices reveals that consumers prefer these prices even if there were products with other prices available. Moreover, above-mentioned the selection problem might be negligible in practice: Since retail markets are very competitive, products which are purchased only infrequently will not survive on retailers' shelves for long. We are therefore confident that there are hardly any products (and therefore prices) which are not covered by our data set.

5. Overview of further empirical approaches to the GfK Consumer Panel

Based on price data obtained from the GfK Consumer Panel, at least three other topics can be addressed empirically. We discuss these issues in the following sections very briefly. For a more detailed survey of the literature and empirical results on these topics, see Fengler (2000).

5.1 The empirical relevance of fixed costs of price adjustment

In addition to psychological pricing points, many other mechanisms of individual price setting and price adjustment that may lead to price rigidities have been developed in the New-Keynesian and Industrial Organization literatures; Köhler and Winter (1993), Köhler (1996) and Blinder et al. (1998) provide surveys. Some of these approaches can be evaluated using the price data obtained from the GfK Consumer Panel.

One aspect of price adjustment considered in the recent literature is the cost associated with adjusting prices. These costs include actual expenses when printing new price lists or changing price tags, but also fictitious costs like lost reputation among consumers. Mostly, these costs are fixed since they do not depend on the magnitude of the price change. Often, these costs are referred to as “menu costs” (Mankiw, 1985). A nice example for adjustment costs are the costs borne by restaurants when printing new menus, and prices of restaurants are changed only infrequently. In a very detailed study of U.S. supermarket chains, Levy et al. (1996) document the existence of fixed costs and their structure in retail stores.

In theoretical models of price adjustment behavior, one can derive the result that firms which are subject to fixed costs of price adjustment change prices more infrequently, but with bigger jumps resulting in discontinuous price paths. Under certain technical assumptions with respect to the stochastic dynamics of the exogenous variables (for example the nature of the input price process), one can show that pricing behavior can be characterized by certain lower and upper bounds. In these circumstances, actual prices will mostly deviate from their optimal levels.

Inspection of figure 3, 4 and 5 reveals that the discontinuous price adjustment can be observed in the coffee retail market. Therefore, we would conclude that there is some evidence for fixed costs of price adjustment in the price data obtained from the GfK Consumer Panel. A detailed analysis of the relevant lower and upper bounds is, however, limited since – as was already mentioned – we cannot observe individual price changes in the data.

5.2 Aggregate consequences of individual price adjustment behaviour

As noted earlier, a comprehensive assessment of the aggregate consequences of microeconomic price rigidities is possible only within the framework of a structural aggregation model. For example, the lumpy adjustment caused by fixed adjustment costs (which is a microeconomic rigidity) might vanish completely in the aggregate price level. To achieve this remarkable result, the adjustment of individual prices has to be staggered in a certain way.¹¹

Comparing the smooth and continuous path of average retail prices (figure 1) with the rigidities documented in individual prices (figures 3 to 5) does not contradict these kinds of models. A more detailed empirical analysis with price data obtained from the GfK Consumer Panel seems possible; however, once again such an analysis would be limited by the fact that no individual time series of price paths are available.

5.3 Price dynamics, price dispersion, aggregate price level, and inflation

The hypothesis that the dynamics and dispersion of individual prices are not independent of changes in the aggregate prices level, i.e., the rate of inflation, is rather old. Mills (1927) found a positive correlation between price changes and the rate of inflation when investigating American whole sale price indices; his findings have been replicated in vast number of subsequent studies.¹² However, we should point out that this empirical regularity has not yet found any satisfying theoretical basis.¹³

The structure of the GfK Consumer Panel suits the purpose of empirical studies in this area perfectly. To our knowledge, there is only one comparable study which uses data with both high frequency and a low aggregation level; these data are from a period of hyperinflation in Argentina (Tommasi, 1991). It is interesting to replicate this study using the GfK data which were recorded in the stable monetary environment of Germany in 1995. Fengler and Winter (2000a) report first results based on an econometric analysis using panel-data methods.

¹¹ See Blanchard (1983, 1987), Caplin and Spulber (1987), Caplin and Leahy (1991), Caballero and Engel (1991), Caballero (1992).

¹² See Vining and Elwertowski (1976), Sheshinski and Weiss (1977, 1983), Parks (1978), Fischer (1981), Danziger (1987), Domberger (1987), Lach and Tsiddon (1992) and, for Germany, Franz (1985) and Gahlen (1988).

¹³ Hartman (1991) and Bryan and Cecchetti (1999) maintain that the correlations might possibly be due to methodological problems and therefore could constitute statistical artefacts without any economic content.

6. Summary and outlook

In many economic models, it is assumed that prices adjust instantaneously to changes of economic conditions (e.g., to shocks in demand or production costs). Since the existence of price rigidities has been frequently documented, more realistic models require that infrequent and lumpy price adjustment have to be taken into account. There are still many unresolved issues in this area, both theoretically and empirically.

In this paper, we show that the dynamics and dispersion of retail prices can be investigated using price data obtained from the GfK Consumer Panel for 1995. Our results document the importance of psychological pricing points for price setting, confirming results from many earlier studies. A new aspect of our analysis that has not been investigated in the literature is the relevance of psychological prices points for price adjustment and aggregation. We interpret our findings as suggestive evidence for the notion that rigidities are relevant for aggregate dynamics in Germany. However, we also confirm that a structural aggregation theory is necessary for a better understanding of the relevance of micro-level rigidities for aggregate dynamics. In such a more comprehensive model, price data obtained from the GfK Consumer Panel might also prove very helpful in the future.

Among the three other areas of empirical research that could potentially be explored with price data from the GfK Consumer Panel, the analysis of the relationship between individual price dynamics, price dispersion and aggregate inflation proves particularly fruitful. Moreover, the very disaggregated, high-frequency data contained in this data-set are almost unique. In other research areas which require that prices changes (and not only distributions of prices) are observed over time, empirical tests unfortunately suffer from the fact that time series of individual prices can be constructed only under additional strong assumptions.

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