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The dark side of coffee.
Price war in the German market for roasted coffee.

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Abstract.
Germany is the second largest coffee market in the world, just overshadowed by the United States. Coffee is the most popular beverage in Germany – in fact more popular than beer. In 1999 the five biggest companies in the raosted coffee market had a combined market share of 84.5%. The market is characterized by fierce competition which continues to squeeze the earnings of the German coffee roasters. The degree of competition was expected to increase even more as a result of a merger in 1997. This paper examines the pricing behavior in the German market for roasted coffee. The second question is whether the degree of competition has changed due to changes in market structure and changes in demand. Changes in market structure are the merger of *Tchibo* and *Eduscho* in 1997. Changes in demand are cyclical demand fluctuations - every year before Easter and Christmas. Empirical results are derived using data on the aggregate market for roasted coffee in Germany during 1992:1 to 2000:12 and indicate that the market is suffering on not only a severe price competition, but on price war.

Keywords.
Market for roasted coffee; Germany; conjectural variation; market power; simultaneous equation system; GMM.

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1. Introduction

Germany is the second largest coffee market in the world. With a share of 9.3% of total green coffee consumption, it is only overshadowed by the United States with a share of 21.6% (DKV 2001). Within Germany, coffee is the most popular beverage, in fact more popular than beer. Per capita consumption of green coffee in 2000 was 6.7 kg (corresponding to 162.4 litre of brewed coffee). In contrast, 'only' 127.5 litres of beer were consumed in the same year (GFK 2000). However, coffee is a stagnating market with negative rates of growth and fierce price competition. The average growth rate of nominal sales for the period 1995 to 2000 in Germany is –2.5% while the average growth rate of consumption is -1.6%.

In 1999 the five biggest companies in the roasted coffee market have been *Jacobs* with a market share of 27% (measured by turnover), the merged company *Tchibo/Eduscho* with 24%, *Melitta* with 13.5% and *Aldi* with 12% as well as *Dallmayr* with 8% (LIENING 2000). These companies have a combined market share of 84.5%. The market for roasted coffee is characterized by fierce competition which continues to squeeze the earnings of the German coffee roasters (METHA 1997b). The degree of competition was expected to increase even more as a result of the merger of two German coffee roasters (*Tchibo* and *Eduscho*) at the beginning of 1997. Market observers expected substantial changes in firms' pricing behavior: "[the merger] could lead to devasting competition among roasters who could be inclined to cut prices for the sake of mere survival" (METHA 1997a).

This paper examines the pricing behavior in the German market for roasted coffee. Especially for 1994 and 1995 the INTERNATIONAL COFFEE ORGANIZATION (ICO) claims that the domestic market in Germany became more competitive. Price reductions does not only reflect changes in world market prices but smaller profit margins in a period of dampened consumption (ICO 1996). This paper examines, first, the pricing behavior in the German market for roasted coffee. The second question is whether the degree of competition has changed due to changes in market structure and changes in demand. Changes in market structure are the merger of *Tchibo* and *Eduscho* in 1997. Changes in demand are cyclical demand fluctuations - every year before Easter and Christmas.

The analysis differs from previous work in two ways: Whereas the existing literature has investigated firms' behavior for the Netherlands (BETTENDORF/ VERBOVEN 1997 and 2000) and for the USA[1] (GOLLOP/ROBERTS 1979), this paper is the first to apply a simultaneous equation framework to the aggregate German market

[1] Cross section analysis, data on the 52 largest firms in the year 1972 (GOLLOP/ROBERTS 1979).

for roasted coffee. Second, it focuses on the question whether suppliers of roasted coffee change their pricing behavior due to exogenous shocks, in particular cyclical demand fluctuations before holidays and merger. The outline is as followed. The next section discusses the theoretical model of market demand and market supply. Section 3 describes the data and the empirical design. Regression results follow in section 4. Concluding remarks contains the last section 5.

2. Theoretical model and specifications.

Roasted coffee is supposed to be a homogenous good.[2] Following BETTENDORF/VERBOVEN (2000) a simultaneous model of demand and supply of roasted coffee is specified. Demand is specified as a linear demand curve homogenous of degree zero in prices and income. Consumption of roasted coffee is determined by the retail price of roasted coffee, the net income of households and prices of other beverages (complementary and substitute) (KUTTY 2000). The demand function can be written as

$$Q_t = a_0 + a_1 p_t + a_2 y_t + a_3 p_t^c + a_4 p_t^s \tag{1}$$

with Q_t as consumed quantity of roasted coffee, $a_k \forall k = 0...4$ as parameters to be estimated, p_t as price for roasted coffee, y_t is the net income of households, p_t^c denotes the retail price of a complementary good (like soda water) and p_t^s the retail price of a substitute good (like caffeine-containing soft drinks, tea or soluble coffee). The index t ($t = 1...T$) designates the time.

Suppliers are assumed to maximize profits by choosing quantity as strategic variable.[3] The profit of firm *i* ($i = 1...n$) at time *t* can be written as

$$\pi_{it} = p_t(Q_t)Q_{it} - C_i(Q_{it}, w_t) \tag{2a}$$

with Q_t as total quantity sold, Q_{it} as quantity sold by firm *i*, C_i as cost function of firm *i* depending on the own quantity sold (Q_{it}) and a vector of input prices w_t. Since 1993 the roasters have to pay a specific tax on roasted coffee. [4, 5] The tax is

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[2] Homogeneity is assumed because of aggregate data in the empirical analysis (see e.g. COWLING/WATERSON 1976 and CLARKE/DAVIES 1982). For the USA (GOLLOP/ROBERTS 1979) and the Netherlands (BETTENDORF/VERBOVEN 2000) homogeneity of roasted coffee is presumed as well.

[3] The resulting model contains the possibility of imperfect competition as well as perfect competition by the value of the elasticity of conjectural variation.

[4] The government invents through the levying of the coffee tax and of the value added tax. The excise tax is 4.30 German Marks per kilogram of roasted coffee. The value added tax on food counts for 7%.

[5] Till 1992 there has been a tax of 1.80 German marks per pound on green coffee and the tax of 2.15 German marks per pound on roasted coffee. Because of the harmonization due to the

symbolized by τ_c while the value added tax is given by τ_{vat}. The equation (2a) can be modified to

(2b) $$\pi_{it} = \frac{1}{1+\tau_{vat}} p_t(Q_t)Q_{it} - C_i(Q_{it}, w_t) - \tau_c Q_{it}.$$

Solving the maximization problem subject to the individual quantity Q_{it} it follows that

(3) $$p_t = (1+\tau_{vat})\frac{\partial C_i}{\partial Q_{it}} - \frac{\theta}{\eta} p_t + (1+\tau_{vat})\tau_c$$

with $\theta = \frac{\partial Q_t}{\partial Q_{it}} \frac{Q_{it}}{Q_t}$ and $\eta = \frac{\partial p_t}{\partial Q_t} \frac{Q_t}{p_t}$. η symbolizes the price elasticity of demand for roasted coffee. θ is the conjectural elasticity of total output with respect to the output of the *i*th firm (conjectural variation).[6] The elasticity of conjectural variation can take values between Zero and One. A value of Zero indicates that there is no response of total quantity to a change in firm *i*'s output change, while a value of One is interpreted as the monopoly case (or perfect collusion). LOPEZ (1984) emphasised that the degree of market power will vary monotonically with the level of θ.

For a market model the individual supply functions have to be aggregated to a market supply function. For simplicity, it is assumed that the cost function has the GORMAN-Polar form (GORMAN 1953, BLACKORBY et al. 1978). This function stresses individual costs functions to be quasi-homothetic. It implies that at the optimum marginal costs are equal over all firms.[7] With respect to firms' behavior the elasticity of conjectural variation is assumed to be identical across all firms (MCCORRISTON/MORGAN/RAYNER 2001).

Using the demand function (1) the price elasticity of demand can be computed as $\eta = a_1 \frac{p_t}{Q_t}$ and used in the equation (3). The relevant supply function for firm i is

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European Single Market the indirect taxation has been abolished. But the member states have intervented for the right to raise national taxes. Germany keeps the tax on roasted coffee (FEUERSTEIN 1996b).

6 Because of the use of aggregated data the formula of e.g. BRESHNAHAN (1982) is not introduced. BRESHNAHAN modeled conjectural variation as firm *i*'s conjectures about other firms' behavior. GOLLOP/ROBERTS (1979) suggested to evaluate the aggregate output response if only the existence of oligopolistic interdependence is examined.

7 Additionally this form allows different firm to have different cost curves but the curves are all linear and parallel (APPELBAUM 1982).

(4) $$p_t = (1+\tau_{vat})\frac{\partial C_i}{\partial Q_{it}} - \frac{\theta_i}{a_1}Q_t + (1+\tau_{vat})\tau_c \,.$$

Data on prices, tax rates and consumption quantity can be easily obtained. The parameters θ and a_1 are derived directly following APPELBAUM (1982). The estimated parameter θ gives evidence for the price setting hypothesis.

Conjectures need not be constant. They may vary over time because firms form conjectures based on their experiences and expectations. Changes in the parameter θ can be lead back to two reasons: First, changes in market structure causes adjustment in pricing strategy. And second, changes in demand affect the pricing behavior.

Concerning roasted coffee, changes in market structure happened at the beginning of 1997: Two German roasters (*Tchibo* and *Eduscho*) officially merged.[8] At that time *Tchibo* was the second largest roaster and *Eduscho* the number three. Because market observer found "uncertainty and fierce competition" in the German coffee market (METHA 1997a), the merger is excepted to influence the pricing behavior.

Changes in demand of roasted coffee happens systematically over the year. The coffee purchases are significantly higher before Easter and Christmas compared to the other months. This could be seen as cyclical demand fluctuations. Anticipating these commonly known demand variations, firms are expected to adjust their pricing behavior. A high level could be interpreted as "boom" and a lower level as "recession". Following the literature on collusive behavior over the business cycle there are two opposite views describing firms' conduct over the cycle. On the one hand, collusive prices tend to move procyclically (e.g. SCHERER 1980, SUSLOW 1988, GREEN/PORTER 1984). If demand shrinks, firms suppose their rivals to underrun the collusive agreement.

On the other hand, collusion is claimed to be more difficult during booms because the incentive to deviate is the greatest (e.g. ROTEMBERG/SALONER 1986, BRESHANAN 1987, DOMOWITZ ET AL. 1995). ROTEMBERG/SALONER (1986) found evidence for an increasing degree of competition in periods of raising demand. Firms have an incentive to cheat on a collusive agreement because the most profitable strategy is to attract consumers via granting price reductions. HALTIWANGER/HARRINGTON (1991)

[8] In April 1997 the *BUNDESKARTELLAMT* (German Antitrust Authority) gave the permission for this merger.

and FABRA (2001) obtained similar results based on deterministic demand shocks.[9] KANDORI (1997) extends the analysis assuming serially correlated demand shocks and finds the same countercyclical movement.[10]

Especially for foods the seasonality and frequency of purchases have to be considered. And in particular for roasted coffee, the possibility of storage has to be taken into account. MCDONALD (2000) described falling prices for seasonal food products due to demand peaks: Seasonal demand increases reduce information costs and costs of informative advertising. The price declines are linked to market concentration and strengthened by a limited number of rivals (MCDONALD 2000). PARKER (1997) argued that demand fluctuations are fluctuations in the elasticity of intertemporal substitution. Considering goods for which the timing of purchases is possible (by e.g. stock holding) demand-driven rise in sales induces relatively low real price increases. Firms smooth prices over time.

To test for variations in the pricing behavior, the period analyzed is divided into subperiods (before and after structural breaks). If pricing behavior changes the conjectural variation can be explained by

$$\theta = \mu + \gamma * dummy \qquad \text{with } dummy = \begin{cases} 1 & after \quad the \quad event \\ 0 & before \quad the \quad event \end{cases}. \tag{5}$$

The dummy variable takes the value Zero before the event, and is set equal to One in the period after the event. Using (5) in the supply equation (4) a test whether firms' behavior has significantly changed is possible. Concerning demand changes the hypothesis is that pricing behavior changes systematically due to anticipated demand fluctuations. This can be tested with the dummy variable taking the value One if the month covers Easter or Christmas and Zero else. Test of the impact of changes in market structure (e.g. the merger) can be driven out in the same way. The dummy variable is Zero before the merger and One after the merger. If the estimated parameter deviates significantly from Zero the hypothesis of no response can be rejected.

[9] In contrast, SPENCE (1977) identified the level of excess capacity and the degree of collusion to be negatively related. Collusive prices tending to move procyclically. But capacity constraints seem to be no restrictive argument for coffee because coffee can be stored easily.

[10] In a market in which demand growth rates are correlated through time, BAGWELL/STAIGER (1997) show that pricing amplitudes are larger when expected duration of the boom (recession) decreases (increases).

4. Data and estimation specifications.

The empirical analysis is based on monthly data for the German roasted coffee market over the period 1992:1 to 2000:12. The main data sources are the GERMAN FEDERAL STATISTICAL OFFICE and the INTERNATIONAL COFFEE ORGANIZATION (ICO). Since Germany does not grow coffee itself and all stocks are on a quite low level, consumption is measured as imports less re-exports (green bean equivalent). Data for imports and re-exports are taken from the ICO denoted in green bean equivalents.[11]

Retail prices and total expenditure per capita are taken from the GERMAN FEDERAL STATISTICAL OFFICE and computed as real values. FEUERSTEIN (1996a) argues that no good is a good substitute for roasted coffee whilst KUTTY (2000) and BETTENDORF/VERBOVEN (2000) see tea as close substitute. Four different beverages are used alternatively: black tea, soluble coffee, soft drinks containing caffeine (for simplicity called 'coke') and soda water.

Knowledge about the production process helps to model marginal costs. The roasting of coffee itself is quite simple (see e.g. SUTTON 1991) including coffee beans, roasting and grinding as well as packaging. All input factors are used in fixed proportions between material input and output. Economies of scale in production are limited (BETTENDORF/VERBOVEN 2000). Thus, firms' marginal costs can be written as a linear function of the inputs. AZZAM (1997) pointed out that this assumption is appropriate especially in food processing industries because the firms cannot affect the yield from the raw material. Using APPELBAUMS (1982) framework marginal costs are inferred indirectly from evolution of input prices.

The main input factor are coffee beans. Measured as a fraction of the total production value the costs of coffee beans count for a share of 67% on average while other input factors take an individual cost share less than 5%. Because the world market prices of green coffee beans are quoted in US-cents, and the retail price in Germany is in German Marks the analysis has to take into account fluctuations in the exchange rate. The relevant marginal cost function includes the prices of green coffee beans of three different varieties $w_i \forall i = 1,2,3$ (in US-cents) and the exchange rate of Dollar versus German Marks. As an additional input factor the model contains the costs for labor which is computed as wage per employee (monthly average). The price index of freight considers the costs of distribution

[11] Because of the standardized measure (green bean equivalents) it is not necessary to distinguish between green, roasted and soluble coffee. The production of one kilogram of roasted coffee needs 1.19 kilogram of green coffee, one kilogram of soluble coffee requires 2.6 kilogram of green coffee (DKV 1997). Such technological requirements make it necessary to use a unified measure.

within Germany while the oversea transportation costs are included in the green bean prices: Quotations for the variety *Other Milds* w^{mild} are for prompt shipment to Bremen/Hamburg, for *Colombian Excelso* w^{colom} for prompt shipment to several major coffee markets including Bremen/Hamburg, and *Robustas* w^{rob} for prompt shipment to LeHavre/ Marseilles. The marginal cost function is given as (6):

$$MC_{it} = w_t^{mild} + w_t^{colom} + w_t^{rob} + exchange\ rate_t + labour\ costs_t + freight_t . \tag{6}$$

Table 1 shows the descriptive statistics of all variables.

Table 1: Descriptive statistics in the sample.

Variable	Mean	standard deviation
Consumption in mln. bags à 60 kg.	0.8314	0.1778
Real retail price of roasted coffee, in German marks per 500g.	8.4397	0.7604
Real household expenditure in bn. German marks.	1.9702	0.1590
Price index of soft drinks containing caffeine (1 liter)	1.0031	0.0223
Real world market price of *Other Milds Bremen/Hamburg*, in US-Dollar per pound.	1.2736	0.4360
Real world market price of *Colombian Excelso*, in US-Dollar per pound.	1.2031	0.4357
Real world market price of *Robustas LeHavre/Marseilles*, in US-Dollar per pound.	0.8424	0.3352
Real Exchange rate US-Dollar/German Marks	0.9830	0.0906
Monthly wages per employee in 1.000 German Marks	5.1144	0.6196
Price index of freight rate	1.6780	0.1643

Using (6) the estimation model for the simultaneous model is specified as:

$$Q_t = \alpha_0 + \alpha_1 p_t + \alpha_2 y_t + \alpha_3 time_t + \alpha_4 p_t^c \tag{1'}$$

$$p_t = 1.07 * \left[\beta_0 + \beta_1 w_t^{mild} + \beta_2 w_t^{colom} + \beta_3 w_t^{rob} + \beta_4 ex_t + \beta_5 wage_t + \beta_6 freight_t\right] - \frac{\theta}{\alpha_1} Q_t + 2.3005 \tag{7}$$

The demand equation includes a time component. While GLANIA (1997) describes a consumption pattern without seasonal variations, BETTENDORF/VERBOVEN (2000) find Dutch coffee demand lowest in the first quarter and highest in the fourth quarter of a year. Testing different consumption patterns, the best fit yields a smooth increasing trend.

Non-linearity in the parameters of the estimation equations (7) requires the GMM estimation procedure (see HANSEN/SINGLETON 1982). The instruments for the system estimation are the different input prices and the exchange rate, the price indices (beverage, freight), labor and the expenditure of households as well as the consumer price index. The estimation considers heteroscedasticity and serial

correlation of the residuals. Thus, the regression standard errors and covariance matrices are corrected for heteroscedasticity and autocorrelation up to a moving average of second degree.

5. Estimation results.

Three different specifications are estimated. First the so-called "*basic model*" without any dummy variables. The estimation should give information about the behavior of the firms in the market over the whole period. The second estimation specifically considers the consequences of the merger ("*merger model*"). The third model specification analyses the impact of cyclical demand fluctuations related to the holidays Easter and Christmas ("*holiday model*"). The estimation results of the structural models are shown in the following table 2.[12]

Table 2. Estimation results (*t*-values in brackets).

			Basic model			**Merger model**			**Holiday model**		
DEMAND	**Constant**	α_0	**3.2008**	***	(4.6274)	**3.5227**	***	(3.8363)	**5.5625**	***	(4.3865)
	Retail Price	α_1	**-0.1023**	***	(-4.9595)	**-0.0578**	***	(-2.5654)	**-0.1108**	***	(-4.3841)
	Trend	α_3	**0.0220**	***	(3.0223)	**0.0240**	**	(2.2964)	**0.0341**	***	(2.9126)
	Income	α_2	**-0.0092**	***	(-2.8163)	**-0.0085**	**	(-2.4167)	**-0.0110**	**	(-2.3701)
	Retail Price 'Coke'	α_4	-0.1743		(-0.3305)	**-1.0211**	*	(-1.7473)	**-2.2393**	***	(-2.7683)
	Holiday Dummy	α_5	--		--	0.2094		(1.0620)	--		--
SUPPLY	**Constant**	β_0	**8.9734**	***	(5.0819)	**11.8804**	***	(3.4139)	**4.7947**	*	(1.7116)
	Other Milds	β_1	**2.1256**	**	(2.0852)	**3.6240**	**	(2.0747)	**2.3433**	**	(2.1895)
	Colombian Excelso	β_2	**-2.0485**	***	(-2.1699)	**-3.5127**	**	(-1.9214)	**-2.5023**	***	(-2.4529)
	Robustas	β_3	**0.3205**	**	(2.8277)	**0.5876**	**	(2.1321)	**0.7310**	***	(2.7659)
	Wage per employee	β_5	**-0.7373**	*	(-1.7614)	-0.7813		(-1.1093)	**-1.9517**	***	(-2.4339)
	Exchange Rate	β_4	-0.0008		(-0.0092)	0.0298		(0.1480)	0.0246		(0.3131)
	Price Index Freight	β_6	**3.1719**	**	(2.1616)	0.7707		(0.6441)	**7.5289**	***	(2.5039)
	Conjectural Variation	θ	**-0.6988**	***	(-4.5189)	**-0.4850**	*	(-1.8832)	**-0.5254**	***	(-2.9231)
	Holiday Dummy	γ	--		--	0.1181		(1.0612)	--		--
	Merger Dummy	γ	--		--	--		--	0.0920		1.8265
	Iterations		28			10			14		
	Final criterion		0.0000076 < 0.00001			0.0000008 < 0.00001			0.0000077 < 0.00001		
	DW[13] demand equation		2.0550			2.3337			1.9166		
	DW supply equation		2.0672			2.2148			1.9775		

* denotes a significance level of 10%. ** a significance level of 5%, *** a significance level of 1%.

[12] The equation (7a) and (7b) are estimated, not the reduced forms. For the second and third model the dummy formula (5) is included in equation (7b).

[13] *DW* is the DURBIN-WATSON Statistic.

The estimated parameters of the retail price is negative and significantly different from Zero. The average own price elasticity is –1.0385 in the *basic model*, -0.5868 in the *holiday model* and –1.1248 in the *merger model*. The average income elasticity is –1.7809, –1.6454 and –2.1293, respectively. The magnitude and especially the sign of this elasticity is surprising. Nevertheless one possible explanation for this finding may be that the analysis uses aggregated data on consumption. Consumption data does not distinguish between different qualities. With increasing income households may change consumption towards less quantity and more quality. This behavior would lead to decreasing quantity and thus, to a negative price elasticity.

Findings for the impact of beverages - other than coffee - are not as clear as for own price and income. Soft drinks with caffeine ('coke') yields the best results. While in the *basic model* 'coke' has an insignificant influence on the demand for roasted coffee, the impact on demand is weak in the *holiday model* and significant in the *merger model*. The findings of the basic model confirms the observation of FEUERSTEIN (1996a). The negative sign in the other models indicates that soft drinks are complements to roasted coffee.[14]

The estimated signs of the coffee varieties indicate that *Other Milds* and *Robustas* influence the retail price positively while a price increase in the *Colombian Excelso* variety reduces the retail price. This relationship is unexpected and may suggest that the latter variety is less important in the German market. Another possible explanations are differences in quality. *Other Milds* and *Colombian Excelso* are important for roasted coffee. The latter is used to produce premium roasted coffees. If the price of *Colombian Excelso* increases, roasters substitutes these more expensive beans. Instead they use the *Other Milds*. Because the water losses during roasting are about 20% independent of the variety, the reduction in one variety must cause a similar increase in one other variety. Such replacements may lead to the negative sign for *Colombian Excelso* and a positive sign for *Other Milds* as well as an absolute value of nearly the same size. Costs due to changes in the exchange rate as well as labor and freight costs do not significantly influence the consumer price for roasted coffee.

[14] The estimated sign of the soft drinks is unexpected. All goods reveal a negative sign, that is, all goods are complements to roasted coffee even black tee and soluble coffee. This relationship must be an aspect of further research.

All estimated parameters of the conjectural variation deviate significantly from Zero. In the basic model the coefficient is $\theta = -0.6988$. Given the level of concentration in the market (CR6 = 0.9), the existence of power to control price among the largest firms is plausible. And especially, the negative value indicates that the competition is more intensive than under BERTRAND-behavior (which would be value of Zero). Price competition with a higher degree of competition than in the BERTRAND-case could be called "price war" – the dark side of coffee.[15]

Significance of dummy variable gives evidence whether exogenous shock has an effect on pricing behavior. The estimated coefficient of the *holiday model*-dummy does not differ significantly form Zero. Hence, months without a holiday have the same elasticity of conjectural variation as months with a holiday ($\theta^0 = \theta^1 = -0.4850$). The annual consumption scheme does not induce structural adjustments in suppliers' prices although this cycle is common knowledge. The 'peaceful times of the year' - Christmas and Easter – do not stimulate variations in the intensity of competition. This confirms the findings of PARKER (1997). He found that price responses to fluctuations in demand are minor for goods for which the timing of purchase is important. But independent of this insignificance the competition is still strong. The estimated coefficient is negative. Related to the equation (7) the price is below the marginal costs – evidence for the price war hypothesis.

After the merger, the number of suppliers is lower affecting the market outcome. The coefficient of the *merger model*-dummy has the opposite sign of the conjectural variation and deviates significantly from Zero. The difference in pricing behavior before and after the merger is significant. Before the merger the conjectural variation was $\theta^0 = -0.5254$, after the merger $\theta^1 = -0.4334$. Hence the impact of the merger is a decreasing degree of price fights: Away from price war towards BERTRAND competition. The merger has driven competition towards BERTRAND-behavior (price competition). But the degree of competition is still strong. The consumers could nevertheless benefit from relatively low prices because of the price war but their benefits become smaller.

[15] To test the stability of the results (e.g. whether the parameter is negative over the whole period or not) the sample period is divided into two subperiods: 1992:01 to 1996:12 and 1997:01 to 2000:12. The results indicate that the conjectural variation does not deviate significantly from Zero in the first period, but in the second. In the second period, the estimated coefficient is negative. Combining these findings gives evidence for the interpretation that the price war behavior in the second period dominate the whole sample. Estimation results should be handled carefully due to the small number of observation. Estimates are given in the Appendix.

Prices below marginal costs over several years is unexpected. An explanation may be the distribution chain. Food retailers often use roasted coffee as special offer and as product to tempt consumers to come in and buy other products as well. Consumer price for one pound of roasted coffee depends not only on the roasters production costs, it depends even more on the price policy of retailers. The ICO has commented that short-term price discounts has increased (ICO 1996).

6. Conclusions.

This analysis examines the pricing behavior of coffee roasters in Germany for the period 1992:1 to 2000:12. The estimated elasticity of conjectural variation deviates significantly from Zero. Even more it is negative indicating a degree of competition which is more intensified than under BERTRAND-behavior: Price war. This pricing behavior varies over time due to exogenous influences. The exogenous influences are the merger of two coffee roasters and retailers *TCHIBO* and *EDUSCHO* in 1997 and the cyclical fluctuations in consumption (before Christmas and Easter). While the merger has intensified the price war, the commonly known consumption scheme does not affect the firms' behavior.

Improvement of the analysis could be made by a few adjustments. First, the retailer and roaster level should be separated from each other. The gain would be that the effect of short-term price discounting could be analyzed straightforwardly. Second, the homogeneity assumption of the good 'roasted coffee' is a very strict assumption. The German market is characterized by extensive choice with many brands and many blends offering different qualities (ICO 1996). The market could be modeled in a more appropriate way concerning differences in quality.

Little is known about the effects of aggregation on the results. Panel data for individual firms' seems to be more appropriate. Furthermore, firm-level data could intend research on differentiated duopoly and the analysis of pricing strategies. Within heterogeneous firms, BERTRAND-behavior could be modeled explicitly with price as strategic variable (FEUERSTEIN 2002, MCMANUS 2001, VICKNER/DAVIES 2000). Or firm's expectations about its rivals' reactions could be analyzed empirically (GOLLOP/ROBERTS 1979). Moreover, the impact of the merger on rivals' pricing behavior could be tested straightforwardly as well as the hypothesis of instantaneous adjustments to new equilibria. Further future research should also be done in the field of long-run and short-run effects and the persistence of commodity price responses (e.g. CASHIN/LIANG/MCDERMOTT 2000, GÓMEZ/CASTILLO 2001).

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Appendix. Stability of results.

Estimation results (*t*-values in brackets): whole period and subperiods.

	Basic model		**whole period** 1992:01 to 2000:12			**First subperiod** 1992:01 to 1996:12			**Second subperiod** 1997:01 to 2000:12		
DEMAND	**Constant**	α_0	**3.2008**	***	(4.6274)	**8.1180**	***	(4.3583)	**-7.3783**	**	(-2.1851)
	Retail Price	α_1	**-0.1023**	***	(-4.9595)	-0.1009		(-0.9448)	**-0.2032**	***	(-3.2304)
	Trend	α_3	**0.0220**	***	(3.0223)	**0.0896**	***	(3.2275)	**0.462**	***	(2.5657)
	Income	α_2	**-0.0092**	***	(-2.8163)	**-0.0370**	***	(-2.5998)	**-0.0196**	***	(-2.9824)
	Retail Price 'Coke'	α_4	-0.1743		(-0.3305)	-1.1831		(-0.6384)	**13.0388**	***	(2.9907)
SUPPLY	**Constant**	β_0	**8.9734**	***	(5.0819)	0.9658		(0.4756)	**6.6503**	**	(2.1032)
	Other Milds	β_1	**2.1256**	**	(2.0852)	**2.1902**	***	(3.4238)	**2.1415**	**	(2.4264)
	Colombian Excelso	β_2	**-2.0485**	***	(-2.1699)	0.2000		(0.2949)	**2.1894**	*	(1.6549)
	Robustas	β_3	**0.3205**	**	(2.8277)	**-1.5810**	**	(-2.2664)	**-2.2064**	***	(-2.7447)
	Wage per employee	β_5	**-0.7373**	*	(-1.7614)	**-4.6196**	***	(-5.4540)	0.2521		(0.2891)
	Exchange Rate	β_4	-0.0008		(-0.0092)	-0.0001		(-0.0003)	**0.1080**	***	(2.6061)
	Price Index Freight	β_6	**3.1719**	**	(2.1616)	**12.2292**	***	(3.7658)	-1.2761		(-1.0303)
	Conjectural Variation	θ	**-0.6988**	***	(-4.5189)	-0.09287		(-0.6373)	**-0.5003**	***	(-2.5954)
	Iterations		21			22			14		
	Final criterion		0.0000051 < 0.00001			0.0000083 < 0.00001			0.0000056 < 0.00001		
	DW demand equation		2.1308			1.400			1.7697		
	DW supply equation		2.1427			1.0243			1.4704		

* denotes a significance level of 10%. ** a significance level of 5%, *** a significance level of 1%.