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by

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Abstract

In this paper the existence and magnitude of market power for German beer, cocoa powder, chocolate, and sugar confectionary exporters are tested. Two theoretical approaches are employed, the 'pricing to market' (PTM) and the 'residual demand elasticity' (RDE) approach. Even though all markets show a significant violation of the 'law of one price', estimations for monthly data from 1991 to 1998 reveal that markets are in most cases perfectly competitive. However, while in some cases significant market power is indicated for the PTM approach, the RDE results do not support these findings. This leads to the conclusion that the underlying theoretical models fail to consistently match the observed price equilibria on the markets under study.

1 Introduction

Various concepts have been introduced to test for existence and magnitude of market power of firms or sectors. Traditional concepts are the 'structure-conduct-performance' approaches, which relate performance measures, such as profits, to indicators describing the industry's structure (e.g. market shares or concentration ratios). These concepts are not based on a formal market model and do not reflect the pricing process (conduct); thus, their results lack a clear economic interpretation with regard to the use of market power. In the 'new empirical industrial organization literature' market models were introduced and estimated which explicitly modeled the conduct (pricing behavior) on the markets under study to test for market power[1]. These models have extensively been employed to investigate domestic markets, but have rarely been used to study international markets (see Barnett et al. 1995, Bhuyan and Lopez, 1997, or Millan, 1999).

To test for market power on international markets Krugman in 1987 introduced the 'pricing to market' (PTM) model. The PTM model can be classified to the 'new trade theory' literature. The PTM is dominating the empirical literature on testing market power on international markets during the last decade (see among others Knetter 1989 and 1993, Marston 1990, Lee 1995, and Gil-Pareja 2000). Recently Goldberg and Knetter (1999) adopted the 'residual demand elasticity' (RDE) approach which was originally developed by Baker and Bresnahan in 1988. The RDE model belongs to the 'new empirical industrial organization' literature.

The PTM and the RDE approach both allow to identify market power, but the extent of market power can only be estimated with the RDE model. The advantage of studying firms' pricing behavior on international markets is that information on marginal production costs, which is rarely easily accessible, is not needed to test for market power. Exchange rate variations, which affect the profitability of exports and lead to adjustments of prices in order to maximize profits, enable us to identify the underlying pricing behavior of firms or sectors and to test for market power.

The aim of the paper is to test for market power of German food and beverage exporters on international markets. We use monthly data for German exports of beer, cocoa powder, chocolate, and sugar confectionary to the main destinations (Canada, US, France, UK, Belgium, and Italy) over the period from April 1991 to May 1998. As market power often is the result of highly concentrated supply structures and/or exclusive product qualities, international food and beverage markets serve as an ideal sample basis to study market power.

[1] Applications of these models can be found in Barnett et al. (1995) or Millan (1999), who investigated specific domestic

For instance, the six biggest exporters of beer, cocoa powder, chocolate, and sugar confectionary to Canada, US, France, UK, Belgium, and Italy hold between 37 and 99 % of total imports respectively. In all these cases Germany is under the top six exporters and the products show specific quality characteristics, e.g. their origin, such as known for beer or chocolate from Germany. The German food and beverage export sectors are highly concentrated; for instance, only two companies manage 85 % of German beer exports[2]. Further, export unit values vary significantly between destinations which indicates price discrimination and market power.

We extend the existing literature by the following aspects: First, we apply two popular model approaches to test for market power, the PTM and the RDE, and compare the results. Even though both concepts aim at testing market power, the consistency of the empirical results has not been investigated yet. Second, we analyze the time series properties of price and exchange rate data generating processes and consider these in the empirical model specifications. As most of the former studies used hihgly aggregated data, an adequate consideration of the time series properties of model variables has often been neglected due to the few number of observations. Unit root tests, for instance, have very little power in small samples. Thus, we have looked for a data set at a higher frequency (monthly) to obtain sufficient observations to consider the properties of the data generating processes of the model variables. Third, we employ a new data set of German food and beverage exports to the main export destinations over the last eight years. Fourth, besides the parameters of the long-run relationships between the model variables, we also estimate the short-run dynamics to describe the adjustment process and to reveal information on the potenial aggregation bias of former studies that used more aggregated time series.

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markets in the US and Spain for the existence and the extent of market power.

2 See Goldberg and Knetter (1999).

The paper is structured as follows: We start with a brief introduction of the theoretical model approaches which is accompanied by a discussion of the significance of certain model assumptions. We continue with reporting some stylized facts on the markets under study. The presentation of the empirical model specifications and the estimation results are following. This chapter is wrapped up by the comparison of the results of the two models. Finally, we summarize our findings and draw some conclusions.

2 Theoretical models

The 'law of one price' states that fob prices of homogeneous products on different international markets ought to be the same for perfectly competitive markets. The PTM model, in constrast, assumes international markets to be separated, and a monopolistic exporter utilizes price discrimination between these markets in order to maximize the profit. In the case of 'normal' demand curves, the exporter sets prices above his marginal production or transaction costs[3]. Markups differ depending on the price elasticity of demand on the destination markets; they increase (decrease) for less (more) elastic demand curves. In this framework variation of exchange rates cause adjustments of the regional (international) price dispersion. If exporters were behaving perfectly competitive and the destination markets are of moderate size[4], then export prices measured in the export market currency are not affected by variations of idividual exchange rates and no price discrimination is employed. To illustrate the PTM model, we assume that a monopolistic exporter faces 'normal' demand curves on international markets (*i=1,…,n*).

(A-1) $$Q_i = Q_i\left(e_i P_i, Z_i\right)$$

Here P_i is the price (unit value) of the traded good measured in the exporter's currency, e_i is the exchange rate between the destination market and exporter's currency, for instance

[3] For simplicity transaction costs are assumed to be the same for each destination market.

\$US/DM, e_iP_i is the price in the destination market currency, and Z_i is a vector of demand shifters on the destination market (e.g. income measured by the GDP)[5]. The exporter's supply can be derived from the profit maximization problem: $\max_{P_i} \Pi_i = P_iQ_i(.) - C(Q_i(.), W)$, which shows the following first order conditions: $Q_i + \frac{\partial Q_i}{\partial P_i} P_i - \frac{\partial C}{\partial Q_i}\frac{\partial Q_i}{\partial P_i} = 0$. C(.) is the cost function of the exporter, which depends on the quantity produced (Q_i) and other cost shifters (W), such as input prices. The exporter maximizes his profits if the marginal revenue $MR = Q_i + P_i(\partial Q_i / \partial P_i)$ is equal to the marginal costs $MC = (\partial C / \partial Q_i)(\partial Q_i / \partial P_i)$. After some rearrangements we obtain

$$\text{(A-2)} \qquad P_i = MC\left(\frac{\eta_i(e_iP_i, Z_i)}{\eta_i(e_iP_i, Z_i) - 1}\right),$$

where η_i is the absolute value of the demand elasticity. η_i is a function of the product price in the destination currency and of demand shifters (Z_i). If we take logarithms and derive (A-2) with respect to the exchange rate, we result the following equation, which indicates the interpretation of the main PTM model parameter, the exchange rate transmission elasticity (see Gagnon and Knetter, 1995):

$$\text{(A-3)} \qquad \frac{\partial \ln P_i}{\partial \ln e_i} = -\frac{\partial \ln \eta_i / \partial \ln(e_iP_i)}{\eta_i - 1 + (\partial \ln \eta_i / \partial \ln(e_iP_i))}.$$

The ratio of relative change in the exporter's price and the relative change of the exchange rate (exchange rate transmission elasticity) depends on the price elasticity of demand on the

4 By moderate size we mean that changes in the profitability of exports to this market do not change marginal production costs (see discussion of model assumption an the end of this chapter).

5 This demand function can also be an excess or the residual demand function on the respective destination market which quantifies the reactions of consumers and competitors to price changes forced by the exporter under study. However, the behavior of competitors is not explicitly modeled, such as in the RDE approach.

destination market (η_i) and its relative change with respect to the price level in the destination market currency $\left(\partial \ln \eta_i / \partial \ln \left(e_i P_i\right)\right)$.

On perfectly competitive markets the exchange rate transmission elasticity is zero as the individual demand elasticity tends to minus infinity. On monopolistic markets an absolute value of the demand elasticity of greater than one is a necessary condition for monopolistic profit maximization. From this follows that the exchange rate transmission elasticity cannot be smaller than minus one. For monopolistic markets we can distinguish the following three cases:

(A-4a) $$\partial \ln \eta_i / \partial \ln \left(e_i P_i\right) > 0 \Rightarrow \left(\partial \ln P_i / \partial \ln e_i\right) \in \left]-1, 0\right[$$

(A-4b) $$\left(\partial \ln \eta_i / \partial \ln \left(e_i P_i\right)\right) \Rightarrow \left(\partial \ln P_i / \partial \ln e_i\right) = 0$$

(A-4c) $$\left(\partial \ln \eta_i / \partial \ln \left(e_i P_i\right)\right) < 0 \wedge \left(1-\eta\right)_i > \left|\partial \ln \eta_i / \partial \ln \left(e_i P_i\right)\right| \Rightarrow \left(\partial \ln P_i / \partial \ln e_i\right) > 0$$

If the absolute value of the demand elasticity increases with the price level, then the exchange rate transmission elasticity has to be in the range from zero to minus one (A-4a). Under this assumption export prices in the destination market currency are stabilized by the marktup adjustment of the exporter.

In case of an isoelastic demand schedule profit maximizing relative markup is independent from exchange rate variations; therefore, the transmission elasticity is zero (A4-b). Thus, for isoelastic demand curves we cannot distinguish between perfect and monopolistic competition.

If the demand elasticity declines with the price level, the transmission elasticity can appear to be even positive (A-4c), which causes a destabilization of prices in the destination market currency[6]. Apart from the second case, the PTM model allows us to conclude from a significant exchange rate transmission elasticity estimates the presence of market power. However, the extent of market power cannot be quantified with this framework.

In contrast to the PTM model the RDE approach considers an oligopolistic market structure. Thus, the competitors' reaction are also represented in the model. The aim is to estimate the residual demand elasticity that exporters face on each destination market. Market power is characterized by a falling residual demand curve or more precisely by a residual demand elasticity in the range between minus one and minus infinity. The residual demand elasticity indicates the extent of market power because its reciprocal absolute value is equal to the Lerner index $\left((P-MC)/P\right)$. To illustrate the generality of this approach, we assume two competitors (k = 1,2) which both face an inverse residual demand function. The resiudual demand of k depends on k's supply (Q^k), the supply of his competitors (Q^j), and other determinants of demand *(Z)*, such as income.

(B-1) $$P^1 = P^1\left(Q^1, Q^2, Z\right)$$

(B-2) $$P^2 = P^2\left(Q^2, Q^1, Z\right)$$

Based on the residual demand and the individual cost functions, the maximization problem of the two competitors can be written as follows[7]: $\max\limits_{Q^k} \Pi^k = Q^k P^k(.) - e^k C^k\left(Q^k, W^k\right)$, with the corresponding first order conditions $P^k + Q^k \underbrace{\left(\frac{\partial P^k}{\partial Q^k} + \frac{\partial P^k}{\partial Q^j}\frac{\partial Q^j}{\partial Q^k}\right)}_{\theta^k} - e^k MC^k = 0$. Here θ^k indicates the conduct parameter of the k^{th} competitor which determines the market equilibrium

6 Gil-Pareja (2000) claims the opposite, but a positive coefficient means, that a depreciation of the exporter's currency leads to a decrease in the export price measured in terms of the exporter's currency. Thus, the effect of the change in the exchange rate is accompanied by an price effect in the same direction. Thus, a positive parameter implies an destabilization of prices in the destination market currency, while significant 'pricing to market' will tend to stabilize price in the destination market currency.

7 k and j represent exporter 1 or exporter 2 respectively. If k = 1, then j = 2.

and e^k is the exchange rate between destination market currency and the k^{th} exporter's currencies. From the stationary solutions of these optimization problems, we obtain the competitor's supply or pricing behavior:

(B-3) $$e^1 MC^1\left(Q^1, W^1\right) = MR^1\left(Q^1, Q^2, Z\right)$$

(B-4) $$e^2 MC^2\left(Q^2, W^2\right) = MR^2\left(Q^2, Q^1, Z\right).$$

To quantify the extent of market power, Goldberg und Knetter (1999), and Baker and Bresnahan (1988) have proposed to estimate a reduced form of the system (B-1) to (B-4) to result the inverse residual demand function of the competitor under study, for instance exporter 1. In the first step we solve (B-2) and (B-4) for the quantity supplied by exporter 2, with $Q^2 = Q^2\left(Q^1, Z, e^2 W^2\right)$. Here $Q^2(.)$ is the residual demand function for exporter 2. In the second step we substitute the quantity supplied by exporter 2 into (B-1), which is the basis for the empirical specification:

(B-5) $$P^1 = P^1\left(Q^1, Q^2\left(Q^1, Z, e^2 W^2\right), Z\right).$$

The residual demand function of exporter 1 is determined by his own supply, by demand shifters, and by shifters for the competitor's production costs, which are assumed to be mostly determined by the exchange rate between the currency of exporter 2 and the destination's market currency. Deriving (B-5) in logarithmic form with respect to Q^1 directly results the inverse of the residual demand elasticity of exporter 1: $\tilde{\eta}^1 = \frac{\partial \ln P^1}{\partial \ln Q^1} = \left.\frac{\partial \ln P^1}{\partial \ln Q^1}\right|_{Q^2 = const.} + \frac{\partial \ln P^1}{\partial \ln Q^2}\frac{\partial \ln Q^2}{\partial \ln Q^1}$. Obviously, the inverse residual demand elasticity or the coefficient of Q^1 in the residual demand function (B-6) consists of two effects, the price reaction to variations of the supply by exporter 1 given the supply of exporter 2 on the destination market (Q^2) and the corresponding conjectural reaction of exporter 1.

The supply of exporter 1 is instrumented as in Goldberg and Knetter (1999) to result an unbiased estimate the following inverse residual demand function:

(B-6) $$P^1 = P^1\left(\hat{Q}^1, e^2, Z\right).$$

If we estimate (B-6) in log-linear from, the coefficient for the estimated export volume $\left(\hat{Q}^1\right)$ represents the inverse residual demand elasticity, which is a measure of market power. The exchange rates between competitors' and the destination market (in this case e^2) account for the competitors' cost changes due to their exchange rate variations to the destination market. The extent of market power increases with decreasing absolute values of the residual demand elasticity. However, absolute values of the residual demand elasticity smaller than one are incompatible with imperfect (monopolistic) competition under profit maximization. If the residual demand elasticity is zero, then perfect competition cannot be rejected.

Before we turn to the empirical model specification of the theoretical approaches, we discuss some assumptions that are essential for the interpretation of the estimation results. First we show that significant exchange rate transmission elasticities (PTM) or a significant residual demand elasticity of less than minus one (RDE) can also occur on perfect competitive markets (case 1). Second, we present conditions under which insignificant exchange rate transmission elasticities or a the residual demand elasticities of minus infinty are revealed for imperfect markets (case 2).

Case 1: Perfect competition can lead to significant exchange rate transmission elasticities (PTM) if, for instance, firms face menu costs in adjusting prices on the destination market[8]. Menu costs cause a lagged adjustment of prices on the destination market to exchange rate changes. In such a situation small changes in the currency values are not transmitted and prices in the destination market currency are kept constant until the cumulative revaluation is sufficient to exceed the menu costs. From the estimation we result a mean value for the transmission elasticity which in this case signalizes PTM for a competitive market. However, significant exchange rate changes still lead to immediate price adjustments on the destination market in the direction as expected for perfectly competitive markets.

A similar effect can occur when firms do not decide prices on a spot market basis, but negotiate contract prices that are kept constant in the destination market currency for the validity of the contract. If goods are partly sold via long term contracts, then we observe a significant exchange rate transmission for the average price level even though market were competitive[9].

Further, marginal production costs of exporters can be affected by exchange rate variations, when imported inputs are used to produce the exported good. In that case, an appreciation of the exporter's currency leads to a decrease of the export price measured in the destination as well as in the exporter market currency because lower prices for the imported inputs will cause a reduction of their prices on the erporter's domestic market[10]. As for imperfect markets, we would also obtain a negative exchange rate transmission elasticity (PTM).

If we assume the exporting country to be an important player on the destination market or if exporters offer a products with specific quality aspects, then the estimation can result a significant residual demand elasticity bigger than minus infinity for perfectly competitive markets. However, it might not be less than minus one. To illustrate the argument let us assume a two country model with an importer and an exporter with producers only located on

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8 For a review of the menu cost literature see Cassino (1995).

9 The opposite can occur on a market with imperfect competition when contracts are signed in the exporter's currency.

the export market. If the exporter's currency is appreciated against the importer's currency, then the new price equilibrium will show a decrease of the price measured in the exporter's currency, assuming 'normal' demand and supply schedules for both markets. In such a situation, we would observe a significant exchange rate transmission elasticity (PTM) and a residual demand elasticity bigger than minus infinity.

Case 2: Besides the fact that an isoelastic demand schedule leads to an insignificant exchange rate transmission even for imperfect competition (market power), this can also occur if the firms hedge the risk of exchange rate variations for the period of contract validity, assuming that contracts are signed in the exporter's currency. In that case the prices in the exporter's currency are kept constant for the contract period even though the exchange rate might vary over time. In the long run exchange rate transmission should still be detected. In the short run, however, we would neither obtain a significant exchange rate transmission nor a significant inverse residual demand elasticity as prices in the exporter's currency are kept constant and vary in the destination market currency according the development of exchange rates, but export quantities are not adjusted[11].

3 Stylized facts and data

Monthly data from April 1991 to May 1998 for German beer, chocolate, cocoa powder, and sugar confectionary exports to the United States (US), Canada (CA), France (FR), Belgium (BL), Italy (IT) and the United Kingdom (UK) are analyzed here[12]. To indicate the potential of market power, we describe the structure of the markets under study (Table 1 to Table 3). In addition, we present the average price differential between the destination markets for each product which indicate the actual use of market power.

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[10] We have at least to assume that exchange rate changes between the destination market and the origin of the inputs are somehow positively related.

[11] The same effect can occur if the time of delivery is also negotiated in the contracts.

[12] Except for the time frame and the frequency, Knetter (1989 and 1993) and Goldberg and Knetter (1999) partly use the same data.

We investigate the market shares of the six biggest importers on the destination markets for each product (Table 1). For instance, the six biggest importers of cocoa powder to the US hold almost 97 percent of the total US imports. Thus, the US cocoa powder import market is highly concentrated. For the other products and import markets this measure ranges between 37 and almost 100 percent. Hence, all markets under investigation show a potential for the utilization of market power.

include Table 1 here

The German position between these competitors is indicated by its relative position, measured by the ranking of the main importers (Table 2).

include Table 2 here

Germany is on all of these import markets in the group of the six biggest import origins, and for many products and destinations Germany holds one of the first two positions. Thus, is one of the main actors on these markets. German exports also account for a significant share of the total destination market imports. For example, they deliver almost 50 percent of French and Italian chocolate imports.

include Table 3 here

In addition, exports to these markets account for significant shares of total German exports. Exports of beer to these destinations make 62 %, cocoa powder 43 %, chocolate and sugar confectionary 44 % of total German exports.

The unit values of German exports show significant variation between destinations for the same product and over the sample period for each destination (Table 4). For instance, unit values of beer exports to France are 70 % lower than for beer export to the UK. The low of one price is significantly violated on all markets, which is a clear indication of market power. The exchange rates, except for France and for Belgium/Luxemburg, also indicate significant variation over the sample period, which is a necessary condition to estimate either the PTM or the RDE model. The relative variation of the exchange rates is close to 10 percent on average for the US, CA, UK, and IT.

include Table 4 here

4 Model Specification and Estimation Results[13]

For the PTM approach Knetter (1993) used the following specification, which can either be estimated by single equations (OLS or SUR procedure) or by a fixed and random effects panel model. The latter approach is often used to increase the degrees of freedom by grouping all destinations with the same fixed effects as in Falk and Falk (1999). We estimate the following single equations by a SUR procedure to consider the potential correlations of residuals between equations:

(A-5) $$\ln P_{i,t} = \alpha_i + \beta_i T_{i,t} + \gamma_i \ln\left(e_{i,t} / PPI_{i,t}\right) + \delta_i \ln\left(GDP_{i,t} / CPI_{i,t}\right) + u_{i,t} .$$

In this model the endogenous variable is the export unit value in the currency of the export origin (German Mark (DM)) ($P_{i,t}$). Exogenous variables are a time Trend (*T*), the deflated exchange rate between destination market and country of origin (e.g. $US/DM), and the deflated gross domestic product. The time trend accounts for a potential continous change of production costs or consumer preferences. The exchange rate is deflated by a producer price index for the destination market (*PPI*) to separate adjustments due to inflation from the reactions of the monopolistic exporter due to exchange rate changes. Variations in the income of consumers on the destination market are reflected by the gross domestic product of the destination market (*GDP*) which is deflated by a consumer price index on the destination market (*CPI*). $\alpha_i, \beta_i, \gamma_i, \delta_i$ stand for parameters to be estimated, and *u* indicates an error term that is supposed to behave i.i.d normal. γ indicates the exchange rate transmission elasticity.

[13] All results that not documented in detail here can be obtained from the authors upon request.

For the specification of the RDE approach, we closely follow the approach outlined in Goldberg and Knetter (1999):

$$\text{(B-7)} \qquad \ln P_{i,t}^{k} = \alpha_i + \beta_i T_{i,t} + \tilde{\eta}_i \ln \hat{Q}_{i,t}^{k} + \sum \lambda_{i,t}^{j} \ln e_{i,t}^{j} + \delta_i \ln\left(GDP_{i,t} / CPI_{i,t}\right) + u_{i,t}$$

In this model the endogenous variable is the price (unit value) of German exports to the respective destination markets measured in the destination market currency (P^k). e^j indicate the exchange rates between competitors and the destination market currency. $\hat{Q}^k$ is the instrumented volume of the German exporters to the destination market[14]. All other variables are defined as above, and. $\alpha_i, \beta_i, \eta_i, \gamma_i, \lambda_i, \delta_i$ stand for the parameters to be estimated.

Figure 1 illustrates for German exports of beer to the US the major model variables that enter the PTM model specification. We see that currency depreciations (appreciations) are accompanied by price decreases (increases) measured in exporter's currency. Thus, we expect a significant exchange rate transmission elasticity which indicates 'pricing-to-market' behavior if the parameter is bigger than minus one.

include Figure 1 here

Before we proceed with the estimation, all variables in the basic PTM specification (A-5) are tested for stationarity (trend-stationarity). We apply the procedures by Dickey und Fuller (ADF-Test), Phillips und Perron (1998) and by Kwiatkowski et al. (1993), which over all revealed compatible results. The lag length of the processes has either been determined by a simple F-test or by the AIC information criterion[15]. In Table 5, the results for the ADF procedure are summarized.

include Table 5 here

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[14] All exogenous variables in (B-7) and the exchange rate between the exporter's and the destination market currency are used as instruments (see Goldberg and Knetter 1999)..

[15] See Pantula et al. (1994).

For all exchange rate and GDP series the null hypothesis of stationarity (KPPS test) is rejected at the 5 % significance level, or the null hypothesis of non-stationarity (ADF- and Phillips test) cannot be rejected. These series show significant movements in levels. For many price (unit value) series stationarity cannot be rejected. For these series we can already conclude that no linear long-run relationship between exchange rates and export prices exists, or no 'pricing-to-market' is indicated. For the remaining markets we cannot reject that all variables of the PTM model specification are I(1) processes. Therefore, we do not employ the basic model specification that is shown in (A-5), but we estimate an error correction model (ECM) reparametrisation of (A-5) which in the case of cointegration ensures the regular statistical properties for at least testing the short-run dynamics and the error correction mechanism (Engle and Granger 1987). The ECM representation of (A-5) is presented in (A-6). The order of the dynamic lag structure of the ECM is chosen with respect to the behavior of the error term. The lag order (q) is symmetrically increased as long as estimation reveals autocorrelated residuals which is tested by a Lagrange multiplier test.

$$
\begin{aligned}
\Delta \ln P_{i,t} &= \alpha_i^* + \beta_i T_{i,t} \\
&+ \phi\left(\ln P_{i,t-1} - \gamma_i \ln\left(e_{i,t-1}/PPI_{i,t-1}\right) + \delta_i \ln\left(GDP_{i,t-1}/CPI_{i,t-1}\right)\right) \\
&+ \sum_{q=1} \omega_q \Delta \ln P_{i,t-q} + \sum_{q=0} v_q \Delta \ln\left(e_{i,t-q}/PPI_{i,t-q}\right) \\
&+ \sum_{q=0} \kappa_q \Delta \ln\left(GDP_{i,t-q}/CPI_{i,t-q}\right) + u_{i,t}^*
\end{aligned}
\tag{A-6}
$$

Equation (A-6) is estimated for all available markets. Cointegration can be test directly in the ECM specification by applying a t-test to the parameter ϕ (see Hansen, 1993 or Kremer, Ericsson, and Dolado, 1992). Whenever ϕ is different from zero, then the null-hypothesis of cointegration cannot be rejected for integrated processes of order one I(1). This holds for all estimation results in Table 6 that are not put in brackets. The coefficient of interest in the PTM model is the long-run transmission elasticity for the exchange rate. This parameter is estimated indirectly in the ECM as indicated by (A-6). To recalculate the parameter, we have to divide the coefficient for the exchange rate variable by the absolute value of ϕ. The results for this parameter are shown in Table 6.

include Table 6 here

On four markets, the US and the CA beer market, the UK sugar confectionary market, and the IT cocoa powder market, we find significant parameters for the exchange rate transmission elasticity around –0.7 which indicate 'pricing to market' behavior. Thus, the use of market power by German exporters cannot be rejected for these products and destinations. Corresponding to the results of the stationarity tests, the results in Table 5 confirm that when no significant linear long-run relationship between exchange rates and prices is indicated by the stationarity results, then the estimation did not reveal a significant transmission elasticity and no cointegration between the time series (Table 6). In case of the existence of a linear long-run relationship (cointegration), the chosen lag order is 2 in most models and the parameter for ϕ indicates a fast adjustment of deviations from the long-run relationship. Lagged adjustments are completed within few months.

Such as for the estimation of the PTM model specification, we start the RDE estimation with testing the stationarity assumption for the variables that enter the empirical specification. Compared with the PTM the RDE model use additional variables, such as the export volumes for the respective products and market, and the currency exchange rates between competitors and the destination market. Furthermore, unit values are not expressed in the export, but in the destination market currency. To identify the main competitors of German exporters on the destination markets, in Table 7 the two main exporters besides Germany on the respective markets are listed. The currency exchange rates between the two and the destination market enter the respective model specification to indicate changes in the supply of competitors on the destination market.

include Table 7 here

On the beer import markets, for example, the Netherlands, Canada, the United States, Belgium, and Ireland are the main competitors of Germany. Their exchange rates to the destination market enter the RDE model specification. For all the variables the same stationarity tests are employed as mentioned above. For most of the export price series (unit values) and for all export volumes the null-hypothesis of non-stationarity is rejected. All exchange rates are tested to be non-stationary. This leads to the conclusion that changes in the export volume have not been affected by changes in the profitability that are caused by de- or revaluations of the exporter's currency. Thus, the estimation of the first step of the RDE approach, the estimation of the instrumented export volumes, does not reveal significant long-run relationships between the exchange rate and the export volumes. This is supported by estimation results for the inverse residual demand elasticity (Table 8)[16]. Hence, market power has to rejected for all destinations and products. Even though we obtained a significant inverse residual demand elasticity in some cases, market power had to be rejected as either coefficients turned out to be positive or in the case of beer exports to France the changes of export volumes are clearly not related to variations of the exchange rate (see Figure 2).

include Figure 2 here

Exchange rates between French Franc and German Mark do not vary considerably (Table 4) and not in the right direction to explain the increase of German beer exports to FR by monopolistic pricing. For a monopolisitc exporter an increase in export volumes ought to be related to a depreciation of the German Mark, but while the volume have almost constantly been increased the exchange rate did not follow a unique and significant trend. This result is confirmed by the PTM model estimates that did not indicate market power on this export market (see Table 6). Thus, the trends in prices and volumes for German beer exports to FR have been caused by some other factors than by the reactions of a monopolisitc exporter to exchange rate variations. For instance, in this case German exporters might have had the goal to increase their market share and to push competitors out of the market.

The RDE results are surprising for two reasons. First, Goldberg and Knetter (1999) obtained for a partly similar data set (German beer exports to US, CA, FR, and UK) significant residual demand elasticities for all destination markets. Second, The PTM approach revealed in some cases significant exchange rate transmission elasticities that indicate market power. This inconsistency might have been caused by fact that perfectly competitive markets can also indicate PTM. However, the significant deviations in the average export unit values over time indicate that obviously price discrimination is applied which relies on the use of market power. However, on these markets the use of market power seems not exclusively to be based on a static profit maximization model. Goldberg and Knetter (1999) do not document the results for the relationship between exchange rates and export volumes. If these relationships do not reveal significant coefficients for the exchange rate, then their conclusions have to be corrected.

In the light of the RDE results, we have to reconsider the PTM results. For the cases with significant exchange rate transmission elasticities, no consistent adjustments of export volumes to changes in the exchange rate could be recovered. Thus, we have to reject the hypothesis of market power for these cases too. The cause behind the significant transmission of exchange rate variations is also likely to be different from a pure monopolistic 'pricing-to-market' strategy.

5 Summary

In this paper we applied two well known empirical models, the 'pricing-to-market' and the 'residual demand elasticity' approach, to test for market power of German food and beverage

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[16] We estimated the RDE appraoch as outlined above to double check the results that from the stationarity tests.

exporters on the main international markets (beer, cocoa powder, chocolate, and sugar confectionary). We compared the estimation results and considered the time series properties of the model variables, which both had an impact on the conclusions drawn from the model estimates.

On many international food markets conditions for the existence of market power are fulfilled, such as concentrated supply and/or demand structures, or specific product qualities. For the products under study we have shown that the supply side is highly concentrated. For instance, for beer, cocoa powder, chocolate, and sugar confectionary the six biggest importers hold a significant share of total imports of the respective destinations. In addition, many products are well known for specific quality characteristics.

The 'pricing-to-market' model identifies market power by the estimation of the exchange rate transmission elasticity. A significant transmission elasticity above minus one indicates the use of market power. The 'residual demand elasticity' approach signalizes market power if the estimates for the elasticity lie in the range of minus one to less than infinity. Both frameworks utilize the effects of exchange rate variations on export volumes and prices.

On four markets, US and CA beer market, UK sugar confectionary, and IT cocoa powder market, we find significant parameters for the exchange rate transmission elasticity which indicate a 'pricing to market' behavior with similar estimates around –0.7. Thus, the use of market power by German exporters cannot be rejected for these products and destinations. Because the RDE model results do not indicate at all, both approaches result partly inconsistent conclusions, which further do not fit to the fact that the law of one price is significantly violated for all products. Even though markets obviously indicate to some extent market power, the applied model approaches do not consistently detect it. Therefore, the observed price discrimination must be caused by other factors than the deviation of demand elasticities between international markets. The explicit consideration of competitors' behavior on the international markets can be one factor that might be worthwhile to enhance the understanding of the pricing process on these markets.

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Tables

Tab. 1: Import shares of the six biggest importers measured by value

	Destination					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**41.3**	**87.8**	**92.2**	**36.8**	43.6	91.4
Cocoa	**96.6**	56.6	**99.8**	97.8	**99.2**	**65.5**
Chocolate	**47.3**	44.4	**56.1**	**47.8**	72.9	68.4
Sugar Confect	**68.4**	85.0	**85.8**	**82.5**	78.3	89.3

Source: Own calculations, data from ITC/UNSD, Trade Analysis System, 1998.
Note: Bold numbers indicate the time series that are analysed in the next section. Intra EU trade is included. BL: Belgium/Luxembourg, IT: Italy, UK: United Kingdom, CA: Canada, US: United States, FR: France.

Tab. 2: Germany's rank in the list of the most important origin of imports measure by value

	Destination					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**4**	**5**	**2**	**2**	1	3
Cocoa	**4**	5	**2**	2	**2**	**2**
Chocolate	**3**	4	**1**	**5**	1	2
Sugar Confect	**2**	2	**2**	**2**	1	2

Source: Own calculations, data from ITC/UNSD, Trade Analysis System, 1998.
Note: See the notes to Table 1.

Tab. 3: Share of imports from Germany of total imports measured by value

	Destination of German exports					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**10.6**	**8.8**	**19.3**	**28.2**	38.9	16.6
Cocoa	**3.4**	6.0	**23.9**	17.3	**21.7**	**14.1**
Chocolate	**4.8**	4.5	**43.6**	**7.1**	54.6	31.7
Sugar Confect	**14.0**	6.6	**15.1**	**18.1**	19.3	18.5

Source: Own calculations, data from ITC/UNSD, Trade Analysis System, 1998.
Note: See the notes to Table 1.

Tab. 4: Average unit values in DM/kg of German exports and exchange rates between German Mark and destination market currencies for the period from April 1991 to May 1998 (fob basis)

	Destination of German exports					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**1,7 (6)**	**1.5 (12)**	**1.1 (20)**	**1.9 (4)**	n.a.	n.a.
Cocoa	**1,9 (34)**	n.a.	**2.9 (30)**	n.a.	**2.0 (25)**	**3.0 (48)**
Chocolate	**4,5 (30)**	n.a	**6.7 (11)**	**6.1 (19)**	n.a.	n.a.
Sugar Confect	**3,6 (11)**	n.a	**4.3 (10)**	**4.2 (10)**	n.a.	n.a.
Exchange rate	**0.6 (8)**	**0.8 (11)**	**3.4 (1)**	**0.4 (10)**	**955 (13)**	**21 (1)**

Source: Own calculations, data from ITC/UNSD, Trade Analysis System, 1998. Oanda, 2000. Deutsche Bundesbank, various issues.
Note: Coefficients of variation for the respective variables are in brackets, n.a.: not available.

Tab. 5: Trend-stationarity (•) of time series (p/e/g) (April 1991 to May 1998)[17]

	Destination of German exports					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**p/e/g**	**p/e/g**	**p/e/g**	**•/e/g**	n.a.	n.a.
Cocoa	**•/e/g**	n.a.	**•/e/g**	n.a.	**p/e/g**	**•/e/g**
Chocolate	**•/e/g**	n.a.	**p/e/g**	**•/e/g**	n.a.	n.a.
Sugar Confect	**•/e/g**	n.a.	**p/e/g**	**p/e/g**	n.a.	n.a.

Source: Own calculations, data from Eurostat, 1999. Federal Reserve Bank of St. Louis, 2000. IMF, 1999. Doornik, PcGive 9.0, 1999.
Note: p: ln (logarithm) of unit values in DM, e: ln of exchange rate deflated by PPI (producer price index), g: ln of GDP (gross domestic product) deflated by CPI (consumer price index). n.a.: not available. A dot indicates that the respective variable is trend-stationary.

Tab. 6: Estimates for the PTM exchange rate transmission elasticities (SUR estimation of ECM specification)

	Destination of German exports					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**-0.65****	**-0.71****	**-2.85****	**[-0.04]**	n.a.	n.a.
Cocoa	**[0.25]**	n.a.	**[2.95]**	n.a.	**-0.78****	**[-0.53]**
Chocolate	**[0.11]**	n.a	**-0.94**	**[-0.29]**	n.a.	n.a.
Sugar Confect	**[0.07]**	n.a	**[4.20]**	**-0.63****	n.a.	n.a.

Source: Own calculations, data from Eurostat, 1999. Federal Reserve Bank of St. Louis, 2000. IMF, 1999. Doornik, PcGive 9.0, 1999.
Note: n.a.: not available. A dot indicates that the respective variable is trend-stationary. ** significant different from zero at 1 % significance level. Except for the parameters in parenthesis, model estimations revealed significant long-run relationships. All models indicate no autocorrelation and no conditional heteroscedasticity of residuals. However, in some case the normality assumption is rejected. The shaded fields show the models with significant pricing to market behaviour that is consistent with the theoretical model.

[17] The augemented Dickey-Fuller Test has been applied to test for trend-stationarity. In addition, the Phillips-Perron procedure and the KPSS-test have been used, for which in most case the same results were obtained at the 5 % significance level (see Phillips and Perron, 1988 and Kwiatkowski et al., 1992).

Tab. 7: Major competitors on German export markets (volume)

	Destination					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	NL/CA	US/NL	BL/UK	IR/NL	n.a.	n.a.
Cocoa	NL/FR	n.a.	NL/IT	n.a.	NL/FR	NL/FR
Chocolate	CA/FR	n.a.	BL/NL	IR/NL	n.a.	n.a.
Sugar Confect	CA/Uk	n.a.	BL/NL	NL/BL	n.a.	n.a.

Source: Own calculations, data from ITC/UNSD, Trade Analysis System, 1998.
Note: Intra EU trade is included. NL: Netherlands, BL: Belgium/Luxembourg, IT: Italy, UK: United Kingdom, CA: Canada, US: United States, FR: France, CH: Switzerland, IR: Ireland. n.a.: not available.

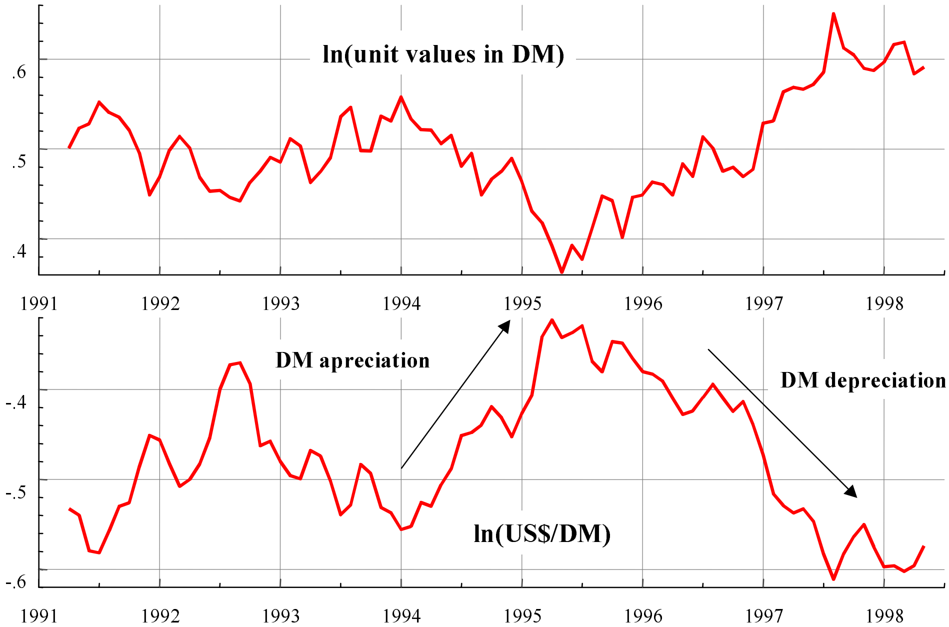
Tab. 8: Results for the residual demand elasticity (RDE) for the period from April 1991 to May 1998 (IV-OLS)

	Destination of German exports					
Product	**US**	**CA**	**FR**	**UK**	**IT**	**BL**
Beer	**0.19***	**0.28**	**-0.71****	**0.58****	n.a.	n.a.
Cocoa	**15.10***	n.a.	**0.02**	n.a.	**-1.30***	**1.41**
Chocolate	**-0.08**	n.a.	**-0.32**	**2.80***	n.a.	n.a.
Sugar Confect	**0.29****	n.a.	**0.52**	**-0.26**	n.a.	n.a.

Source: Own calculations, data from Eurostat, 1999. Federal Reserve Bank of St. Louis, 2000. IMF, 1999. Doornik, PcGive 9.0, 1999.

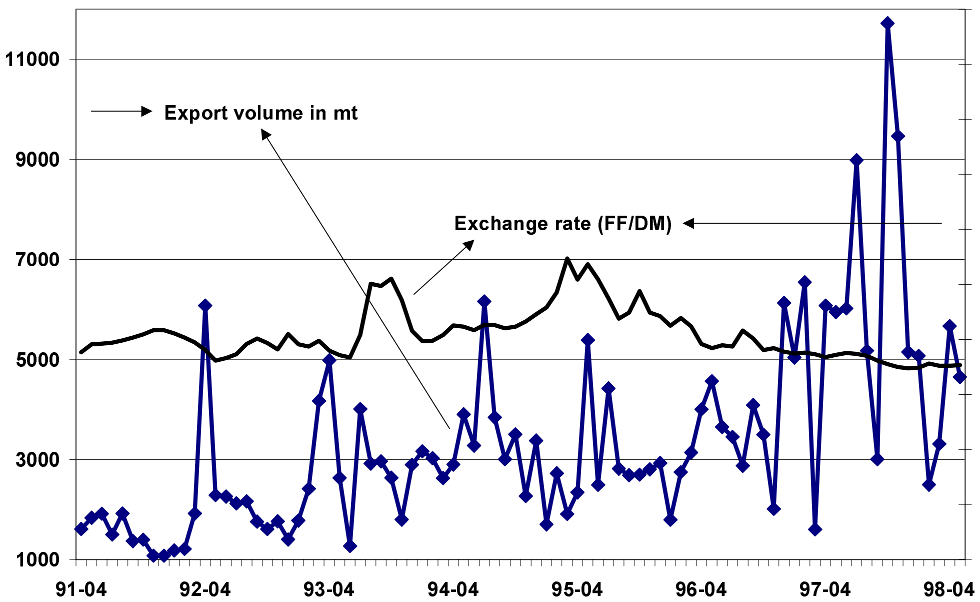
Figures

Fig. 1: Unit values in DM per L for German beer exports to the US and exchange rates (US$/DM) from April 1991 to May 1998



Source: SAEG, various issues, Deutsche Bundesbank, various issues.

Fig. 2: Volumes and unit values for beer exports to FR in French Franc from April 1991 to May 1998



Quelle: SAEG, various issues, Deutsche Bundesbank, various issues.