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A Brand Specific Investigation of International Cost Shock Threats on Price and Margin with a Manufacturer-Wholesaler-Retailer Model

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A Brand Specific Investigation of International Cost Shock Threats on Price and Margin with a Manufacturer-Wholesaler-Retailer Model[I]

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Abstract: In times of increasing oil prices and a weak dollar, European companies that focus their business on the US market may find themselves in a weak position. While many businesses can hedge this kind of risk by relocating production to the US, or employing financial remedies, these strategies may not work throughout the consumer goods industry. Especially for brands whose consumption is strongly impacted by country of origin (e.g. French whine, Swiss chocolate, German beer, etc.), there are only limited possibilities to bypass these challenges. To react efficiently to these threats, managers need a precise picture of complete market mechanisms before they can set up an appropriate marketing strategy to react. We aim to enhance the understanding of market mechanisms that are caused by exogenous cost shocks for typical consumer goods. The contribution of our work is twofold: To investigate the underlying process and to derive concrete managerial suggestions. We hereby propose a combination of two different empirical frameworks to measure the effects of exchange rate variations in fast moving consumer markets. Furthermore we extend existing work in being the first to model vertical interactions with a Manufacturer-Wholesaler-Retailer Model.

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Within this framework we investigate how changes in local currency affect the strategic management variables of price, margin and profit in a typical consumer goods market. While it is widely known that exchange rate changes cause variations in export/import prices and numerous studies show that the effect of currency fluctuations decreases within the distribution process, recent marketing research in this area has not explicitly accounted for the mechanisms that occur within the distribution channel. Many empirical studies implicate that exogenous cost shocks, which are caused by exchange rate changes, are passed through imperfectly to final consumer prices. We therefore show that the margins of the players involved in the distribution process will be affected differently by exchange rate variation dependent on the competitive situation. Although our empirical study focuses on the effect of exchange rate variations on strategic marketing variables of a selected fast moving consumer good, our framework can be easily adapted to any other market and other sources that cause a change in production cost.

Keywords: Exchange Rate Pass-Through; Structural Choice Modelling; Endogeneity; International Marketing; Pricing; Channel Management

JEL classification: M31, F12, L66, F14, L13

1. Introduction

In times of increasing oil prices and a weak dollar, European companies, which focus their business on the US market, may find themselves into a weak position. While many businesses can hedge this kind of risk by relocating production to the US, or employing financial remedies, these strategies may not work throughout the consumer goods industry. Especially for products whose consumption is strongly impacted by country of origin (e.g. French whine, Swiss chocolate, German beer, etc.), there are only limited possibilities to bypass these challenges. To react efficiently to these threats, managers need a precise picture of complete market mechanisms before they can set up an appropriate marketing strategy to react. We aim to enhance the understanding of market mechanisms that are caused by exogenous cost shocks for typical consumer goods.

When deriving a profit-maximizing price strategy in a foreign market, possible changes in local currency have to be considered. It is known that exchange rate fluctuations cause variations in export and import prices (e.g., Goldberg & Knetter, 1997). However, numerous studies, theoretical as well as empirical, find that the effect of currency fluctuations decreases towards the final consumer price (e.g Bacchetta & Wincoop, 2003), or even becomes insignificant (Campa & Goldberg, 2006). Some authors argue that a major determining factor of the impact of currency variation on price and margin is channel length (e.g. Clark, Kotabe & Rajaratnam, 1999).

The effects that may occur when exchange rates are volatile can be contrasted by a simple example of cross-border pricing (see Fig. 1): Given that a manufacturer M produces a product in the country of its origin (in the following referred to as *home*), causing manufacturing cost c measured in his homeland currency €, exchange rate variations exr will enter his decision making while passing the border to a foreign country (in the following referred to as *foreign*) with a different currency $. If the product is distributed via a wholesaler (W) and a retailer (R) to the final consumer (DEMAND), all changes in consumption caused by variations in price, i.e. $q(P_R^\$)$ will enter manufacturer's target function indirectly via a non-trivial price mechanism. Hence exchange rate changes that force manufactures to change their import prices $P_M^\$$ will have an impact on the profit function as long as consumer demand $q(P_R^\$)$ reacts to price changes. The extent of this effect strongly depends on how much of the price adjustment will be passed through to the final consumer price $P_R^\$$, i.e. how much will be captured by W and R.

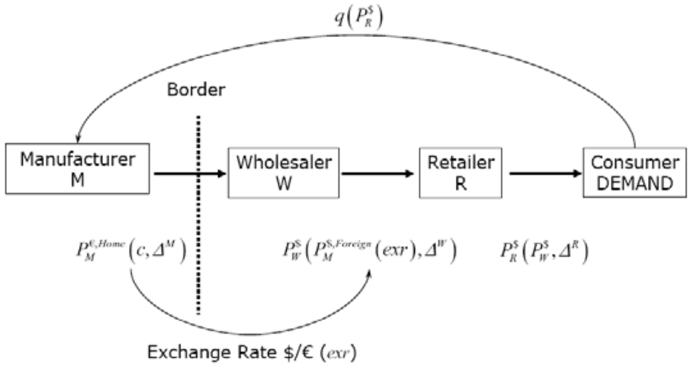


Fig. 1: A simple Example of Cross-border Pricing

This implicates that exogenous cost shocks caused by exchange rate changes might be passed through imperfectly to final consumer prices. Clearly, a change in cost that is incompletely passed through leads to changes in margins, i.e. Δ. We therefore expect that the margins of all players involved in the distribution process can be affected by exchange rate variation. This raises the question: Who actually benefits or is harmed by exchange rate variation?

To address this research question we apply two different theories:

(1) In keeping with the New Empirical Industrial Organization (NEIO, e.g. Bresnahan, 1989), we set up a structural econometric model which enables us to capture the distribution process drafted in Fig. 1. Although our empirical study focuses on the effect of exchange rate variations on strategic marketing variables of a selected fast moving consumer good, our framework can be easily adapted to any other market and other sources that cause changes in production cost. Recent work in quantitative marketing research has focused on the effects of competition and channel interaction in national markets using the NEIO methodology (e.g. Kadiyali, Sudhir & Rao, 2001). Although these models are applied to various marketing problems, e.g. product line extensions (Draganska & Jain, 2001; Kadiyali, Vilcassim & Chintagunta, 1999) advertising (Chintagunta, Kadiyali & Vilcassim, 2003) and channel interaction (Sudhir, 2001; Besanko, Dubé & Gupta, 2003; Villas-Boas & Zhao, 2005), less attention has been paid to problems in an international environment. The increasing globalization of business activities makes it more and more necessary for marketing managers to learn about what kind of marketing-mix strategies work in the international context.

(2) To measure the extent of the effect of exchange rate variations on strategic management variables (i.e. prices, margins and profit), we adopt the exchange rate pass-through-concept (ERPT) common in empirical trade theory. The ERPT is defined as the extent to which exporters pass along exchange rate-induced margin increases/decreases by lowering/raising prices in export market currency terms (see e.g. Goldberg & Knetter, 1997).

To gain an insight into the market mechanisms for a typical consumer good, we use a micro econometric framework that incorporates three different intermediaries in the distribution process, i.e. manufacturer, wholesaler and retailer. This model of "twice double marginalization" is incorporated into a structural choice model that follows the tradition of Berry, Levinsohn and Pakes (1995), hereafter referred to as BLP. Given the estimation results, we follow Goldberg (1995) in calculating ERPT coefficients for various exchange rate changes by performing counterfactual experiments.

The paper is structured as follows: Section 2 details our model and discusses all necessary assumptions. Dataset and estimation results are briefly described in Section 3. The results of the counterfactual experiments are presented in Section 4 and Section 5 evaluates these results.

2. Model Formulation

The framework in which we construct our model consists of two different parts. In the first part, we follow the NEIO tradition of constructing a structural econometric framework that enables us to measure consumer's choice, competitive behaviour and supply conditions (sections 2.1 – 2.3). Taking the distribution process of a typical consumer good market into account, we additionally integrate vertical relations into our model. In the second part, we clarify the ERPT-concept, which enables us to quantify the impact of exchange rate changes on market outcomes (section 2.4). In section 2.5 we derive hypothesis that will be part of our empirical investigation.

2.1 Demand Model

Our demand model is based on a random coefficient random utility specification, now commonplace in the analysis of differentiated demand for consumer goods (e.g. Nevo, 2000).

Following the work of McFadden (1974), a logit framework can be used to address discrete choice problems in differentiated product markets (e.g. Anderson, Palma & Thisse, 1992).

To capture the demand side within the structural model, consumers are assumed to choose the product which maximizes their utility. Each utility is a function of product attributes and individual characteristics. However, the researcher can only observe some attributes and characteristics. Idiosyncratic tastes and marginal utility for a particular good might vary over consumers. Thus utility to consumer *h* from purchasing product *i* is:

$$u_{h,i} = X_i \gamma_h - p_i \beta_h + \xi_i + \varepsilon_{h,i}\,, \tag{2.1}$$

where X_i are observable exogenous variables, p_i is the observed price for product i, ξ_i are unobservable product characteristics and $\varepsilon_{h,i}$ is an individual-product specific unobservable. We assume that taste parameters β_h and γ_h may differ for each consumer. Following Nevo (2001) we decompose the individual taste parameters into mean values β, γ and consumer specific variations form the mean, σ_h:

$$\begin{pmatrix} \beta_h \\ \gamma_h \end{pmatrix} = \begin{pmatrix} \beta \\ \gamma \end{pmatrix} + \sigma_h \tag{2.2}$$

While β and γ are assumed to be invariant across consumers, σ_h might vary.

Consumer-specific taste variation is assumed to consist of two parts: observed individual characteristics (e.g. demographics) and unobserved additional characteristics. Given that no individual information is available, neither component of individual characteristics is observed. To overcome the lack of information we add the additional demographic information D_h to account for observable variation in taste. The unobserved component is assumed to be a normally distributed stochastic process ν_h with mean zero and constant variance. The the formally given distribution for both components, σ_h, becomes

$$\sigma_h \equiv \Pi D_h + \Sigma \nu_h\,, \tag{2.3}$$

where Π is the matrix of coefficients that measures how taste characteristics vary with demographics and Σ is a matrix of coefficients that measures the influence of unobserved variations (e.g. Nevo 2000).

Given these specifications, equation (2.1) can be decomposed into three different parts (Berry, 1994):

$$u_{h,i} = \delta_i + \mu_{h,i} + \varepsilon_{h,i} \tag{2.4}$$

All product-specific parts that do not vary across consumers are incorporated in the mean utility $\delta_i \equiv X_i\gamma - p_i\beta + \xi_i$. Idiosyncratic taste variations from the mean are included in $\mu_{h,i} \equiv [- p_i, X_i]\ \sigma_h$ where $[- p_i, X_i]$ is a $1 \times (K+1)$ row vector. The last two terms represent a mean-zero heteroscedastic deviation from the mean utility that captures the effects of the random coefficients. If we assume that the individual product-specific unobservable $\varepsilon_{h,i}$ is i.i.d. extreme-value distributed, it can be integrated out in the multinomial logit model (MNL). The purchasing probability of individual *h* choosing product *i* becomes

$$P_{h,i} = \frac{\exp\left(\delta_i + \mu_{h,i}\right)}{1 + \sum_j^J \exp\left(\delta_j + \mu_{h,j}\right)}.^{1} \tag{2.5}$$

If no idiosyncratic taste variation exists, i.e. if all consumers behave in the same way, equation (2.5) reduces to the MNL model:

$$P_{h,i} = \frac{\exp\left(\delta_i\right)}{1 + \sum_j^J \exp\left(\delta_j\right)}. \tag{2.6}$$

In this case, the market shares equal the purchasing probability of any consumer *h* in the population:

$$s_i = P_{h,i} = \frac{\exp\left(\delta_i\right)}{1 + \sum_j^J \exp\left(\delta_j\right)}. \tag{2.7}$$

At the true values of δ and market shares *s* this equation holds exactly. To find the true values of δ that match observed and predicted shares, equation (2.7) has to be inverted (Berry, 1994). In the standard MNL case, δ can be inverted analytically. So equation (2.7) becomes

$$\ln\left(s_i\right) - \ln\left(s_O\right) = \delta_i \equiv X_i\gamma_h - p_i\beta_h + \xi_i, \tag{2.8}$$

[1] We assume that the indirect utility of the "no purchase" option is set to zero.

Where s_o is the market share of the outside good. Finally we can use standard instrumental variable estimation techniques to estimate the unknown parameters.

However, if consumers vary in their purchasing behaviour, the assumption of homogenous taste preferences may lead to biased estimation results. If we try to capture idiosyncratic variations from the mean, we encounter two problems: First, we have to match market shares with each consumer's purchasing probability. Due to the unknown number of consumers in the population, we have to use simulation techniques to approximate the integral that joins the probabilities. Second, we need to invert the mean value δ_i to estimate the underlying parameters. Due to the nonlinearity, which results from the first step, the inversion must be done numerically.

To recover the true parameters, Berry (1994) suggests a contraction mapping procedure which can be incorporated within the estimation procedure:

$$\delta_i^{d+1} = \delta_i^d + \ln s_i - \ln s_i(\delta_i^d, \mu_{h,i}; \Pi, \Omega) \tag{2.9}$$

where s_i are the observed shares and $s_i(..)$ the predicted shares, given by the mean of $P_{h,i}$. BLP show that for every starting value δ^d converges to a fixed point. Given the mean utility, our estimation problem becomes

$$\xi_i = \delta_i - \left(X_i\gamma - p_i\beta\right). \tag{2.10}$$

Given appropriate instruments, (2.10) can be estimated by generalized method of moments (GMM).

2.2 Supply Model

For a consumer goods industry, it is reasonable to assume that manufacturers do not serve the final consumer directly. Furthermore, manufacturers have to pass along a distribution line. In our proposed model, we assume that the distribution to the final consumer is reached by passing two intermediaries (i.e. retailer and wholesaler[2]). This distribution structure can be incorporated into a "twice double marginalization" model (see Fig.2 for an illustration of our suggested model).

[2] We like to mention that the wholesaler serves as an importer who might bears the additional transaction cost.

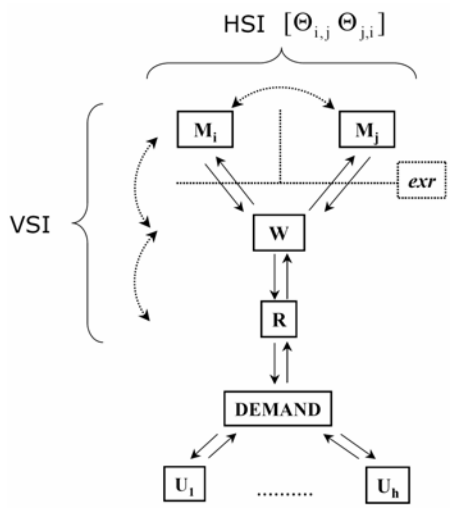


Fig. 2: A Model of Twice Double Marginalization

2.3 Model Assumptions:

To model the vertical strategic interaction (VSI) between manufacturers (M_i and M_j), wholesaler (W) and retailer (R), we assume that the competition in the distribution channel is given by the so-called Manufacturer-Stackelberg (MS) game (Choi, 1991). Furthermore, assuming that only two competing manufactures exist, the horizontal strategic interaction (HSI) between these players can be measured by the unspecified conduct parameters $\Theta_{i,j}$ and $\Theta_{j,i}$. For simplification, we additionally assume that wholesaler and retailer act as perfect category managers (e.g. Sudhir, 2001). To capture the effect of exchange rate change *exr* on market outcome, we assume that all relevant production costs are given in the home country currency of M[3]. Consumer behaviour is incorporated into our model given the stated assumptions in the previous section. If we assume that all players involved maximise their profits, we can calculate price-cost margins (PCM) for every stage in the distribution process.

[3] Thereby we rule out exchange rates to have a double impact in the decision process.

Price Cost Margins:

As we assume a MS game, the last stage of the game has to be solved first, meaning we must observe the maximization problem of R before we can calculate W and finally M's decisions. After rearrangement, the PCM of retailer R becomes

$$\left(p_i - w_i - c_R\right) = -s_i \left(\frac{\partial s_i}{\partial p_i} + \frac{\partial s_i}{\partial p_j}\right)^{-1}. \tag{2.11}$$

Analogously, we can calculate the first order condition for W as

$$\left(w_i - m_i - c_I\right) = -s_i \left(\frac{\partial s_i}{\partial p_i}\left(\frac{\partial p_i}{\partial w_i} + \frac{\partial p_i}{\partial w_j}\right) + \frac{\partial s_i}{\partial p_j}\left(\frac{\partial p_j}{\partial w_i} + \frac{\partial p_j}{\partial w_j}\right)\right)^{-1}. \tag{2.12}$$

To calculate the PCM for W, i.e. eq. (2.12), we need to know the change in final consumer price p given marginal changes in wholesale price w. Given consumers reactions, i.e. $\partial s_i/\partial p_i$ and $\partial s_i/\partial p_i$, we can partially derivative (2.12) with respect to w_i and w_j. Clearly, the price decision of W given marginal changes in the import price m can also be obtained by the partial derivative of (2.13) with respect to m_i and m_j. Given this, the first order condition for the manufacturer i can be rearranged to:

$$\underbrace{\left(m_i - c_i(exr_i)\right)}_{margin} = -s_i \left(\begin{array}{ll} \dfrac{\partial s_i}{\partial p_i} & \left(\dfrac{\partial p_i}{\partial w_i}\left(\dfrac{\partial w_i}{\partial m_i} + \dfrac{\partial w_i}{\partial m_j}\Theta_{j,i}\right) + \dfrac{\partial p_i}{\partial w_j}\left(\dfrac{\partial w_j}{\partial m_i} + \dfrac{\partial w_j}{\partial m_j}\Theta_{j,i}\right)\right) \\ + \underbrace{\dfrac{\partial s_i}{\partial p_j}}_{consumers\ response} & \underbrace{\left(\dfrac{\partial p_j}{\partial w_i}\left(\dfrac{\partial w_i}{\partial m_i} + \dfrac{\partial w_i}{\partial m_j}\Theta_{j,i}\right) + \dfrac{\partial p_j}{\partial w_j}\left(\dfrac{\partial w_j}{\partial m_i} + \dfrac{\partial w_j}{\partial m_j}\Theta_{j,i}\right)\right)}_{channel\ and\ copetitive\ response} \end{array}\right)^{-1} \tag{2.13}$$

The left-hand side (LHS) of equation (2.13) shows manufacturer i's margin. Intuitively, the margin depends on the marginal production cost, which is a function that can be affected by exchange rate variation *exr*. Thus, neglecting the right-hand side (RHS) of (2.13), a firm that follows a constant margin strategy would increase its price just as much as the marginal costs are changed by a cost shock caused by currency variations. This would imply a pass-through of 100% on prices. Clearly this strategy cannot be efficient because it disregards the strategic effect of price on purchased quantity. As pointed out before, given consumers, channels and competitor response, every change in price will have a substantial impact on the manufacturers' market share. In our purposed model, market response is given by the derivative of firm i's market share with respect to the final consumer price of its own brand and that of the competitors. The competitive response of the RHS can be deconstructed into two different sources of influence: To the extent that the pricing policy of both manufacturers has no direct impact on final consumer prices, VSI enters equation (2.13), i.e. $\partial p/\partial w$ and $\partial w/\partial m$. Besides the vertical relationship, we have to account for the influence of the competitive game played by the manufacturers, i.e. the HSI, on the pricing decision. While we initially do not specify the conduct parameters $\Theta_{j,i}$ and $\Theta_{i,j}$, we can integrate them as additional parameters into our estimation routine.[4]

Following the NEIO methodology, two different approaches can be used to derive information about the underlying HSI game: the menu approach, which ex ante sets up different types of games (i.e., parameters for $\Theta_{j,i}$ and $\Theta_{i,j}$), and the conjectural variation approach, which estimates $\Theta_{j,i}$ and $\Theta_{i,j}$ from the data (Kadiyali, Sudhir & Rao, 2001). We will use both approaches to gain insight into the degree of manufacturers' brand competition.

2.4 Measuring Exchange Rate Pass-Through

Following trade theory, we define the extent to which exchange rate induced price changes are translated to demanders of a product via exchange rate pass-through ERPT (see e.g. Goldberg, 1995). Formally, the ERPT is given by the ratio between a percentage change in price $\Delta p/p^{t-1}$ and a percentage change in exchange rate $\Delta exr/exr^{t-1}$, i.e.

$$\varphi_{i,k} = \frac{\Delta p / p^{t-1}}{\Delta exr / exr^{t-1}} \text{ with } p \in \{p_i, w_i, m_i\}^{5} \tag{2.14}$$

In our model, three different types of ERPT could be identified: (I) between manufacturer and importer (II) between importer and retailer and (III) between retailer and final consumer. Although ERPT-coefficients could be calculated analytically, due to the complexity of our model we follow Goldberg (1995) in computing them by performing counterfactual experiments. Thereby we estimate the structural model described in section 2.1 and 2.2 using exchange rate variation as an additional instrument in the first step. Given our estimation

[4] Note: all necessary derivatives for MNL Model can be found in the appendix.

[5] Given this structure, the ERPT coefficient might be interpreted as an elasticity coefficient of on how sensitive prices react on exchange variations. Please note that this approach is not only limited to price changes caused by currency variations. Other sources (e.g. energy cost, transportation cost, etc.) that influence prices can also be calculated.

results, we use simulation techniques to evaluate the effects of cost shocks triggered by currency variation on market outcomes (e.g. prices, margins and profits) of all players involved. Using the given results we compute (2.14) for a range of different exchange rate variations. Additional details are given later on.

2.5 Hypothesis

Given our model described in the subsections before, we propose the following hypotheses:

As conventional modern trade theory dictates (e.g. Goldberg & Knetter 1997), we expect that *exchange rate changes are passed through imperfectly within the distribution process* (H1).

Recent empirical studies in trade theory focus primarily on the effects of currency on export or import prices rather than on final consumer prices and thereby only mainly concentrate on H1. While this might be sufficient for macroeconomic policy decisions, marketing decisions need a more precise picture. Building on our framework presented in the subsections above, we are able to test the influence of exchange rate variations on a more precise level that incorporates various decision makers.

As we expect the exchange rate pass-through to be imperfect, it is straightforward to assume that *margins buffer exchange rate variations* (H2). This hypothesis is also supported but not tested within the conceptual framework of Clark, Kotabe and Rajaratnam (1999).

While we focus mainly on the impact of currency variations that directly impact manufacturers behaviour, we also explore how exchange rate changes affect the decisions making within the distribution process. Following Bacchetta and van Winccop (2003) we expect that *the effect of exchange rate variations decreases towards final consumer price* (H3).

This also implies that *the actors in the distribution process are affected differently by exchange rate variations* (H4).

As margins tend to be a crucial factor that influences the extent of pass-through, i.e. H2, we expect that t*he degree of competition has an impact on the exchange rate pass-through* (H5). This hypothesis is also supported but not tested by the theoretical work of Chang and Lapan (2003). As margins tend to be higher for lower degrees of competition, we also suggest that a *lower degree of competition imply a lower exchange rate pass-through* (H6).

3. Empirical Study

3.1 Data

We apply our model to the product category “premium beer brewed in Europe” that is distributed in the US. While this market is fragmented, we focus on the two leading European beer exporters, Heineken and Beck’s, which claim dominant market shares in this product category (see e.g. Modern Brewery Age, 1995). Many studies provide evidence that exported European beer is substantially affected by currency variations (e.g. Glauben & Loy, 2002; Knetter, 1989; Goldberg & Knetter, 1999) and underline the effect of exchange rate variation on market outcomes and strategic marketing decisions (see Heineken Shareholder Conference 2003).

To perform our empirical analyses within our model of twice double marginalization, we combine two different types of data sources:

1.) Retail data taken from the second largest supermarket chain in the greater Chicago area, in order to model the relationship between consumers, retailer and wholesaler.[6]

2.) Foreign trade statistics, assuming that the reported retail data from Chicago is a subset of imported beer imported into the US. The United States Department of Agriculture Foreign Agricultural Service reports monthly sales data on “beer made from malt in glass less than 4 litres” for Germany and the Netherlands. Beck’s and Heineken are the leading beer exporters in their countries to the US market and claim a market share of more than 75 percent of beer exports from their countries. We use this information as a proxy for import prices.

[6] We used Dominick's Finer Food Data reported by the University of Chicago Graduate School of Business.

Table 1
Descriptive statistics of endogenous variables

Brand	Variable	Max	Mean	Min	SD
Beck's	Import price	1.26	1.19	1.13	0.04
	Wholesaler price	2.6	2.46	2.29	0.1
	Final consumer price	3.18	2.75	2.47	0.19
	Quantity	7638	3203.31	823	1243.91
	Share	0.10	0.04	0.01	0.01
Heineken	Import price	1.369	1.31	1.27	0.03
	Wholesaler price	2.59	2.5	2.34	0.09
	Final consumer price	3.28	2.98	2.55	0.21
	Quantity	8823	3102.60	789	1550.85
	Share (%)	14	4	1	3

Table 1 provides descriptive statistics of all endogenous variables included in our empirical study. On average, we found the price of Heineken beer to be between 2 to 10 percent higher than that of Beck's.[7]

3.2 Results

Our results suggest that Stackelberg competition with Beck's as leader in a pricing game best describes our data[8]. Given the HSI for the manufacturers, we estimate demand and supply side parameters.

Demand Side Estimates

Using demographic variables such as income and squared income to characterise the effect of observable heterogeneity, we find lower price sensitivity for consumers with higher income, which is consistent with pre-existing literature (e.g. Nevo, 2001). We also find that households with lower incomes generally purchase more units in case of a promotion in a previous period.

[7] Also important to note is the fact that, although the total quantity of Heineken and Beck's sold in the US in the mid-90s increased, the US beer market is now a mature market with decreasing sales (see e.g. Heineken's annual shareholder conference, 2001).
[8] We use a model comparison test suggested by Kadiyali (1996) and Kadiyali, Vilcassim & Chintagunta (1996). Our results are also confirmed by our estimated conduct parameters.

Table 2
Demand Side Estimates[9]

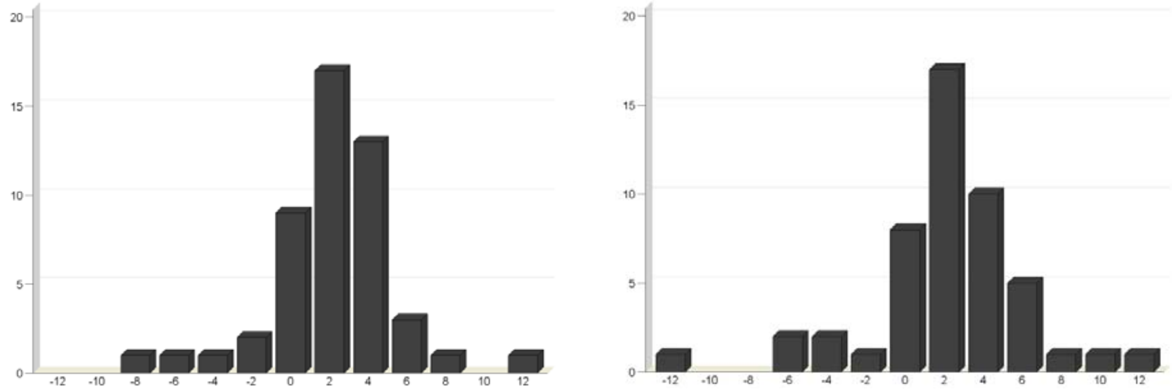
Parameter	Estimated Mean	Estimated Variance	Demographic Variables		
			Age	Income	$Income^2$
Brand Specific Constant Beck's	-8.98004 (<.0001)	1.603004 (0.0550)	-0.04524 (0.5528)		
Brand Specific Constant Heineken	-10.2442 (<.0001)	0.237822 (0.3089)	0.037508 (0.3345)		
Price	4.479484 (<.0001)	0.037202 (0.1308)		2.33562 (<.0001)	-0.037569 (0.1825)
$Price_{t-1}$	5.76771 (<.0001)	0.004344 (0.7282)		-2.02418 (<.0001)	
Bonus	0.005513 (0.2165)	0 (0.7505)			
Price-Cut	0.003393 (0.0469)				
Season	-0.03492 (0.0017)				

Willingness to pay

Table 3: Descriptive Statistics of Consumers Willingness to Pay (in USD/litre) (n = 50)

WTP	Max.	Mean	Min.	Std. Dev.
Beck's	13.67	1.56	-8.49	13.92
Heineken	17.29	1.94	-12.09	16.15

[9] (p-value)



WTP-Distribution Beck's | WTP-Distribution Heineken

Fig. 3: WTP-Distribution of Beck's and Heineken (in USD/litre)

Supply Side Estimates

Table 4: Supply Side Estimates

Parameter			**Estimate**
Manufacturer	*Beck's*	Constant	0.92 (<.0001)
		Energie	3.765 (<.0001)
	Heineken	Constant	1.523 (<.0001)
		Energie	-4.638 (0.005)
	shared cost	Glas	-0.03 (<.0001)
Wholesaler		Constant	0.39 (<.0001)
		Wages	0.001 (<.0001)

Operation Cost

Given the supply side estimates reported in table 4, we can calculate operation cost for manufacturers and the wholesaler (see table 5). Our results show a comparative disadvantage for Heineken given higher production cost compared to Beck's. Various beer industry experts confirmed our results, suggesting higher production costs for Heineken are due to differences in the production process. While Beck's beer is brewed using all natural ingredients, Heineken uses preservatives in the brewing process. The use of preservatives complicates the production process, thereby increasing production cost. However, a production cost level that includes advertising, management and distribution costs was estimated by R.D. Weinberg & Associates, whose 1996 study showed US mass beer producers to face a production cost of \$0.79/litre (see Consumer Reports, 1996).

Table 5: Calculated Operation Cost (USD/litre)

Operation Cost	Max.	Mean	Min.	Std. dev.
Beck's	0.90	0.75	0.70	0.03
Heineken	0.97	0.87	0.81	0.04
Wholesaler	1.13	1.05	1.00	0.03

While the calculated manufacturing cost seems to be valid, the wholesalers' operation cost might be over estimated. This is caused by the fact that we assume the wholesaler serves as importer for both brands. Therefore derived operation cost also will include taxes and toll-fees, which we cannot separate in our estimation.

Our results show higher production costs for Heineken than for Beck's, indicating a comparative production disadvantage for Heineken. In contrast, demand side estimates suggest a higher willingness to pay for Heineken, indicating some demand advantages. Taking both effects together, we find higher margins for Heineken than for Beck's. These findings would deviate from the general framework were the leader (Beck's) used to charge higher margins than the follower (Heineken).[10] However, our results can be drawn back to a lower effect of market response (indicated by a higher willingness to pay) on the margin for Heineken than for Beck's (see eq. 2.13). Taking both effects together, the positive demand effect seems to compensate for the comparative cost disadvantage of Heineken. Given more sold units and higher margins, Heineken claims more profit for all actors in the distribution line.

4. Counterfactual Experiments

Following Goldberg (1995), we use the estimated GMM results of the Stackelberg pricing game with Beck's as leader to perform counterfactual experiments. Assuming exchange rate

[10] Given identical firms the Stackelberg leader realizes higher margins due to the fact that the price set by the leader exceeds the price set by the follower.

changes in a range of –75% (appreciation of foreign currency) to +75% (depreciation of foreign currency), we compute equilibrium prices, quantities, market shares and margins for every different shock on the cost function.

Given our estimation and the results reported in chapter 3, we can construct demand-supply relations for every stage in the distribution process that enable us to calculate the effects of exogenous cost shocks caused by currency variations.

To clarify the process of counterfactual experiments within our framework, we assume for the sake of simplicity that manufacturers directly serve final consumers' demand. However, later on we will use the complete set up to calculate the effects of exchange rate variation on market outcomes. Using the first order condition of a manufacturer as our supply function, we can rearrange equation (2.13) to model the supply decision:

$$p_{\$} = c_{\$}\left(c_{€}, exr\right) + \Delta_{\$}\left(q\right) \tag{4.1}$$

Note that the manufacturer's margin Δ depends on consumers and competitive response. While we are not able to observe the production cost measured in terms of the manufacturer's homeland currency, we assume that $c_{€}$ can be described by a linear transformation of cost instruments $Z_{\$}$ measured in the currency of the target country and cost parameters ω. Given that unobservable effects influence the cost function a random error η is added.

$$p_{\$} = c_{\$}\left(Z_{\$}, \eta; \omega\right) + \Delta_{\$}\left(q\right) \tag{4.2}$$

Using the estimated cost parameters $\overline{\omega}$ and demand parameters $\overline{\beta}$ reported in section 3, we can calculate equilibrium prices as

$$p_{\$}^{*} = c_{\$}\left(Z_{\$}; \overline{\omega}\right) + \Delta_{\$}\left(q^{*}\right) \tag{4.3}$$

with final consumer demand given by

$$q^{*} = d\left(p_{\$}^{*}, X; \overline{\beta}\right).\text{[11]} \tag{4.4}$$

The demand function $d(..)$ is constructed using the random coefficient model reported in section 2.1.[12] Exogenous variables that shift the demand function are expressed by X.

[11] While p and q affect each other, we use numerical simulation methods to calculate the outcomes.
[12] Note that any other specification can be used to model consumer demand.

While our model was estimated using exchange rate changes as additional instruments, the reported coefficients $\bar{\varpi}$ are subject to the currency variations. It being the case that we are not able to separate the effect of these variations ex post, we investigate the effects of deviations from the average exchange rate on market outcomes.[13] This is done by introducing an exogenous shock (1+*r*) into cost structure. The percentage deviation from the average is given by *r*. So equation (4.3) becomes

$$p_{\$}^{\,r} = c_{\$}\left(Z_{\$};\bar{\varpi}\right)\cdot\left(1+r\right)+\Delta_{\$}\left(q^{r}\right), \tag{4.5}$$

and consumers demand can thus be written

$$q^{r} = d\left(p_{\$}^{\,r}, X;\bar{\beta}\right). \tag{4.6}$$

Building the difference between the calculated prices given by equations (4.3) and (4.5), i.e. $\Delta p_{\$} = p_{\$}^{*} - p_{\$}^{r}$ the ERPT- coefficient can be calculated regarding equation (2.14) as

$$\varphi = \frac{\Delta p_{\$}}{p_{\$}^{*}}\cdot\frac{1}{r}. \tag{4.7}$$

Using equation (4.7) to calculate the ERPT coefficient for every member of the distribution process, we obtain different values for manufacturer, wholesaler and retailer. Our results underline the fact that the effect of exchange rate variation decreases towards the final consumer price. However, we also find greater slopes for import prices compared to wholesale and final consumer prices that indicate different degrees of price adjustments. These findings are consistent with recent research in empirical trade theory: Campa and Goldberg (2006) demonstrate in an empirical study of over 21 OECD countries that the influence of currency fluctuations tend to be much lower on final consumer price than on import prices. Their results also give evidence to the fact that exchange rate pass-through is closely linked to margins in the distribution line. We find evidence for their results by showing that the changes in margin caused by currency variation decrease towards the end of the distribution line (see Fig. 3).

The results reported in table 6 show ERPT coefficients less than one that decrease towards the final consumer price and thereby confirm our hypotheses 1 and 2. Our results are consistent with the empirical work of Glauben and Loy (2002), who report average ERPT-coefficients of

[13] Note that currency variations have affected the observed market outcomes and thus the market equilibrium. We use the mean of exchange rate variation given in our data as average.

-0.65. They apply a Pricing to Market (PTM) and a Residual Demand Elasticity (RDE) approach to examine the influence of currency variations on German and Dutch beer exports using aggregated export prices. Various studies have shown that the effect of currency variations tends to be higher on export prices than on import prices (e.g. Goldberg & Knetter, 1997).

Table 6: ERPT-Coefficient given average exchange variations

ERPT-Coefficient	Mean
$\varphi_{m,Beck's}$	0.542
$\varphi_{m,Heineken}$	0.551
$\varphi_{w,Beck's}$	0.193
$\varphi_{w,Heineken}$	0.213
$\varphi_{p,Beck's}$	0.153
$\varphi_{p,Heineken}$	0.172

To analyze the effects of fluctuating exchange rates, we calculate market outcomes for n = 150 different exchange rate changes. The main results are highlighted in figures 4 and 5.

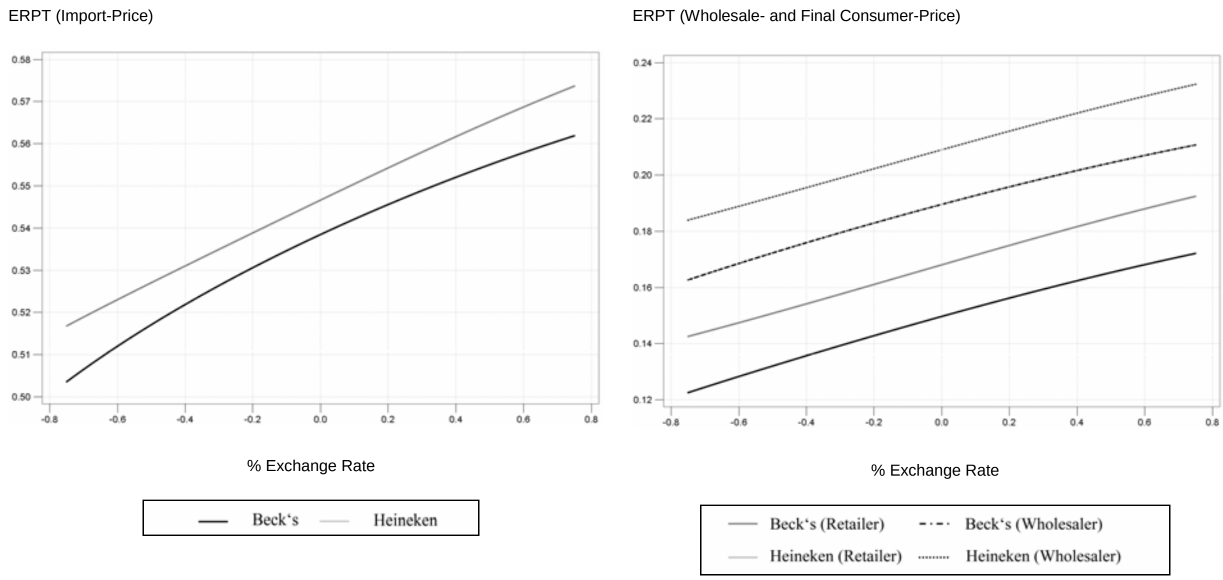


Fig. 4. ERPT coefficients for various exchange rate changes

Figure 4 highlights a slightly higher ERPT-coefficient of Heineiken compared to Beck's. This can be drawn back to different sources of influence.Firstly, given a higher willingness to pay for the brand Heineken, Heineken is able to charge higher prices in the market and therefore is able to avoid greater exchange-rate-induced price changes. Secondly, Heineken bears a higher production cost, which enforces a greater need to pass through. A third point that significantly impacts the pass through decision is the assumed asymmetric competition structure between Beck's and Heineken. As our results show, the leader in a pricing game tends to pass through less than the follower (see Table 7). These results are consistent with the work of Chang and Lapan (2003).

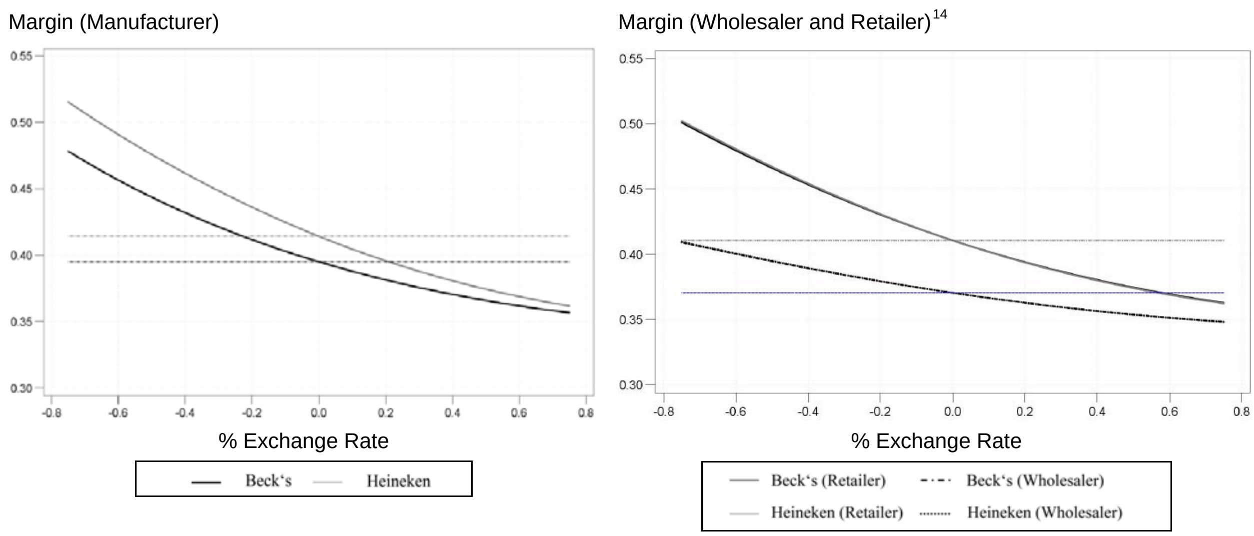


Fig. 5. Effect of Exchange Rate Changes on Margins

Using the effect of exchange rate variations on prices, we calculated margins for all actors involved in the distribution process. Figure 5 shows that manufactures benefit more from appreciations of the dollar (here represented by negative values) than distributors. In the opposite case, when the dollar depreciates, manufacturers' margins will suffer more than those of the distributors. This result can be traced back to the two effects pointed out before. As depreciation rises, the pressure of production cost on margins intensifies. Due to the elastic reaction of consumers, manufactures are not able to pass through the amount that would be necessary to compensate for the higher production cost (measured in terms of the target county currency), therefore margins tend to fall with depreciation. So we find hypothesis 2 to be confirmed: Margins serve as buffer for exchange rate variations. As this buffer is found to become lower towards the end of the distribution process, it is straightforward to argue that all

[14] Note that the equal margins for both brands are the result of the assumed category maximizing behavior of wholesaler and retailer.

actors are affected differently by exchange rate variations. We can thereby confirm hypothesis 4.

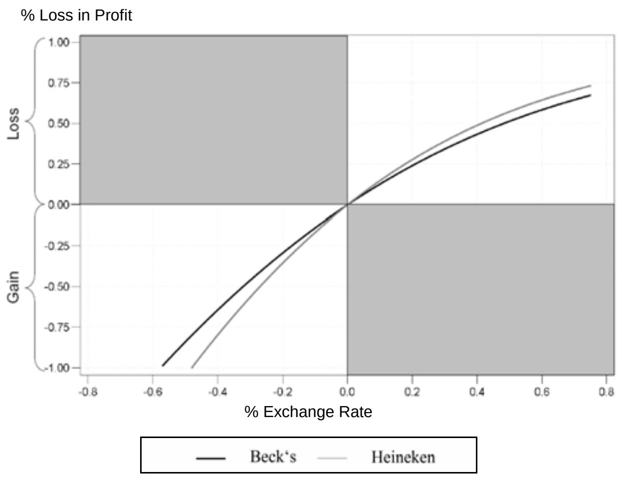


Fig. 6. Percentage Loss in Profit caused by Exchange Rate Changes

As pointed out before, two different effects, i.e. pressure of production cost and consumer reaction, influence the manufacturer's profit maximising strategy.As the pressure of production cost on the profit function decreases, Heineken can benefit more from appreciations than Beck's – i.e. the advantage of demanders' lower price sensibility tends to outweigh than the disadvantage of higher production costs. In the case of depreciation, the effect is the opposite: cost increases and Heineken suffers more than Beck's. So we find a relatively higher loss in profits for Heineken given a depreciation of the dollar (see figure 6). Clearly the vulnerability given depreciation is higher for Heineken than for Beck's.

While the previous analysis examined the effects of various exchange rate variations given a special competition game, the following discussion concentrates on market outcomes given different types of competition and currency variations.

Table 7: Average ERPT-coefficient and margins given different competition games

	Bertrand		**Collusion**	
	∅ ERPT	**∅ Margin**	**∅ ERPT**	**∅ Margin**
Beck's	0.559	0.392	0.425	0.484
Heineken	0.549	0.421	0.468	0.485
Wholesaler: Beck's	0.196	0.419	0.159	0.405
Wholesaler: Heineken	0.209	0.420	0.189	0.405
Retailer: Beck's	0.155	0.374	0.128	0.368
Retailer: Heineken	0.167	0.374	0.155	0.368

	Stackelberg: Beck's → Heineken		**Stackelberg: Heineken → Beck's**	
	∅ ERPT	**∅ Margin**	**∅ ERPT**	**∅ Margin**
Beck's	0.537	0.403	0.558	0.393
Heineken	0.546	0.423	0.539	0.426
Wholesaler: Beck's	0.189	0.418	0.196	0.419
Wholesaler: Heineken	0.209	0.418	0.205	0.419
Retailer: Beck's	0.149	0.373	0.155	0.374
Retailer: Heineken	0.168	0.374	0.165	0.374

Our results show relatively low ERPT-coefficients for a cooperative pricing strategy played between manufactures. This can be drawn back to higher margins, in the case of collusion, which lower the pressure that results from depreciation of the dollar. Manufacturers' margins will therefore react more elastically to price changes caused by currency variations and be able to take consumers' reaction to price changes into account more. It should be mentioned that, given the structure of the Stackelberg game, followers' market outcomes are nearly identical to the Bertrand pricing game results. Taken together, the results depicted in Table 7 are prove that exchange-rate-induced price changes increase with competitiveness, being the greatest in the case of complete competitive behaviour. These results are consistent with findings by Gross and Schmitt (2000), who show in a theoretical framework that the degree of ERPT is strongly influenced by the degree of competition.

To conclude: our results evince that a cooperative manufacturer strategy directly impacts the degree of ERPT for distributors. Price agreements lead to changes in the distribution of margins: while manufacturers will gain margin, distributors will loose it. Both hypothesis 5 and 6 can thus be confirmed.

5. Conclusions and Further Research

In this paper, we have investigated the influence of exchange rate variation on market conduct. We look at the US beer market, which upholds our stated assumptions. We find the pricing game in the beer market to be asymmetric and slightly cooperative. We also demonstrate that the ERPT decreases towards the final consumer. Our results reveal that foreign manufacturers gain (lose) more compared to other intermediaries in the distribution channel in case of an appreciation (depreciation) of the foreign currency.

Due to the fact that we use a static rather than a dynamic framework, we are unable to draw conclusions about changes in competition caused by exchange rate shocks. However, further work should transfer our approach into a dynamic structural econometric model (e.g. Bajari, Benkard & Levin, 2006).

Appendix:

I. Willingness to Pay (WTP):

Following Besanko, Gupta and Jain (1998) we calculate the WTP given our demand side estimates as

$$WTP \equiv \frac{(X_i \gamma_h)}{\beta_{hj}} \text{ with } \gamma_h = \gamma + \Pi D_h + \Sigma \nu_h \text{ and } \beta_h = \beta + \Pi D_h + \Sigma \nu_h .$$

II. Calculated derivatives for MNL Model:

MARKET RESPONSE			$\frac{\partial s_i}{\partial p_i} = -s_i(1-s_i)\beta$	$\frac{\partial s_i}{\partial p_j} = s_i s_j \beta$
COMPETITIVE RESPONSE				
	Vertical	retailer ← importer	$\frac{\partial p_i}{\partial w_i} = (1-s_i)$	$\frac{\partial p_i}{\partial w_j} = -s_j$
		importer ← manufacturer	$\frac{\partial w_i}{\partial m_i} = 1 - \frac{2s_i}{1+s_i+s_j}$	$\frac{\partial w_i}{\partial m_j} = -\frac{2s_j}{1+s_i+s_j}$
	Horizontal	Bertrand	$\Theta_{i,j} = 0$	$\Theta_{j,i} = 0$
		Collusion	$\Theta_{i,j} = 1$	$\Theta_{j,i} = 1$
		Stackelberg (leader *i*, follower *j*)	$\Theta_{i,j} = 0$	$\Theta_{j,i} = \Theta_{j,i}^{follower}$

$$\Theta_{j,i}^{follower} = \frac{\left\{ \begin{array}{l} s_i \left[s_j \left(38 + s_j \left(3 + 2s_j(5s_j - 12)\right)\right) - 31 \right] + s_j \left[s_j \left(19 + s_j \left(1 + 2s_j(s_j - 3)\right)\right) - 31 \right] + \\ s_i s_j \left[23 + 2s_i^5 + 2s_i^4 \left(5s_j - 3\right) + s_i^3 \left(1 + 4s_j(5s_j - 6)\right) + s_i^2 \left(19 + s_j \left(3 + 4s_j(5s_j - 9)\right)\right) \right] \end{array} \right\}}{\left\{ \left[1 + s_i + s_j\right] \left[\left(s_i - 1\right)^3 + s_j \left(s_i(2s_i - 3) - 1\right) + s_i s_j^2 \right]^2 \right\}}$$

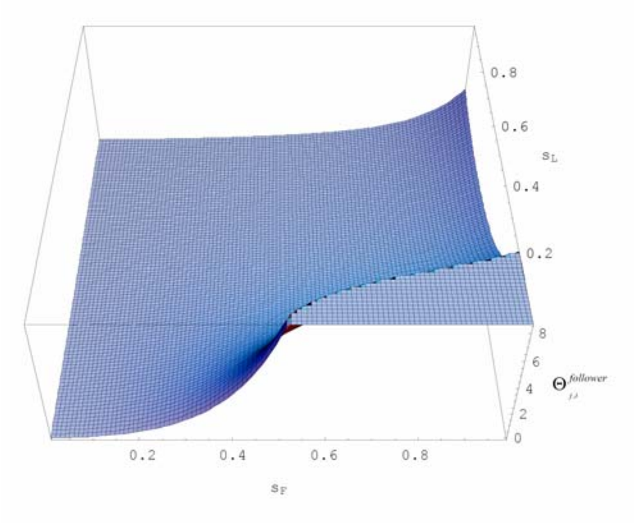


Fig. 7: Values of the Reaction Coefficient for the Follower given Different Market Shares

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