(2006) 2(2) CompLRev Supp 1 ISSN 1745-638X (Online)

THE COMPETITION LAW REVIEW

An Experimental Investigation of Article 82 Rebate Schemes[*]

Martin Beckenkamp[+] Frank P. Maier-Rigaud[•]

Abstract

We conduct an experiment to test standard theoretical predictions concerning switching behavior in a rebate and a discount scheme. Beyond theoretical expectations we find that rebate and discount schemes exert a significant attraction that enhances the potentially exclusionary effect of the schemes. From a competition policy perspective this is an important result because it emphasizes that it may be crucial to analyze to what extent firms deviate predictably from decision patterns prescribed by standard economic theory. Competition policy cannot afford to neglect the possibility of boundedly rational firms deviating systematically from standard theoretical predictions.

[*] Financial support from Competition Law Scholars Forum (CLaSF) is gratefully acknowledged. We thank Stefan Bechtold, Christoph Engel, Orit Dayagi-Epstein, Hendrik Hakenes, Martin Hellwig, Marc Pirrung, Reinhard Selten, Andreas Seip, Michael Stratmann and the participants of the 6th CLaSF conference in London for comments on an earlier version of this paper.

[+] Max Planck Institute for Research on Collective Goods, Bonn, Germany, e-mail: beckenk@coll.mpg.de.

[•] BonnEconLab, Laboratory for Experimental Economics, University of Bonn, Germany; Max Planck Institute for Research on Collective Goods, Bonn, Germany; European Commission, Directorate General Competition, Brussels, Belgium; e-mail: maier-rigaud@microeconomics.de. The views expressed are those of the author and not of the EuropeanCommission.

1 Introduction

The European Commission is currently reviewing its approach to Article 82 EC. One, if not the most important issue regarding the assessment of abuses of dominance are rebate schemes. In September 2003 the European Court of First Instance upheld a Commission decision finding the system of rebates operated by the tyre manufacturer Michelin abusive.[1] In December 2003 the Court likewise upheld a European Commission decision against British Airways for its rebate system for UK travel agents.[2] The issue of rebates also arose in the recent US case of LePage's who sued 3M for monopolizing the market through a rebate system.[3] The fundamental issue in these, current and future rebate cases is the identification of the effects of rebate schemes. Proper competition policy can only be devised if the impact of rebate schemes on the decision making of firms is understood. Economics is supposed to provide a significant input to the policy question concerning rebate schemes under Article 82 as well as to the individual analysis of rebates on a case by case basis once the application of Article 82 has been reformed.

This paper focuses on an analysis of the theoretical and behavioral responses triggered by rebate schemes and does, therefore, not aim at taking a position in the ongoing policy debate on retroactive rebate schemes as exclusionary abuse under Article 82. In our analysis we consider two mathematically identical embodiments of such rebate schemes: 1) retroactive rebates and 2) discounts. In the discount scheme a reduced price is granted from the start and the discount has to be reimbursed at the end of the reference period if the quantity threshold has not been reached. In the rebate scheme a reduced price is granted "retroactively" once the quantity threshold has been reached. The effects of these two

[1] Case T-203/01 Manufacture française des pneumatiques Michelin v Commission of the European Communities [2003] ECR II-04071.

[2] Case T-219/99 British Airways plc v Commission of the European Communities [2003] ECR II-05917.

[3] LePage's Inc. v 3M, 324 F.3d 141 (3rd Cir. 2003).

schemes are experimentally tested by confronting participants with different price schemes in a formally identical risky decision-making environment.[4] The discount and rebate schemes are compared with a conventional linear price scheme.

The principal idea behind this experimental investigation is that actual behavior needs to be explored in a controlled environment to allow an empirical assessment of such price schemes. Based on findings in behavioral economics it seems plausible that systematic behavioral effects of rebate schemes outside the realm of standard economic theorizing exist and can be experimentally identified. This paper therefore goes a step further than traditional economic analysis in the sense that the behavioral response is no longer mechanically prescribed but empirically tested in a controlled environment.

In order to allow such a comparison between theoretical assumptions and empirical results, we first discuss the potential of rebate schemes to create switching costs in a theoretical context that relies on standard economic assumptions. In particular, the theoretical model used relies on the risk neutral maximization of expected profits. Secondly, we conduct an experiment that aims at collecting empirical data for a behavioral study of rebate schemes in the laboratory. Thus rebate schemes will be explored experimentally by making use of tools that were developed in the field of experimental economics and psychology. This approach enriches the discussion on Article 82 by providing the empirical basis on which competition policy can and should be developed.[5]

Already from a theoretical perspective, the impact of rebate and discount schemes on competition is a complex issue. Complexity may, however, even become greater if the standard assumptions made in economic theory, that is,

[4] Although rebate and discount schemes need not be formally identical (such as for example under discounting) our experiment is designed so that both schemes are isomorph.

[5] See for example Tor (2002) or (2003) who argues in favor of a boundedly rational approach to competition policy. See Tor, A. (2002) The Fable of Entry: Bounded Rationality and the Efficacy of Competition, *Michigan Law Review*, 101, 482-557 and Tor, A. (2003) Illustrating a Behaviorally Informed Approach to Antitrust Law: The Case of Predatory Pricing, *Antitrust*, 18, 52-57.

rational profit maximizing behavior as prescribed by expected utility theory, are not (or not sufficiently) fulfilled. Experimental data can shed some light on the possibility of systematic and predictable deviations from standard economic results in this context.

2 Theoretical Background

2.1 Rebate, discount and linear pricing schemes

There are two upstream firms that produce a homogenous product at marginal cost c. The product is bought by a downstream retailer, that sells the good to final consumers. The upstream firms are referred to as A and B, where A denotes the firm that is assumed to be dominant in the upstream market.[6] Denote by $T_i(q_i)$ the downstream firm's payment to upstream firm i depending on the amount of units q_i bought.

The *upstream firm A offers a rebate scheme*, that is, $T_A(q_A) \equiv wq_A$ if $q_A < \bar{q}$ and $(1-\alpha)wq_A$ otherwise, where $w \geq 0$, $\alpha \in (0,1)$ and $q_A \equiv \sum_{t=1}^{\tau} q_{At}$, where τ denotes the final subperiod of the reference period. In this scheme, the downstream firm's average per unit price and marginal price equals w if $q_A < \bar{q}$ units are purchased and $(1-\alpha)w$ otherwise. Since $\alpha > 0$ the downstream firm is rewarded for purchasing at least $\bar{q}$ units. This implies that firm A uses a rebate scheme where α is the percentage discount off the list price w once $\bar{q}$ units have been bought.[7]

The *upstream firm B* in contrast *offers a conventional price scheme*, i.e. a linear pricing schedule implying a cost of $T_B(q_B) \equiv vq_B \; \forall q_B \geq 0$ for the downstream

[6]Although we do not model this explicitly, this is an important assumption that could be motivated for instance by capacity constraints.

[7]Note that from a modelling perspective the pricing behavior of the upstream firms is the result of a profit maximizing calculus based on behavior downstream. We do not model this explicitly because it unnecessarily complicates the exposition without adding any particular insight to the question at hand.

firm, where $q_B \equiv \sum_{t=1}^{\tau} q_{Bt}$.

Consider the following variation to firm $A's$ pricing strategy that we refer to as discount scheme. An upstream firm C *may offer a discount price schedule* $T_C(q_C) \equiv (1-\alpha)wq_C + F(q_C)$ if $q_C < \bar{q}$ and $(1-\alpha)wq_C$ otherwise, where $q_C \equiv \sum_{t=1}^{\tau} q_{Ct}$. This scheme is mathematically equivalent to the retroactive rebate scheme if $F(q_C) = \alpha w q_C \ \forall \ q_C$. The only difference is that the reduced price $(1-\alpha)wq_C$ is paid from the start and $F(q_C)$ is only paid if $q_C < \bar{q}$.[8]

The downstream firm buying the good incurs only the cost of its purchases from the upstream firm(s) when it purchases $q_i \geq 0$ units of the good. Let p denote the retail price and $q_t(p, X)$ the consumers demand function.[9]

The upstream firms profits are given by $\pi_i^u \equiv T_i(q_i) - cq_i$ and the downstream firm profit is given by $\pi^d \equiv \sum_{t=1}^{\tau} \pi_t^d$, where π_t^d is given by:

$$\pi_t^d \equiv \begin{cases} q_t(p,x)p - \sum\limits_{i\in\{A,B\}} T_i(q_i) & \text{if} \sum\limits_{i\in\{A,B\}} q_i + s_t \geq q_t(p,x) \\ \sum\limits_{i\in\{A,B\}} (q_i + s_t)p - \sum\limits_{i\in\{A,B\}} T_i(q_i) & \text{otherwise.} \end{cases} \tag{1}$$

The level of stock at time t is denoted by s_t.[10] Let $E(p^*)$ denote the expected profit maximizing price and $E(q) \equiv E(q_t(p^*, X))$ the corresponding expected profit maximizing quantity.

Based on the price scheme information of the upstream firms and the demand function, the downstream firm calculates its expected profit maximizing price. Given that price, it can determine the corresponding expected quantity that final

[8]Note that due to this isomorphism we will be able to concentrate on rebate schemes in the following theoretical exposition. All results directly apply to discount schemes as well.

[9]Where $X \sim N(\mu, \sigma)$ is a normally distributed random variable with a mean of μ and a standard deviation of σ. Note that demand in each subperiod is therefore not only dependent on price but also on the normally distributed random term X whose realization is denoted by x.

[10]$s_0 \equiv 0$ and $s_{t+1} \equiv \sum_{i\in\{A,B\}} q_{it} + s_t - q_t(p,x)$.

consumers will buy and order accordingly. We consider the case where pricing of the downstream retailer exerts some inertia, that is, for example, due to menu cost, prices are fixed at the beginning of the reference period for the whole period. Ordering decisions can, however, be taken at least twice during the reference period.

We consider the reference period to be divided into τ subperiods, with subperiod $t \in \{1, ..., \tau\}$. The demand in each subperiod $q_t(p^*, X)$ is a random variable from one and the same random process and we assume that the demand in each subperiod is independent from each other. This implies that we consider the special case where the cumulated expected sales in each subperiod increase linearly and proportionally in time.[11]

From a theoretical perspective there exist now at least two possible approaches for deriving predictions within this framework: either rational profit maximizing behavior or boundedly rational behavior can be presumed.

2.2 Rational behavior

We are now interested in the question under what conditions it is profit maximizing for the downstream firm to switch suppliers. In order to simplify we consider the situation in the τ'th subperiod with $v = (1-\alpha)w$, where the retailer has already bought $\sum_{t=1}^{\tau-1} q_t^o$ units, sold $\sum_{t=1}^{\tau-1} q_t$ units and therefore holds a stock of $s_\tau = \sum_{t=1}^{\tau-1}(q_t^o - q_t)$ units.[12]

In order to determine under what constellation it is rational to leave the

[11] For a discussion of time in the context of rebate schemes see Maier-Rigaud, F. P. (2005) Switchings Costs in Retroactive Rebates - What's time got to do with it?, *European Competition Law Review*, 26, 272 - 276. The article discusses a common fallacy according to which the length of the reference period matters for assessing foreclosure in rebate schemes.

[12] Due to the recursive nature of the problem over time the calculation of the expected profit maximizing stock at τ is difficult. We assume here that q_t^o has been chosen in an optimal fashion for all $t \in \{1, ..., \tau-1\}$. Given the stochastic nature of the process, any arbitrary $\sum_{t=1}^{\tau-1} q_t^o$ could be the outcome of an optimal process, albeit with different probabilities.

rebate scheme, we need to calculate the optimal quantity a profit maximizing risk neutral retailer would want to have available. If the retailer chooses to remain in the rebate scheme, the optimal quantity the firm should keep available for serving demand is

$$q_R^* \equiv \begin{cases} \arg\max_{q_R} p^* \left(\int_{-\infty}^{q_R} x f(x)dx + q_R \int_{q_R}^{\infty} f(x)dx + \sum_{t=1}^{\tau-1} q_t \right) \\ -(1-\alpha)w \left(q_R + \sum_{t=1}^{\tau-1} q_t \right) & \text{if } q_R + \sum_{t=1}^{\tau-1} q_t \geq \bar{q}, \\ \arg\max_{q_R} p^* \left(\int_{-\infty}^{q_R} x f(x)dx + q_R \int_{q_R}^{\infty} f(x)dx + \sum_{t=1}^{\tau-1} q_t \right) \\ -w \left(q_R + \sum_{t=1}^{\tau-1} q_t \right) & \text{otherwise.}^{13} \end{cases} \tag{2}$$

If the retailer decides to switch, the optimal quantity the firm should keep available for serving demand is

$$q_S^* \equiv \arg\max_{q_S} p^* \left(\int_{-\infty}^{q_S} x f(x)dx + q_S \int_{q_S}^{\infty} f(x)dx + \sum_{t=1}^{\tau-1} q_t \right) - w \left(\sum_{t=1}^{\tau-1} q_t + s_\tau \right) - v(q_S - s_\tau). \tag{3}$$

Based on the optimal quantity (composed of the remaining stock plus newly bought quantities, i.e. $q_R^* = s_\tau + q_\tau^o$), expected profits given the retailer remains

[13] Note that the latter case only arises if $\bar{q} - \sum_{t=1}^{\tau-1} q_t$ is large, that is, past sales were substantially lower than expected.

in the scheme is given by

$$E(\pi|R) \equiv \begin{cases} p^* \left(\int\limits_{-\infty}^{q_R^*} xf(x)dx + q_R^* \int\limits_{q_R^*}^{\infty} f(x)dx + \sum\limits_{t=1}^{\tau-1} q_t \right) & \\ -(1-\alpha)w \left(q_R^* + \sum\limits_{t=1}^{\tau-1} q_t \right) & \text{if } q_R^* + \sum\limits_{t=1}^{\tau-1} q_t \geq \bar{q}, \\ p^* \left(\int\limits_{-\infty}^{q_R^*} xf(x)dx + q_R^* \int\limits_{q_R^*}^{\infty} f(x)dx + \sum\limits_{t=1}^{\tau-1} q_t \right) & \\ -w \left(q_R^* + \sum\limits_{t=1}^{\tau-1} q_t \right) & \text{otherwise,} \end{cases} \tag{4}$$

where, given that $v = (1-\alpha)w$, it is trivial that the retailer would prefer to switch if $q_R^* + \sum\limits_{t=1}^{\tau-1} q_t < \bar{q}$ in the latter expression.

Expected profits given the retailer decides to switch to the linear pricing scheme offered by firm B while planning the corresponding optimal quantity of $q_S^* = s_\tau + q_\tau^o$ is

$$E(\pi|S) \equiv p^* \left(\int\limits_{-\infty}^{q_S^*} xf(x)dx + q_S^* \int\limits_{q_S^*}^{\infty} f(x)dx + \sum_{t=1}^{\tau-1} q_t \right) \\ -w \left(\sum_{t=1}^{\tau-1} q_t + s_\tau \right) - v(q_S^* - s_\tau), \tag{5}$$

If $E(\pi|R) = E(\pi|S)$, the downstream firm is indifferent between switching supplier (i.e. choosing firm B) and remaining with the current firm (i.e. firm A).

By solving for s_τ, we obtain the relevant switching threshold. Given the difficulties of integrating a Gaussian normal distribution, we calculate the numerical switching points for the experimental parameters using a Riemann approximation. The relevant numerical values based on the parameters used in the experiment will be presented in a later section.

2.3 Boundedly rational behavior

The concept of bounded rationality was originally introduced by Simon (1955) with a view to the cognitive limitations of the human mind.[14] At least since Selten (1978), the concept has broadened to encompass not only limitations of knowledge and computational capacity but genuinely different aspects such as motivation, adaptation and emotion.[15] The concept of 'bounded rationality' although not clearly defined, is a decidedly descriptive as opposed to prescriptive concept.

A given response to a decision task often depends on how the decision task is presented. Decision tasks in the field but also the games modelled after such tasks can be framed in more than one way. In other words, a decision situation that is identical or isomorph from a mathematical point of view is presented in different "frames" (in analogy to one and the same picture presented in different frames).

In many experimental studies, systematically different choices depending on the frame (for instance by varying the formulation of the decision task) can be observed. These systematic deviations are generally called "*framing effects*".[16] A classical example is the change from risk-averse to risk-seeking behavior depending on whether the consequences of a decision problem (such as vaccination) are presented as a gain (200 of 600 threatened people will be saved) or as a loss (400 of 600 threatened people will die).[17]

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[14]See Simon, H. A. (1955) A Behavioral Model of Rational Choice, *Quarterly Journal of Economics*, 69, 99-118.

[15]See Selten, R. (1978) The Chain Store Paradox, *Theory and Decision*, 9, 172-159. The game theoretical analysis of the chain store game by backward induction is simple and does not put any strain on the cognitive abilities even of game theoretically untrained participants. It is a prime example that boundedly rational behavior is not only about cognitive limitations.

[16]See Tversky, A. and Kahneman, D. (1981) The Framing of Decisions and the Psychology of Choice, *Science*, 211, 453-458. Selten and Berg referred to such effects as presentation effects. See Selten, R. and Berg, C. C. (1970) Drei experimentelle Oligopolspielserien mit kontinuierlichem Zeitablauf, in: Sauermann, H. (ed.) *Beiträge zur experimentellen Wirtschaftsforschung*, vol. II. Mohr, Tübingen, 162-221.

[17]Another framing effect concerns the order of play. Rapoport (1997), for example, has shown that sequential quantity decisions in a duopoly context push market shares towards the Stackelberg result even if these quantity decisions are not announced to the competitor and the

Framing effects, however, are not simply the result of mistakes, i.e. unsystematic deviations around some true values, but are the result of systematic *biases*. Boundedly rational decision makers under- or overestimate certain decision options systematically (and predictably). Understanding the psychological mechanisms that lead to biases has been the subject of study for many decades.

In this context, *prospect theory* developed by Kahneman and Tversky is pertinent.[18] In the original formulation of the theory, the term prospect referred to a lottery. Prospect theory suggests an explanation for framing effects, for example changes from risk-seeking to risk-averse behavior and vice versa, by assuming that the evaluations around losses and gains are based on a reference point.

According to prospect theory, the mapping of payoffs into utilities is not linear, but the value of gains or losses follows a nonlinear, "S"-shaped function (See Figure 1). The consequence is that decision makers who evaluate a decision framed as a loss will tend to take decisions that are risk-seeking (in this case, the (negative) change in value of decreasing profits is lower than the (positive) change in value of increasing profits in absolute terms) while decision makers who evaluate their decision in the realm of gains will be more risk-averse (in this case, the (negative) change in value of decreasing profits is higher than the (positive) change in value of increasing profits in absolute terms).

Prospect theory has been widely used in behavioral economics in order to explain a diverse range of situations that appear inconsistent with standard economic theory, such as the equity premium puzzle, the status quo bias, various gambling and betting puzzles, inter-temporal consumption and the endowment effect.

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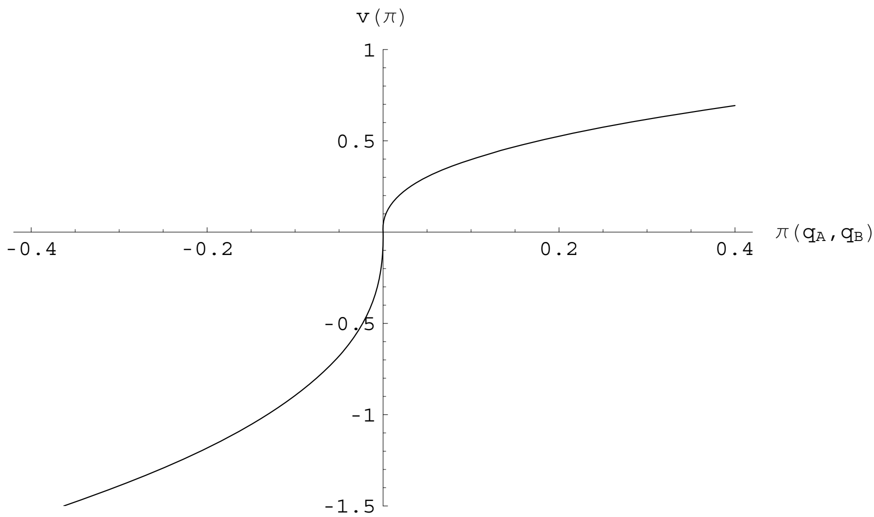
game therefore remains isomorph to its simultaneous play version. See Rapoport, A. (1997) Order of Play in Strategically Equivalent Games in Extensive Form, *International Journal of Game Theory*, 26, 113-136.

[18]See Kahnemann, D. and Tversky, A. (1979) Prospect Theory: An Analysis of Decision under Risk, *Econometrica*, 47, 263-292.

[19]The function is given by $u(\pi) \equiv \pi^{\alpha}$, $\forall\, \pi \geq 0$ (win frame) and by $u(\pi) \equiv -\gamma(-\pi^{\beta})$, $\forall\, \pi < 0$ (loss frame). The values of the parameters used in Figure 1 were $\alpha \equiv 0.4$ $\beta \equiv 0.4$ and $\gamma \equiv 2.25$.

Figure 1: Mapping of payoffs according to prospect theory[19]



In the domain of marketing, Folkes and Wheat (1995) observed changes in the perception of prices in dependence of pricing schemes.[20] Mowen and Mowen (1991) developed a model of time and outcome valuation (TOV) that incorporates both theoretic considerations and empirical results from prospect theory and approach-avoidance-conflict theory (Miller 1959).[21] By integrating the latter, the impact of time on the valuation process in win- and loss-frames can be explained. TOV assumes that the "S"-shaped function of prospect theory flattens over time with different gradients in the win- and in the loss-frame. Therefore, according to TOV both losses and gains in the future are "discounted" compared to immediate

[20]See Folkes, V. and Wheat, R. D. (1995) Consumers' Price Perceptions of Promoted Products, *Journal of Retailing*, 71, 317-328.

[21]See Mowen, J. C. and Mowen, M. M. (1991) Time and Outcome Valuation: Implications for Marketing Decision Making, *Journal of Marketing*, 55, 54-62. See also the empirical analysis by Juliusson, E. Á., Karlsson, N., Gärling, T. (2005) Weighing the Past and the Future in Decision Making, *European Journal of Cognitive Psychology*, 17, 561-575 and Miller, N. E. (1959) Liberalization of Basic S-R Concepts: Extensions to Conflict Behavior, Motivation, and Social Learning, in: Koch, S. (ed.), *Psychology: The Study of a Science*, McGraw-Hill, New York, 196-292.

gains and losses, with different discount rates respectively.

3 The Experiment

3.1 Design

The experiment was conducted at the experimental laboratory of the Economics Department of the University of Bonn using a computer program based on the z-Tree[22] software package. A total of 120 students signed up for the experiment through the Econlab panel. Due to the absence of two participants our data consist of $N = 118$ observations. In all treatments participants were in the position of a retailer having to choose from what firm (A or B; C or B) to procure and what quantity to procure for the fourth quarter, i.e. $\tau = 4$. The fact that the quantity of the first three quarters had already been bought either from firm A (offering a rebate scheme) or firm C (offering a discount scheme) was imposed to mimic dominance of these firms.[23]

A table containing the highest possible sales quantities for the last 10 years was also available to the participants. This table was constructed according to the random variable X (cf. footnote 9), i.e. the table was constructed from a normally distributed variable (as will be described below, one half of the participants received a table with low variance and the other half a table with high variance - the expected quantity of sales was held constant).

In order to ensure that participants orientate themselves according to this random model, they were also informed that sales of the product are season independent, but that there are differences in the highest possible sales per year,

[22]Fischbacher, U. (1999) z-Tree. Zürich Toolbox for Readymade Economic Experiments, University of Zürich, *Working Paper* no. 21.

[23]It is important to note that participants decided for the first time in the fourth quarter and that the decision for the first three quarters was attributed to another retail manager in the instructions and not to themselves. This presentation was explicitly chosen in order to reduce a possible confirmation or status quo bias.

and that their marketing research department expects demand per quarter that corresponded to our random model, i.e. 300 units (for further details compare the translated instructions in Appendix A).

Altogether, participants were assigned to 10 different treatments. The treatments were based on three different experimental factors that were partially crossed over (Scheme-condition (REBATE, DISCOUNT) x Variance-condition (LOW, HIGH) x Switch-condition (STRONG REMAIN, WEAK REMAIN, SWITCH)).

The following table summarizes the design of the experiment composed of two main stages. Participants were split up in two different *chronologies*. Half of the participants were in a rebate scheme (A) in the first stage and had to decide whether to switch to a linear scheme (B). The other half of the participants began with a discount scheme (C) and had to decide whether to switch to a linear scheme (B). After this decision they had to decide about the quantity they wanted to buy. Once that choice was made, they were asked to make a quantity decision based on the counterfactual. In the second stage participants were confronted with the respective other scheme, i.e. discount instead of rebate and rebate instead of discount. Here again, they first had to decide whether they wanted to switch or remain and then what quantity they wanted to buy. After these decisions the quantity chosen in the counterfactual had to be provided.

The second experimental factor in our design was the *variance* of demand, i.e. the highest possible sales during the last ten years. In both, the *high* and *low* condition, the average was held constant. This was made possible by constructing the demand table with high variance out of the low variance table by multiplying the distance from the average over ten years (300 units) with the factor 2.[24] For example, instead of 315 units in the fourth quarter 2005 in the low variance

[24]Technically, such distributions can be created by taking standard-normalized values (with mean = 0 and variance = 1) and by transforming these z-values by multiplying them with a constant a and adding a constant b in condition 1 and by multiplying with a' ($a' > a$) and adding the constant b in condition 2. In our case, $a = 25$, $a' = 50$ and $b = 300$

condition you find a value of 330 in the high variance condition.

Table 1: Overview of experimental treatments

treat. (n)	**chronology**	**variance**	**rational**
1 (12)	AB-CB	High	strong Remain
2 (12)	AB-CB	High	weak Remain
3 (11)	AB-CB	Low	strong Remain
4 (11)	AB-CB	Low	Switch
5 (12)	AB-CB	High	Switch
6 (12)	CB-AB	High	strong Remain
7 (12)	CB-AB	High	weak Remain
8 (12)	CB-AB	High	Switch
9 (12)	CB-AB	Low	strong Remain
10 (12)	CB-AB	Low	Switch

The third experimental factor concerned the quantities of the first three quarters that were manipulated in a way such that it would either be rational to *remain* within the rebate or discount scheme, or to *switch* to the linear scheme.

In the first stage participants were confronted with the actual realized sales in the first three quarters. Based on the three different treatment conditions: either more than $\frac{2}{3}$ (strong remain), exactly $\frac{2}{3}$ (weak remain) or less than $\frac{2}{3}$ (switch) of the total expected demand were sold in the first three quarters (and the rest was stocked).

If participants had chosen to continue to buy from the firm with the rebate or discount scheme this implied that participants could either buy a sufficiently large quantity to meet the yearly threshold in order to get an overall unit price of $(1-\alpha)w = 0.9$ or order a lower quantity entailing an overall unit price of $w = 1$. If participants choose to switch to the firm with the linear scheme, they would pay $v \equiv (1-\alpha)w = 0.9$ per unit for the quantity bought in the fourth quarter and $w = 1$ for the quantity bought in the first three quarters.

After these two decisions [25] were made participants were asked to decide upon a quantity in the counterfactual, i.e. what quantity they would have chosen if

[25] The two decisions refer to the price scheme and the quantity decision.

they had not decided to remain or switch.

Following these decisions, a number was randomly drawn. The random process corresponded to the model underlying the distribution of sales in the quarters. The number drawn determined the maximum potential sales for the fourth quarter. Participants were paid according to their decisions. If a higher quantity was bought than could be sold, the input costs were lost. If realized demand could not be met, profits were foregone.

The second stage corresponded to the first stage, except for the scheme, that is, those in the rebate scheme were now in the discount scheme and vice versa.

The third stage of the experiment consisted in a measurement of risk preferences.[26]

3.2 Hypotheses

Our *central hypothesis* is the expectation that both rebate and discount schemes develop an *"attraction" effect* that a non-behaviorally informed standard economic theory would not predict. This "attraction" effect consists in a high reluctancy to quit rebate or discount schemes, even in the switch condition where it is rational to switch to the linear scheme. This expectation is based on the assumption that participants evaluate the situation as a *sunk cost* situation. If this assumption is adequate, an "attraction" effect should be found, i.e. an emphasized status quo bias in the discount and the rebate scheme.[27] By referring to an "attraction" effect we want to explicitly distinguish this effect from a status quo bias, that can be expected anyway, but is stronger than usual in rebate and discount schemes.

[26]See Holt, Ch. A. and Laury, S. K. (2002) Risk Aversion and Incentive Effects, *American Economic Review*, 92, 1644-1655. Since exactly the same instructions translated into German were used in order to elicit risk attitudes in the present experiment, we do not replicate the instructions here.

[27]Note that this is likely to be more pronounced in the field than in our experiment where participants had no influence on sales. With the possibility to influence sales at a given price, the perception that the threshold is within reach may be further strengthened.

In addition to the central hypothesis, we expect a higher bias in the rebate condition compared to the discount scheme due to discounting effects of losses over time. In the following we will motivate these expectations, that can essentially be derived from prospect theory.

In our decision tasks, we conjecture that participants consider a negative payoff, i.e. the order payments. Therefore, we expect that participants are focussed on the loss-frame of the valuation function.[28] In other words, we conjecture that participants focus on the prices that have to be paid. From this point of view the following situation is salient for the participants: Either to change from the rebate/discount scheme into a linear price scheme and thus incur an additional (negative) payment of 90 units with certainty (the lost rebates/discounts for three quarters), or to stay in the rebate/discount scheme and maintain the possibility to reduce the payments. In both *remain* conditions this consideration is rational, in the *switch* condition, however, this consideration results in inadequate decisions.

Both in rebate and in discount schemes participants have to compare the expected profits given they choose to remain in the rebate scheme with the profits in case of a switch to the linear price scheme. Of course the quantity to be ordered in τ depends on the size of the stock in case of a switch. In addition, however, the optimal order quantities irrespective of the stock size depend on whether the participant decides to switch or not. A salient difference between the two schemes is that the decision to switch to B is a decision that implies an additional payment of 90 (i.e. 0.1×900) with certainty. Furthermore, a switching decision allows to order the optimal quantity without regard to the threshold. In contrast, the decision to remain in the rebate/discount scheme corresponds to a decision, where the quantity ordered is not optimal but may allow higher profits

[28] It is misleading to tag this part of the valuation-function as "loss-frame". Prospect-theory maps payoffs on subjective valuations of these payoffs. Negative payoffs are not necessarily "losses". For example, investments can be analyzed with prospect theory as well, for instance in studies of the Concorde fallacy (sunk cost fallacy).

through two channels. First, a higher quantity increases expected sales (this is due to the fact that at most the total available quantity can be sold) and second, the rebate/discount advantage over the quantity bought in the past is not lost. Now consider the point where expected profits in both schemes are equal, i.e. the indifference point. In our scenario this point corresponds to a quantity sold in the first three quarters of the year of $\sum_{t=1}^{\tau-1} q_t = 783$ with $s_\tau = 117$ for the low variance condition and $\sum_{t=1}^{\tau-1} q_t = 767$ with $s_\tau = 133$ for the high variance condition.

Due to identical expected profits at the indifference point, both options are on one and the same point of prospect theory's valuation function within the loss-frame. The participant's decision to change into the linear price scheme, where the optimal quantity to buy in the fourth quarter is always $q_t^o = 288 - s_\tau$ for the high and $q_t^o = 294 - s_\tau$ for the low condition, is also a decision to incur a loss with certainty. In this case, the sunk costs are eliminated and an optimal quantity for the fourth quarter can be planned.

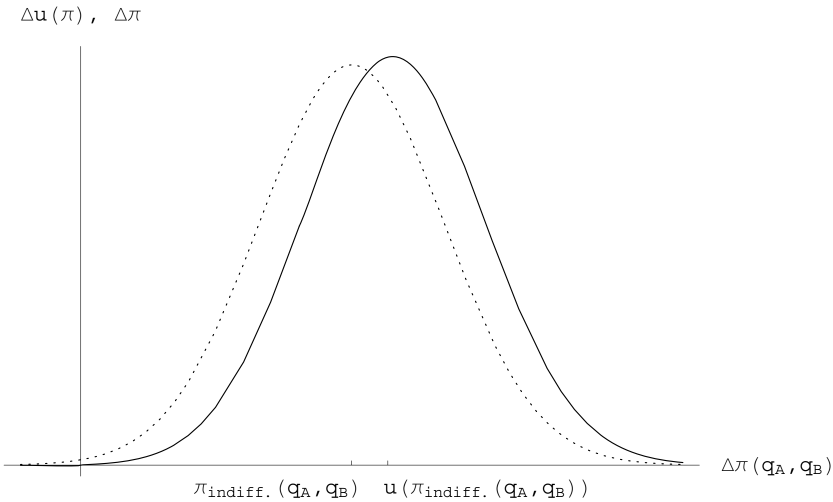
This situation, however, is transformed by the valuation function $u(\pi)$. Higher losses weigh less than corresponding gains. Figure 2 depicts the two probability density functions. The dotted profit function $\pi(\cdot)$ represents the given situation.[29] The solid curve gives the resulting subjective distribution that results from the product $u(\pi) \times \pi(\cdot)$. Figure 2 demonstrates the shift of the indifference point after this convex transformation. Instead of being indifferent at this point, a preference for the rebate scheme can be expected, because its corresponding valuation point is shifted to the right.

Furthermore, our experiment gives an interesting extension of classical experiments, because the choice to remain in the rebate/discount scheme does not

[29]For presentational purposes we have replaced the true $\pi(\cdot)$ by $N(90, 25\sqrt{1.5})$. Note that underlying demand is $N(\mu, \sigma)$ but since only units that are available can be sold, the actual profit function is skewed.

[30]Integrating the resulting subjective distribution and dividing $u(\pi) \times \pi(\cdot)$ by the area guaranteed that both curves have a normalized area of 1. Other than $\pi(\cdot)$ the resulting distribution is even asymmetric.

Figure 2: Profit function and its convex transformation[30]



merely consist in either paying a fixed amount with probability ρ or paying another fixed value with probability $1 - \rho$, but that both the area of lower profits and the area of higher profits are continuously distributed.

In line with prospect theory we expect risk-seeking behavior at the indifference point, because losses (i.e. lower expected profits in our scenario) count less than gains (i.e. higher expected profits) in the "loss-frame". Therefore, given two price schemes A and B such that rational actors should be indifferent between the two options, we expect a preference for choosing option A - the rebate/discount scheme - because in this case losses (i.e. a higher price for the units of the first quarters) have not yet been realized and the chance to compensate losses by gains is maintained. We expect that this tendency is strong enough to find a reluctancy to switch to the linear price scheme even if this were the rational choice. In other words, we expect that participants in the *switch* condition stay within the rebate/discount scheme, although this is not a rational choice. We also expect that participants in the two *remain* conditions have a strong tendency to remain in the rebate/discount scheme.

The analysis so far does not allow distinct predictions for rebate and discount schemes. The analysis is also independent of the exact point participants focus on as long as they are in the "loss-frame". This makes our predictions rather general and robust against differences in anchors. Our interpretation of prospect theory's valuation function is non-parametric and does, therefore, not entail any estimation of parameters.[31] As a result, any arbitrary *convex* transformation of payoffs would yield the same predictions.

The following hypothesis is much more sensitive with respect to foci (i.e. salient features) that are set within the instruction set. It is derived from the TOV model due to Mowen and Mowen (1991) who conjecture that both, gains and losses are discounted over time. As a consequence, the moment in time where losses are realized is relevant. According to our *time framing hypothesis* we expect stronger effects in rebate than in discount schemes because in the former losses are immediate, whereas in the latter there is a time lag between the decision and the loss.[32] In other words, the price $v \equiv (1-\alpha)w$ is paid right from the start in discount schemes whereas in rebate schemes a price $w > v$ is paid.

An alternative explanation could postulate different anchors of discount compared to rebate schemes within the valuation function of prospect theory. In this case, the assumption is that in case of the rebate scheme the participants have invested to earn the rebate. This would be sunk costs and this is why they should stick to their earlier decision, whereas in case of the discount scheme they risk an additional out of pocket payment. This should lead to risk-averse behavior and higher orders. Based on our setting, such different anchors are implausible, because we tried to prevent the sunk-cost-phenomenon as much as possible by

[31] We only need the properties of the shape of the function not its functional form.

[32] Please note, that although this time lag might be relevant in practice, in our experiment this lag consisted in 1) the understanding of the instructions and thus the imagined time lag and 2) in a minimal lag in the discount condition because the loss is not immediate but only becomes apparent with the next feedback form the participant receives.

instructing participants that they are new in the firm and make their decision for the first time. Furthermore, this hypothesis does not imply an exact prediction of the strength of the effects of the discount-scheme compared to the rebate-scheme, because in both cases participants should buy more and the loss aversion in case of the discount-scheme should lead - seemingly paradoxically - to risk-seeking behavior, i.e. increased orders to prevent from losses. In summary, this type of explanation postulates two different mechanisms that are at work in case of the discount-scheme compared to the rebate-scheme, but both mechanisms lead to similar effects and estimating such effects requires an exact parametrization of the mechanisms. On the other hand, TOV allows clear comparisons between rebate and discount schemes and makes clear predictions. We expected corresponding effects in our experiment.

Besides the hypotheses mentioned above, we were also tentatively interested in the influences of risk-seeking and risk-averse behavior in such price schemes. Therefore, we introduced an experimental variation of variances. We also used a test that measures risk attitudes. Measuring risk preferences is also important from a theoretical point of view because neoclassical theory now typically involves conditional predictions that depend on risk attitudes.[33] Due to the fact that higher variances incorporate higher risks we should find some differences between the situation with a high variance compared to the situation with a low variance, because risk-aversion should be more pronounced in the situation with a high variance.

3.3 Experimental Results

Besides the general confirmation of our hypotheses we found a high amount of participants deviating from prescriptive rational profit maximizing decision making, leading to a high "noise"-rate. Given the complexity of the task, this is not

[33] It is not clear, however, whether such attitudes should be understood as a personal trait or as a disposition mostly triggered by the situation (i.e. a personal state).

overly surprising. The total error rate of false switches (instead of remaining) and false remaining (instead of switching) is 28.0% ($N = 236$).[34]

Our central hypothesis concerns status quo biases created by rebate/discount schemes. In the weak remain condition we found only 22.9% ($N = 48$) who switch to a linear price scheme while in the strong remain condition only 21.3% ($N = 94$) switched. Furthermore, we expected that the error rate is even higher in those cases where it would be rational to switch from a rebate/discount scheme into the linear price scheme. Indeed, in this case 37,2% of all ($N = 94$) participants remained in the rebate/discount scheme although it would have been rational to switch to the linear price scheme.

Testing the independence of the rates of rational/ irrational behavior and the switch-conditions (where it is either rational to stay or rational to switch) by pooling both stages of the experiment yields a significant result ($\chi^2 = 5.92$; $p \leq 0.0150$; $N = 236$). Therefore, it could be demonstrated that besides the high error rates that can be observed in our scenario we find a status quo bias yielding an "attraction" effect of rebate/discount schemes. Although we could also find a higher "attraction" effect within the rebate condition compared to the discount condition (40.4% versus 34.0%, $N = 47$ respectively), this difference was not significant ($\chi^2 = 0.18$; $p \leq 0.6696$; $N = 94$).

A closer look at the variance conditions also yielded the interesting result, that the significance of rebate/discount "attraction" was mainly produced in the high variance condition. Whereas the "attraction" effect is significant with high variances ($\chi^2 = 5.67$; $p \leq 0.0172$; $N = 144$), it is not significant for the low variance condition ($\chi^2 = 0.93$; $p \leq 0.3355$; $N = 92$). This could be attributed

[34] In a follow up study we would adapt our instructions by making it more salient that there may be good contextual reasons for the order strategies of the predecessor such as capacity constraints or simply that it was reasonable to order from A/C because the alternative firm could not offer this price from the beginning. Ex post we believe that some of our participants may have been irritated by the fact that the alternative firm offers the same price without any further conditions for the fourth quarter and that no plausible explanation for the ordering behavior in the previous quarters was given. If this conjecture is right, reactance may have caused at least part of the high noise-rate.

to the fact that a higher available quantity is perceived as being more attractive under high variance of demand because it reduces the risk of not being able to fully serve demand.

With respect to risk preferences, we were unable to find any correlation between decisions in the main experiment and the risk attitude test, suggesting that risk preferences are rather a state than a personal trait.

4 Conclusion

In the experiment conducted we found that discount and rebate schemes as defined in this paper exert a significant "attraction" on participants. This result is in line with prospect theory or any alternative theory that postulates a convex transformation of payoffs.

The experimental findings presented indicate that standard economic theory relying on risk neutral profit maximizing behavior tends to underestimate potential foreclosure effects.

This would imply that if a rebate scheme develops a "foreclosure" effect, this effect is greater than standard economic theory based on the maximization of expected profits would predict. Based on our empirical results, competition policy would be ill-advised not to allow for foreclosure effects above and beyond what a standard economic model would predict.

Concerning the external validity of these findings and their direct implications for Article 82 EC, caution is required. One has to bear in mind, for example, that the analysis focusses on individual decision-making whereas decisions in firms are typically the outcome of a corporate decision-making process. Whether a corporate decision-making process improves or reduces "rationality" remains highly debated in the literature and appears to depend largely on the exact circumstances of the process. Based on the strength of the effects found, we would, however, be surprised not to encounter similar decision patterns in a corporate environment.

These findings should also trigger follow-up experiments. Future experiments should focus on the strength of the attraction effect compared to the status-quo bias. This would allow a more precise estimation of the potential foreclosure effects of rebate schemes.

APPENDIX A

[all]

INSTRUCTIONS

In the following experiment you will be in the role of a newly hired procurement manager of a retailer for the year 2005. This retailer sells a product of daily use. The sales of the product are not subject to seasonal fluctuations. There are no indications for changes in the market. Your role consists in generating profits for the retailer in the year 2005. Your sales price is fixed at 1,50 ECU. Your remuneration in this experiment is based on the profits of the retailer transformed into Euro based on an exchange rate. Given that the sales price is given, the procurement price (see section I) and the sales quantity (see section II) is crucial in determining profits.

I. PROCUREMENT

[Instructions CB only]

You have the choice between firm C and firm B to procure the product. Firm C offers a discount of 10% and B offers a constant price.

Firm C offers the following discount: The discounted price per unit is 0,90 ECU. If you procure at least 1200 units from that firm within the year, you do not have to repay the discount of 0,10 ECU per unit, that you would otherwise have to repay for every unit received at discounted price.

[Instructions AB only]

You have the choice between firm A and firm B to procure the product. Firm A offers a rebate of 10% and B offers a constant price.

Firm A offers the following rebate: The price per unit is 1,00 ECU. If you procure at least 1200 units from that firm within the year, you receive a rebate of 0,10 ECU per unit for all units bought within the year, otherwise your price remains at 1,00 ECU per unit.

[all]

Firm B offers the following price: Irrespective of the quantity you procure within the year, you always pay 0,90 ECU per unit.

As manager of procurement in your retail company, you decide for the 4th quarter 2005 from what company you would like to order and how many units you would like to order. For your decision it is important to note that 900 units where bought from

[Instructions CB only]

Firm C in the first three quarters at the preliminary price of 0,90 ECU.

Examples:

- If you decide to procure 300 units from firm C in the 4th quarter, you pay 270 ECU for the last 300 units. For the total year, you have procured 1200 units and paid 1080 ECU.
- If you decide to procure 300 units from firm B in the 4th quarter, you pay 270 ECU for the last 300 units. Since overall you bought less than 1200 units from firm C, you have to repay the discount of 90 ECU to firm C. For the total year, you have paid 1170 ECU.
- If you decide to procure 150 units from firm C in the 4th quarter, you pay 135 ECU for the last 150 units. Since overall you bought less than 1200 units from firm C, you have to repay the discount

of 105 ECU to firm C. For the total year, you have paid 1050 ECU.

- If you decide to procure 150 units from firm B in the 4th quarter, you pay 135 ECU for the last 150 units. Since overall you bought less than 1200 units from firm C, you have to repay the discount of 90 ECU to firm C. For the total year, you have paid 1035 ECU.

[Instructions AB only]

Firm A in the first three quarters at the preliminary price of 1 ECU.

Examples:

- If you decide to procure 300 units from firm A in the 4th quarter, you pay 300 ECU for the last 300 units minus the rebate of 10% on all 1200 units. This is a rebate of 120 ECU. As a result you have to pay 180 ECU for the 300 units bought in the 4th quarter. For the total year, you have procured 1200 units and paid 1080 ECU.
- If you decide to procure 300 units from firm B in the 4th quarter, you pay 270 ECU for the last 300 units. Since overall you bought less than 1200 units from firm A, do not qualify for the rebate. For the total year, you have paid 1170 ECU.
- If you decide to procure 150 units from firm A in the 4th quarter, you pay 150 ECU for the last 150 units. Since overall you bought less than 1200 units from firm A, you do not qualify for the rebate offered. For the total year, you have paid 1050 ECU.
- If you decide to procure 150 units from firm B in the 4th quarter, you pay 135 ECU for the last 150 units. Since overall you bought

less than 1200 units from firm A, you do not qualify for the rebate offered. For the total year, you have paid 1035 ECU.

[all]

II. SALES

As procurement manager you have to estimate how many units you will be able to sell and procure units accordingly. In the appendix you find quarterly demand information of the last 10 years. During the experiment you will receive the sales information of the first three quarters of 2005. After your decision you will be informed about demand in the fourth quarter. As mentioned before, 900 units have been procured in the first three quarters of 2005. This corresponds to 300 units per quarter as calculated by your market research department. Despite sales fluctuations in every quarter you are expected to sell on average 300 units per quarter. Your market research department could not identify seasonal fluctuations and there exists no pattern in yearly fluctuations as well. Concerning your quarterly demand, you should therefore orient yourself on a sales volume of 300 units irrespective of any information. At the beginning of 2005 your stocks were empty. If demand in the first three quarters was below 900 units you have stocks. It is now your task to decide from what firm to buy and how many units to buy there based on information on sales and current stocks

III. PROFIT CALCULATION

Profit is calculated from yearly procurement and sales. The number of sold units is multiplied with the sales price of 1,50 ECU. In order to obtain the profits, the costs of all procurement are deducted from that amount.

If you do not have any further questions, please click on START. You will then be asked to fill out control questions

Once you have answered the control questions, please wait until the experiment is started.

The sales situation in the last 10 years was:

[all High Variance]

year	quarter	demand (highest possible sales)
1996	1	276
	2	54
	3	540
	4	30
1997	1	126
	2	252
	3	552
	4	192
1998	1	474
	2	54
	3	336
	4	570
1999	1	90
	2	210
	3	324
	4	132
2000	1	504
	2	540
	3	366
	4	228
2001	1	462
	2	420
	3	288
	4	228
2002	1	582
	2	312
	3	282
	4	360
2003	1	492
	2	438
	3	0
	4	378
2004	1	18
	2	336
	3	360
	4	330

[all Low Variance]

year	quarter	demand (highest possible sales)
1996	1	288
	2	177
	3	420
	4	165
1997	1	213
	2	276
	3	426
	4	246
1998	1	387
	2	177
	3	318
	4	435
1999	1	195
	2	255
	3	312
	4	216
2000	1	402
	2	420
	3	333
	4	264
2001	1	381
	2	360
	3	294
	4	264
2002	1	381
	2	360
	3	294
	4	264
2003	1	396
	2	369
	3	150
	4	339
2004	1	159
	2	318
	3	330
	4	315