

Pricing and rebate policies for the newsvendor problem in the presence of a stochastic redemption rate

F.J. Arcelus^{a,b,*}, Satyendra Kumar^c, G. Srinivasan^d

^aUniversity of New Brunswick, Canada

^bDepartamento de Gestión de Empresas, Universidad Pública de Navarra, Campus de Arrosadía, 31006 Pamplona, Navarra, Spain

^cManugistics Software Services (India) Pvt. Ltd., Hyderabad, India

^dFaculty of Business Administration, University of New Brunswick, Fredericton, Canada

Received 1 June 2005; accepted 1 October 2006

Available online 18 December 2006

Abstract

This paper develops the pricing/rebate/ordering policies of a profit-maximizing vendor, faced with a stochastic rebate-redemption rate and a price/rebate-dependent random demand, all within the single-period framework of the newsvendor problem. The profitability of these policies directly relates to the redemption rate, which in turn depends upon the rebate value by itself and relative to the sales price. A random element accounts for the uncertainty in the estimation of such rate. The decision variables are the sales price, the rebate value and the order size. A numerical example and various sensitivity analyses illustrate the main managerial insights of the model. One of the key results is that the introduction of uncertainty in the redemption rate, contrary to what happens when moving from a deterministic to a stochastic demand, leads the rebate policy to dominate its price–discount counterpart.

© 2006 Published by Elsevier B.V.

Keywords: Newsvendor problem; Operations/marketing interface; Mail-in rebate; Stochastic redemption rate; Price/rebate dependent demand

1. Introduction

Rebates, where buyers receive a monetary reward redeemable after purchase, have become prominent as sales promotion tools. Kinsman (2004) reports coupon activity in the neighbourhood of 300 billion in 2002, a jump of about 3.5% from 2001, for a value of approximately \$6.8 billions up to 4.5% from 2001. Arguably the most serious drawback as to the profitability of rebate campaigns is the random nature of their redemption rate. There are estimates (Kinsman, 2004) of around 3.7 billion coupons redeemed in 2002, for a rate slightly exceeding 1%. Leone and Srinivasan (1996) reports rates between 2% and 6%. Kumar et al. (2004) mentions 248 billion coupons dropped in 2001, with less than 2% redeemed. Procter and Gamble experienced even lower rates in its 2001 Luv diaper campaign and dropped the rebate programme when the redemption rate hit

*Corresponding author. Departamento de Gestión de Empresas, Universidad Pública de Navarra, Campus de Arrosadía, 31006 Pamplona, Navarra, Spain. Tel.: +34 948 169413; fax: +34 948 169404.

E-mail addresses: arcelusf@yahoo.com (F.J. Arcelus), skumar_iima@yahoo.com (S. Kumar), srini@unb.ca (G. Srinivasan).

the 1% level (PROMO, 2002). Even with large rebates, redemption barely reaches the 50% level (McGinn, 2003; CBC Marketplace, 2005). Such wide variety of estimates is a common feature of coupon redemption rates throughout the years. From the vendor's perspective, the presence of low redemption rates represents an attractive feature of most rebate campaigns. Buyers activate specific purchase policies, lured by the equivalence of a price discount, without the knowledge and/or concern for hidden costs that often materialize after the purchase and that prevent most of them from cashing in such an incentive (e.g. CBC Marketplace, 2005).

The research literature has also focussed its attention to the study of rebates as promotional trade incentives and especially as alternative sales promotion to price discounts (e.g. Arcelus and Srinivasan, 2003; Bell and Drèze, 2002; Khouja, 2006; Kumar et al., 2001, 2004), but only within a multi-period framework or with a deterministic redemption rate (Arcelus et al., 2005). It is the purpose of this paper to develop the pricing/rebate/ordering policies of a profit-maximizing vendor, faced with a stochastic rebate–redemption rate and a price and rebate-dependent random demand, all within the single-period framework, which corresponds to the newsvendor problem (NVP). In its earlier versions, the profit-maximizing decision maker places a single order to satisfy a random demand, independent of price, so as to balance the demand-uncertainty costs of over- and under-stocking. Throughout the years, the NVP has attracted considerable attention, as researchers have attempted to incorporate modern concerns, including price-dependent demand and different demand error structures (e.g. Khouja, 1999; Lau and Lau, 2001; Petruzzi and Dada, 1999; Silver et al., 1998).

The organization of the paper is as follows. The next section presents the basic model subject of this paper in two parts. The first meshes together various trends of analysis, hitherto only studied independently, if at all, within the single-period NVP structure. Included here are price and rebate dependent stochastic demand with different demand-error structures. Further, the redemption rate is modelled as linear and S-shaped functions of the rebate value and of the sales price and is subject to uncertainty, which is considered as asymmetric in nature and a function of rebate. The second part deals with derivation of the optimal policies. Section 3 presents a numerical example and sensitivity analyses to illustrate additional managerial insights, for which a formal proof is not feasible, due to the complexity of the analytical expressions. This includes discussions on how to evaluate the cost of the rebate campaign and on how to determine the portion of the pricing and rebate policies that actually go through to the end customer. One of the key results is that the introduction of uncertainty in the redemption rate, contrary to what happens when moving from a deterministic to a stochastic demand, leads the rebate policy to dominate its price–discount counterpart. Section 4 completes the paper.

2. Modelling the vendor's decision process

This section starts with a description of the basic elements of the vendor's decision process, followed by the derivation of the first-order optimality conditions and a statement on their economic implications. The section concludes with an examination of the second-order conditions and a determination of the existence and uniqueness of the optimal solution. The arguments of the functions and the asterisks to denote optimality are omitted whenever possible, to simplify notation.

2.1. Elements of the model

The development of the vendor's decision-making process requires the identification of the following elements:

- (i) *The vendor's cost/revenue parameters:* c , the unit purchase cost; v , the unit salvage value for over-stocking; and s , the unit shortage cost of under-stocking. The rebate-related parameters appear later.
- (ii) *The vendor's decision variables:* p , the unit selling price; q , the order size; and R , the face value of the rebate.
- (iii) *A single-period demand, x ,* which includes a deterministic component of $g(p, R)$ units and a stochastic element, ε . The only requirements for the deterministic demand function, g , are its being downward (upward) sloping and at least twice differentiable, with respect to p (R). Further, the stochastic element, ε ,

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات