



Contents lists available at ScienceDirect

European Journal of Operational Research

journal homepage: www.elsevier.com/locate/ejor

Short Communication

The newsvendor problem under multiplicative background risk

Benoît Sévi*

Université d'Angers (GRANEM), LEMNA and Bordeaux Management School (CEREBEM), Faculté de Droit, Économie et Gestion, Université d'Angers,
13 allée François Mitterrand, BP 13633, 49036 Angers Cedex 01, France

ARTICLE INFO

Article history:

Received 4 June 2008

Accepted 26 January 2009

Available online 5 February 2009

Keywords:

Newsvendor problem

Multiplicative background risk

Multiplicative risk vulnerability

Derived utility function

Expected utility

ABSTRACT

This note studies the single-period newsvendor problem when the newsvendor faces a multiplicative neutral independent background risk in an expected utility framework. It is shown that multiplicative risk vulnerability is a sufficient condition to guarantee a decrease in the optimal order. A weaker sufficient condition which has more interpretability is also provided and discussed. This result sheds light on situations where exchange, tax or inflation rates risks, which apply multiplicatively to the final wealth, are at work.

© 2009 Elsevier B.V. All rights reserved.

1. Introduction

The question examined in this paper is how a (independent) neutral multiplicative background risk (MBR), i.e. with mean equal to unity, affects the optimal order of the newsvendor in an expected utility framework. The introduction of a MBR can be thought as an inflation, a tax or a non-hedgeable exchange rate risk.¹ Despite a huge literature, both in economics and in operation research, the general issue of the newsvendor facing a multiplicative background risk has no been examined yet.

The so-called “newsvendor problem”, also known as the “newsboy problem” is one of the standard of the OR literature and is described in many textbooks. In its simplest version it gives rise to the single-period problem (SPP) whose case is considered in the present paper. Amazingly, the consideration of risk preferences when studying this problem is much rare as noted in Khouja (1999). This is quite puzzling because decision in a SPP seem to be influenced by risk. Schweitzer and Cachon (2000) and Benzion et al. (2008) show that with comparison with the expected profit-maximizing newsvendor, choices in an experimental setting are systematically biased. Indeed, risk preferences are of primary importance when considering the SPP.²

* Tel.: +33 680414509.

E-mail address: benoit.sevi@gmail.com

¹ Even if derivatives instruments exist, it could be argued that the hedge is unadapted almost surely, at least because of the quantity risk (the number of contracts to trade is unknown *ex ante*). The remaining risk still applies multiplicatively in this case and could be considered as the MBR in our work.

² Apart from risk factors, Benzion et al. (2008) identify several other more technical factors affecting order quantity decision as the mean demand, the order-size of the maximal expected profit or the demand level of the immediately preceding round, among others.

The issues occasioned by the introduction of risk preferences in the SPP have received some treatment in the formal literatures of economics and OR. Important work relying on expected or non-expected utility includes that of Eeckhoudt et al. (1995), Keren and Pliskin (2006), Wang and Webster (2009) and Wang et al. (2009). Eeckhoudt et al. (1995) provide a number of comparative statics results when (i) the newsvendor is facing an independent additive risk (background risk) and (ii) the riskiness of the demand is exogenously increased. A synthetic presentation of all their findings is given in their Table 1 (p. 793) and are described in Khouja (1999). Keren and Pliskin (2006) have derived a closed-form solution to the SPP problem under risk aversion but under rather restrictive restrictions, namely a uniform distribution for demand. Others have investigated the question of loss-aversion using a mean-shortfall objective function (Wang and Webster, 2009). A burgeoning literature has emerged about the interplay between the SPP and risk preferences when the decision maker has a “coherent measure of risk” (Ahmed et al., 2007; Choi and Ruszczyński, 2008), namely a CVaR or a mean-absolute deviation decision rule.

In this note, we choose to remain in an expected utility framework because it appears the most used criterion for the choice under risk despite its well-known limitations.³ Wang et al. (2009) discuss the impossibility of expected utility to work well with both small and large stakes. Another drawback lies in the difficulty to elicit the “true”, if it exists, utility function of the decision maker (Choi and Ruszczyński, 2008). Nevertheless, expected utility remains a useful tool to derive a qualitative sensitivity analysis in very many contexts (see Gollier, 2001). It must be noted that the present anal-

³ See Starmar (2000) for an exhaustive presentation.

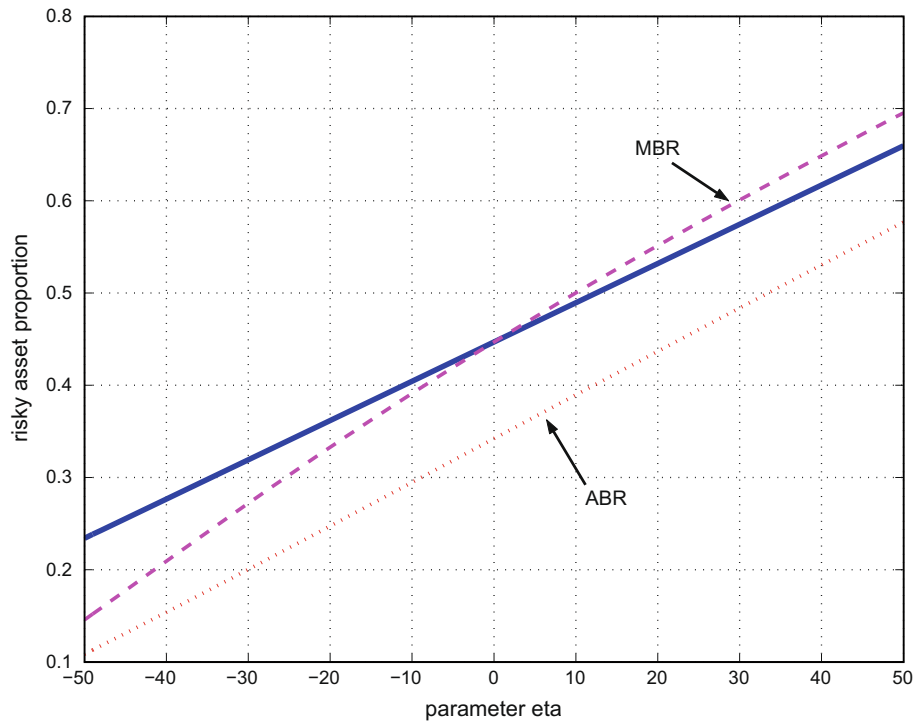


Fig. 1. Risky asset proportions for the portfolio choice model. Solid line [dotted line] [dashed line] represents the case without [with additive, ABR] [with multiplicative, MBR] background risk.

ysis is only valid for expected utility because under non-expected utility, the impact of a background risk can have some amazing effects in comparison with the expected utility case (see Quiggin, 2003).

It is well-known that absolute risk aversion as defined in Pratt (1964) is not sufficient *per se* to provide comparative results when more than one risk are involved. Following Ross (1981), a large normative literature has emerged aiming at restricting preferences toward risk to guarantee some comparative results when several risks are considered.⁴ From this literature, very few articles deal with the issue of non-additive risk.⁵ Nachman (1982), Pratt (1988) and Finkelshtain et al. (1999) are exceptions but due to the very general form adopted for the background risk in their papers, few clear-cut conclusions are drawn.

To date, the most significant contribution about MBR is Franke et al. (2006) (hereafter FSS). Authors provide a number of conditions on the utility function to guarantee that the introduction of any unfair MBR, i.e. with a mean lower than unity, will lead unambiguously the decision maker to “behave more cautiously” (p. 147). The motivation of the FSS’ paper is that in real-life, risks rather apply multiplicatively than additively. In this case, the classical “additive” framework for decision analysis is not adapted.

The next question is then about the relevancy of introducing a MBR in the analysis of the SPP. Could a MBR really have an impact on the behavior of a newsvendor? Is the selling season not too short? To motivate our analysis, consider the case of exchange rate risk.⁶ In mid-September, the US dollar expressed in euro equals 0.80 against only 0.63 in the last days of July 2008. This corresponds to an increase of about 22% in a period of less than 3 months. Similar phenomena can be observed in the USD/Yen rate evolution which has

experienced variations of about 20% during July–August 1999, April–July 2002 and September–December 2008. These examples illustrate how dramatic can some changes in exchange rates be, even for currencies from developed countries. Frankel and Rose (1996) and more recently Kaminsky (2006) provide a number of similar “crashes” for emerging economies.⁷ Such sharp variations in exchange rates may lead to conclude that, in some cases, the manager may have to consider the MBR and to take his decision accordingly.

The plan of the note is as follows. In the next section, we present a simple numerical example to illustrate the ambiguous impact of a MBR when the utility function is not adequately chosen. In Section 3, we present the benchmark case of the SPP under risk aversion which has been studied in Eeckhoudt et al. (1995). We then use this case to derive our main result with MBR, provide some intuitions about the result and relevancy of the proposed conditions on the utility function. Section 3 concludes.

2. A numerical example

FSS provide a simple example emphasizing the puzzling effect of a MBR. As noted by authors, “The results for the multiplicative case do not simply mirror those of the additive case” (p. 147). We adapt their example but using a continuum of risk parameters to show that in some cases, the introduction of a MBR may well increase the participation in the risky activity. Consider first a portfolio choice problem where the individual can allocate his wealth between a risk-free asset, whose return is 0.05 and a risky asset whose return is either 0.132 or 0.088 with equal probability. An additive background risk is added to this initial lottery in the form of an increase or a reduction of the final wealth of 30 with equal probability. The individual has a utility function of the hyperbolic

⁴ This literature is excellently surveyed in Gollier (2001, Chapters 8 and 9).

⁵ Franke et al. (2006) point out that “Surprisingly, very little attention has been given to the case where the background risk is multiplicative.” (p. 147).

⁶ In a special section dedicated to currency crashes, Sornette (2003, p. 260) provides some examples of currency bubbles and crashes.

⁷ Currencies of emerging countries are more prone to experience large movements of speculative positions, labelled “speculative attacks”, from international investors. Our first examples showed that even for currencies from developed countries, large drops are likely to occur.

Download English Version:

<https://daneshyari.com/en/article/477138>

Download Persian Version:

<https://daneshyari.com/article/477138>

[Daneshyari.com](https://daneshyari.com)