

PORTFOLIO REBALANCING WITH VAR AS RISK MEASURE

CHUNHUI XU¹, KYOICHI KIJIMA², JIE WANG¹ AND AKIYA INOUE¹

¹Department of Management Information Science
Chiba Institute of Technology
Chiba 275-0016, Japan
xchunhui@yahoo.co.jp

²Department of Value and Decision Science
Tokyo Institute of Technology
Tokyo 152-8552, Japan

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ABSTRACT. *Portfolio rebalancing is an important task in portfolio management. In the present study, we investigate how to perform rebalancing at the least cost. In the present paper, we use VaR as a risk measure and formulate portfolio rebalancing problems with an optimization model by considering the requirements with risk and return of a portfolio as the constraints and rebalancing cost as the objective. Since the model built herein is a nonlinear integer programming model, conventional combinatorial optimization methods are ineffective. In the present paper, we first propose a soft method for solving this complicated model and then test the model and the soft method by conducting portfolio rebalancing experiments on the New York stock market.*

Keywords: Investment, Portfolio selection, Portfolio rebalancing, Integer programming, Soft approach

1. Introduction. The purpose of the present paper is to propose a method for adjusting portfolios economically in order to achieve the goals of adjustment with the least cost.

A portfolio must be adjusted when a market has moved or when investors' investment strategy or tolerance for risk has changed. In the present paper, portfolio rebalancing means changing a portfolio such that the adjusted portfolio will be more desirable to investors.

Since the performance of a portfolio is evaluated based on its return and risk, we must first decide how to measure the return and the risk of a portfolio. Return is generally measured as the expected return on investment. In the present study, we use the expected profit rate as the measure of return of a portfolio. The situation for risk measurement is a somewhat more complicated, as various measures have been proposed for risk, including variance (see Markowitz (1952)), value at risk (VaR, see Morgan (1996)), and conditional value at risk (CVaR, see Rockafellar and Uryasev (2000)). Dowd (2002) has presented an introduction to these risk measurements. In the present study, we adopt VaR as a measure of risk, although the discussion on VaR remains unresolved¹. There are two reasons for incorporating VaR directly into portfolio rebalancing. First, investors tend to express risk preferences in terms of VaR, which is currently a standard risk measure in the finance industry. Second, it is desirable to work with VaR directly in the context of mean-risk tradeoff when the preferences of investors are expressed in terms of VaR. Gaivoronski and Pflug (2004) noted that efficient frontiers constructed on the basis of other measures can be a poor approximation of the mean-VaR efficient frontier. Therefore, using VaR

¹See Artzner, et al. (1999) and Szego (2005) for this discussion.