OR Models for Stock Index Passive Replication & Risk-Control Replication

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Abstract

Purpose: the present paper aims to formulate two stock picking models respectively aimed at replicating a benchmark (section A) and implementing a volatility portfolio related to that benchmark (section B).

Design / Methodology / Approach: the picking model in question is characterised as an OR (Operations Research) problem subjected to the UCITS allocation weights CAPs.

Findings: the backtesting outcomes of the proposed model as regards the NASDAQ-100 confirm that it achieves its goals: the resulting portfolio is in fact characterised by the same systematic risk and the same total risk of the benchmark. As a result of the MVO approach adopted, the tracking error is entirely due to a positive Jensen's alpha and the tracking error volatility is negligible.

Practical Implications: the proposed model is preferable with respect to a passive ETF, even accounting for the transaction costs.

Originality and Value: with respect to the current academic models based on PCA (Principal Components Analsis) the MVO approach hereby adopted delivers a higher correlation to the benchmark and a positive Jensen's alpha.

Keywords: Portfolio Management, Passive ETF, Operations Research, Mean Variance Optimisation, Benchmark Replication

JEL Codes: G11, D53

Paper Type: Research Paper

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I. Introduction

The first section of this paper (Section A) aims to backtest a stock picking model intended to replicate a benchmark. The model in question is formulated as an OR model which returns the optimal stock selection at each rebalancing date, assuming the portfolio rebalancing to be performed at inception of each semester. The optimal stocks set is characterised as follows:

a) a systematic risk in line with that of the benchmark, i.e.: a portfolio β fairly close to 1
b) a negligible specific risk, which is the parameter to be minimised
c) a return that be at least equal to that of the benchmark

As regards requirement c), the empirical research by Colecchia & Prandi regarding the Swiss stock index has confirmed that MVO portfolio whose model is characterised by such inequality are capable of overperforming the benchmark. Such overperfromance is perfectly in accordance with the purpose of the proposed model.

The second section of this paper (Section B) aimes to backtest a model which capitalises on the volatility portfolio proposed by Colecchia & Prandi, hereby refined with inclusion of the benchmark momentum among the rebalancing input parameters.

Both proposed models deal with a securities input sample encompassing:

- the most liquid stocks related to the benchmark, selected according to a market capitalisation cutoff, in order to minimise the BidAsk spreads and consequently the rebalancing costs
- one passive ETF replicating the benchmark

The passive ETF, which in turn consists of several stocks, is allowed to be granted a weight of 10% whereas the stocks cannot be allocated a weight higher than 5%. The constraints above mentioned make the resulting portfolio compliant with the UCITS diversification requirements, namely with the 5/10/40 rule.

The benchmark involved in the present empirical study is the NASDAQ-100 but recommendations are drafted in order to generalise the model to other stock indices.

[...]

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