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Optimal market timing strategies under transaction costs

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Abstract

In this paper, we consider optimal market timing strategies under transaction costs. We assume that the asset's return follows an auto-regressive model and use long-term investment growth as the objective of a market timing strategy which entails the shifting of funds between a risky asset and a riskless asset. We give the optimal trading strategy for a finite investment horizon, and analyze its limiting behavior. For a finite horizon, the optimal decision in each step depends on two threshold values. If the return today is between the two values, nothing needs to be done, otherwise funds will be shifted from one asset to another, depending on which threshold value is being exceeded. When investment horizon tends to infinity, the optimal strategy converges to a stationary policy, which is shown to be closely related to a well-known technical trading rule, called Momentum Index trading rule. An integral equation of the two threshold values is given. Numerical results for the limiting stationary strategy are presented. The results confirm the obvious guess that the no-transaction region increases as the transaction cost increase. Finally, the limiting stationary strategy is applied to data in the Hang Seng Index Futures market in Hong Kong. The out-of-sample performance of the limiting stationary strategy is found to be better than the simple strategy used in literature, which is based on an 1-step ahead forecast of return. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Market timing is an investment strategy which attempts to outperform the market. It entails the shifting of funds between asset classes. The principal job of a market timer is to time when to enter and when to exit the market, by shifting funds between risky and riskless assets. To decide on a suitable time to be in and out of the market, market timers would like to generate buy/sell signals according to various indicators derived from their analysis, or from a model based on historical market data.

Market timing strategies have long been used to test the predictability of stock market. One of its earliest usage can be found in a well-known paper "Can stock market forecasters forecast?" published in 1934 by Cowles. In that article, Cowles tested the Dow Theory by the use of a market timing strategy and apparently provided strong evidence against the ability of Wall Street's most famous chartist, William Peter Hamilton, to forecast the stock market. This confirms the efficient market hypothesis (EMH) of Fama [1], which hypothesizes that no one can beat the market. When the EMH in its weak form holds, no trading strategy based on historical price data can earn excess return over the naive buy-and-hold strategy.

However, in the last decade there has been more and more empirical evidences against the EMH, and even the foundation paper by Cowles [2] was challenged. Brown et al. [3] "review Cowles' evidence and find that it supports the contrary conclusion". They concluded that "The contribution of this paper is not simply to show that Hamilton was a

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successful market timer. Alfred Cowles' [2] analysis of the Hamilton record is a watershed study that led to the random walk hypothesis, and thus played a key role in the development of the efficient market theory. Ever since Cowles' article, 'chartists' in general, and Dow theorists in particular, have been regarded by financial economists with skepticism. Our replication of Cowles' analysis yields results contrary to Cowles' conclusions. At the very least, it suggests that more detailed analysis of the Hamilton version of the Dow Theory is warranted. In broader terms it also suggests that the empirical foundations of the efficient market theory may not be as firm as long believed". This result is certainly encouraging to market timers.

The debates on the timing ability of the fund managers between academic community and practitioners have a long history. The negative opinion about market timing probably should stem back to two important articles by Sharpe [4] and Jeffery [5]. But even before Brown et al.'s work in 1998, there were already many empirical works which found that market timing strategies can outperform the market. For example, Vandell and Stevens [6] documented that portfolio performance can be improved by market timing. Shilling [7] remarked that market timing can be better than a buy-and-hold strategy. Larsen and Wozniak [8] found that "Market timing can work in the real world". Wagner [9] studied "Why market timing works". Two most recent papers by Kao and Shumaker [10] and Levis and Liodakis [11] studied the profitability of size and value/growth rotation market timing strategies in the US and UK markets, respectively.

In view of this empirical evidence, more research is needed to investigate how to devise a good market timing strategy. In this paper, we would like to settle the following problem: if stock returns are indeed predictable, how can the predictability be best exploited by a suitable market timing strategy? This question is important not only to market timing practitioners, but also to academics who are interested in testing models for stock returns. The usual method to test a model for stock returns is to first calculate the expected future return from the model. If the expected 1-step ahead excess return is positive, the obvious trading rule is to hold the risky asset, otherwise to hold the riskless asset. This simple trading rule has been used by many researchers in the testing of the predictability of stock returns. These include Breen et al. [12], Leitch and Tanner [13], Pesaran and Timmermann [14,15], Knez and Ready [16], Lander et al. [17] and Lee [18]. In the presence of transaction costs, the above approach is modified by first computing the trading profit of the "simple" strategy mentioned above and then deducting the transaction costs from the profit. If no significant profit can then be derived, the conclusion of no predictability of the model is drawn. However, this is an unfair test of the model's predictability, because the "simple" strategy which was used to test for predictability may not be optimal in the presence of transaction costs. The model can be rejected not because it has no predictability, but because the "simple" strategy is not the proper strategy to use. The following paragraph will explain why the "simple" strategy may not be optimal under transaction costs.

When transaction costs are not negligible, the optimal market timing strategy or trading rule should be different from the "simple" strategy. Even if the expected excess return in the next period is negative, it may still be worthwhile to hold the risky asset because in subsequent periods, the expected excess return may turn out to be positive again, and transaction costs may be saved if we do not switch away from the risky asset too readily. As reported by Chua et al. [19]. "Optimal market-timing strategy involves multiperiod forecasts, rather than the single-period projections generated within most simulation studies. The investor must make his timing decision based on forecasts beyond the next period, because he knows he will eventually be switching back to common stocks. His decision must therefore take into account the round-trip transaction costs, how many periods he will be out of the stock market and the incremental return from the switches. ⋯ Simulating optimal market-timing behavior entails both a multiperiod market return forecasting model and a dynamic programming model to determine when to switch."

The objective of this paper is to derive optimal market timing strategies under transaction costs, assuming that the return generating process is not perfectly random. One type of models suggested for the return series in the literature is the autoregressive-moving-average processes (ARMA). Chopra et al. [20], De Bondt and Thaler [21], Fama and French [22] and Poterba and Summers [23] found correlation in returns of individual stocks and various portfolios over three-to-ten year periods. Hodrick and Srivastava [24], Mark [25] and Taylor [26,27] found positive autocorrelation among exchange rate returns. Conrad and Kaul [28] reported a first-order autocorrelation of 0.2 for a value-weighted portfolio of the largest companies during the period 1962–1985. Goodhart [29] and Goodhart and Figliuoli [30] reported the existence of negative first-order autocorrelation of the price changes at the highest frequencies.

In this paper, we formulate the problem for the general ARMA model, and then assume a simple autoregressive model with order one, i.e. AR(1), for the return structure and derive the strategy that should be taken in order to maximize the expected average continuously compounded return, or the expected total excess return. We first derive the optimal trading strategy for a finite investment horizon using stochastic dynamic programming techniques. We then analyze the limiting behavior of this optimal trading strategy when the investment horizon tends to infinity. Interestingly, we find that the limiting strategy turns out to be a familiar rule in technical trading, i.e., the momentum index trading rule.

This paper is organized as follows. In Section 2, we identify a suitable objective function for market timers. This is essential because without a well specified objective function, it is not possible to compare trading strategies. Section