STATISTICAL PROCESS CONTROL FOR PORTFOLIO RISK MANAGEMENT

Robert Mefford, School of Management, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117, 415-422-6408, mefford@usfca.edu
Nicholas S.P. Tay, School of Management, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117, 415-422-6100, tay@usfca.edu

ABSTRACT

Statistical Process Control (SPC) has been extensively used for quality control in a wide range of manufacturing and service organizations but has not been applied to investment portfolio management. In this paper the potential application of SPC to allocation and risk management of investments is explored. SPC can be used to identify a shift in market sentiment which in turn can signal to investment managers to change portfolio allocations to-or-from riskier assets and/ or to employ hedges. Measures of investment sentiment is tested for their forecast capabilities using equity market data. Process control charts are then developed from the empirical data. How the SPC charts can be employed to improve portfolio performance in terms of improving returns and reducing risk are discussed.

Keywords: Asset Allocation, Control Chart, Forecasting, Sentiment.

Introduction

Ever since Edward F. Deming developed the use of statistical process control for quality improvement in manufacturing in the 1940's, its impact has expanded into many sectors beyond manufacturing. Statistical process control (SPC) has been employed in many service industries including government and health care to improve quality and productivity, but curiously, SPC has not been used in finance to any significant degree. Yet the basic premise on which SPC is based, which is identifying whether a process is experiencing normal or abnormal variation, would seem to be quite applicable to portfolio risk management. Investment decisions are often made on the basis of judgements of whether an asset market is in a normal or an abnormal state (i.e. boom or bust). This is where statistical process control may be useful to inform such investment decisions. In this paper, we explore the philosophy behind SPC and show how it is relevant to portfolio risk management. We also test empirically the forecasting ability of control charts for predicting market upturns and downturns in the U.S. equity markets from 1926 to 2014 and report improvement in portfolio performance that emerges from using control charts to manage the risk of various investment portfolios.

To construct control charts useful for risk management of investments, we need to first determine which variables to use as indications of market normality. It has been shown in [1] that investor sentiment predicts stock returns in the cross-section. Evidence in [2] suggest that sentiment variables such as Close-end fund discount rate, Share turnover, and Equity share in new issues have strong predictability for forward returns during recessions while First-day returns of IPOs, Number of IPOs, and Dividend premium are better predictors during expansions. We can develop mean and range charts for these variables using the historical data. Control charts can then be constructed on the basis of our empirical

results. Control limits can be set at two or three sigma (95% or 99.7%) limits depending on the confidence we wish to have in the signal. However, the control limit does not have to be breached for action to be undertaken. For example, in manufacturing control charts are monitored and trends upward or downward are noted. If a distinct trend emerges the process will be adjusted before it reaches an out-of-control condition.

The same approach can be used in portfolio risk management to adjust the portfolio or its hedges prior to reaching its control limits. When the control charts indicate that the markets are moving rapidly toward a correction, the portfolio manager can respond accordingly in several ways. The most straightforward would be to adjust the asset allocation moving toward bonds and cash in a down market situation and equities and other riskier investments in the reverse scenario. Also the portfolio manager may choose to take on hedges when the control charts indicate a down market is developing. There are a range of hedges available such as short selling of stocks or indices, long and short futures on various assets, and options. By using hedges selectively only when the control charts signal a down market, the costs of hedging can be reduced significantly and the hedges might be targeted more effectively. Conversely, when the signal is an upmarket, momentum strategies and long futures and options position, as well as leverage, can be employed to exploit the opportunity and increase portfolio returns. The result may be a better risk to return ratio for the portfolio and one that is more dynamic in adapting to changing market conditions.

REFERENCES

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