Financial Analysts Journal ›

Volume 56, 2000 - Issue 5

PORTFOLIO MANAGEMENT

Time Diversification and Estimation Risk

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Pages 55-62 | Published online: 02 Jan 2019

Cite this article https://doi.org/10.2469/faj.v56.n5.2390

Abstract

The recommendation that investors with long investment horizons tilt their portfolios toward stocks is commonplace. We used a nonparametric bootstrap approach to investigate whether in a mean-variance-efficient portfolio, the weights for U.S. stocks and U.S. T-bills vary in a systematic manner with investment horizon. This approach allowed us to analyze the impact of estimation risk on the optimal weights of stocks and fixed-income securities. The results show that an investor can gain from time diversification: The weights for stocks in an efficient portfolio were significantly larger for long investment horizons than a one-year horizon.

Practitioners commonly recommend that investors with long investment horizons tilt their portfolios toward stocks and away from fixed-income securities. This behavior is an important example of putting into practice the concept of time diversification, which

implies that a systematic relationship exists between the portfolio weights for a particular asset class and investment horizon.

We analyzed whether mean-variance-efficient portfolio weights for stocks and bills vary significantly with the investment horizon for a buy-and-hold strategy. In this analysis, we kept the risk price, the slope of the efficient frontier, constant while varying the investment horizon from 1 year to 5 years to 10 years. The data were real U.S. return data from 1900 to 1997 for a well-diversified stock portfolio and a short-term, nominally risk-free rate.

We presupposed that investors form optimal investment strategies based only on historical estimates of the following parameters or inputs to the optimization problem—means, variances, and covariances. The model we used is an unconditional model in the sense that agents do not explicitly try to model any possible time-series relationships among the assets. We implicitly accounted for any possible time dependencies in the observed return-generating processes, however, by resampling a great number of return series from the original data through the use of a computer-intensive method called “bootstrapping.” In particular, we used a nonparametric moving block bootstrap with a block length of 60 months in which serial dependence and cross-sectional correlation were preserved within the blocks. The real bonus of the bootstrap approach is the possibility of generating empirical distributions of optimal weights. Thus, we could not only analyze the existence of time diversification but could also test whether time diversification is significant in a statistical sense (i.e., if significant statistical differences exist between the optimal weights for different investment horizons).

With the bootstrap approach, we could also study the impact of estimation risk (meaning that the true parameters of the return distributions are unknown) on the optimal weights of stocks and bills. In a mean-variance context, estimation risk implies that the inputs to the mean-variance model are only sample estimates, not the true parameters.

The results show that estimation errors increase with the risk price and with the investment horizon. The first effect is a result of error maximization, which implies that the optimization framework chooses assets with overestimated expected returns and underestimated risks. The second effect is partly a result of fewer nonoverlapping observations existing at longer investment horizons than at shorter horizons.

We provide strong evidence that for all risk prices, the weights of stock in an efficient portfolio are significantly larger for the longer horizons. A tentative explanation is that for certain investment horizons, the return-generating process for stocks is mean reverting and/or the process for bills is positively autocorrelated. Because the return spread between stocks and bills is almost constant over the investment horizons, the change in portfolio weights might stem from the fact that with longer investment horizons, the standard deviation for stocks falls whereas the standard deviation for bills increases.

Our evidence supports the existence of time diversification: The weights for stock in efficient portfolios are significantly higher for long investment horizons than for a one-year horizon.

We would like to thank seminar participants at Lund University, the Finance and Macro workshop at EPRU, Copenhagen Business School, the annual meetings of the Southern Finance Association 1998 and the European Financial Management Association 1999, and the Research Department at the Federal Reserve Bank of Atlanta for valuable comments.