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The Large-Sample Distribution of the Maximum Sharpe Ratio with and without Short Sales¹

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Abstract

In the Markowitz paradigm the portfolio having *maximum Sharpe ratio* is optimal. Previously the large sample distribution of this statistic has been calculated when short sales are allowed and sample returns and covariance matrix are asymptotically normally distributed. This paper considers the more complex situation when short sales are not allowed, and provides conditions under which the maximum Sharpe ratio is asymptotically normal. This is not always the case, as we show, in particular when the returns have zero mean. For this situation we obtain upper and lower asymptotic bounds (in distribution) on the possible values of the maximum Sharpe ratio which coincide when the returns are asymptotically uncorrelated. We indicate how the asymptotic theory, developed for the case of no short sales, can be extended to handle a more general class of portfolio constraints defined in terms of convex polytopes. Via simulations we examine the rapidity of approach to the limit distributions under various assumptions.

Keywords: Optimal Portfolio, Maximum Sharpe Ratio, Asymptotic Distribution, Asymptotic Normality, Short Sales.

JEL Classification: C58, C46, G11

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