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The Mismeasurement of Risk

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Abstract

Investors typically measure risk as the probability of a given loss or the amount that can be lost with a given probability at the end of their investment horizons. This view of risk considers only the final result, but investors perceive (or should perceive) risk differently. They are affected by exposure to loss throughout the investment period, not just at its conclusion. We introduce two new ways of measuring risk—within-horizon probability of loss and continuous value at risk—that reveal that exposure to loss is substantially greater than investors normally assume. Investors typically measure risk as the probability of a given loss or the amount that can be lost with a given probability at the end of their investment horizons. This view of risk considers only the final result, however, whether the horizon is one month, one year, or one decade. It ignores what might happen along the way. We argue that investors and investment managers care, or should care, about exposure to loss throughout their investment periods. For example, an asset manager may face termination if the portfolio under management falls below a certain value at any point within a measurement period. A hedge fund will suffer withdrawals if it experiences a significant loss at any point within its investment horizon, which may threaten its solvency. A borrower may breach a covenant in a loan agreement if assets penetrate a specified threshold at any time during the term of the loan. A borrower of securities who wishes to anticipate incremental collateral requirements must focus on the distribution of the securities' market values throughout the borrowing period. Finally, institutions faced with capital requirements are monitored continually, not just at the end of a particular interval. These examples are but a few of the many circumstances in which investors should pay attention to probability distributions throughout the entire duration of their investment horizons. For this reason, we introduce two new approaches to risk measurement—within-horizon probability of loss and continuous value at risk (VAR)—which are based on the concept of “first passage.” We apply these risk measures to currency hedging and hedge-fund exposure to loss. Our examples reveal that if loss is measured at the end of a long horizon, currency hedging has little impact on the probability of loss, but if performance is monitored throughout a long horizon, hedging reduces probability of loss substantially. Moreover, VAR measured continuously throughout the investment horizon is significantly greater than conventionally measured VAR for both hedged and unhedged portfolios. Our examples also demonstrate that a hedge fund's exposure to loss is much greater than is implied by the distribution of the fund's value at the end of its investment horizon. Our analysis reveals that interim probability of loss is greater than terminal probability of loss. Moreover, unlike terminal probability of loss, which declines with time, interim probability of loss increases with the length of the investment horizon. This feature of within-horizon probability of loss presents a new challenge to the widely held view that time diversifies risk. Finally, our analysis implies that many investors are exposed to substantially greater risk than they assume and they should, at the least, be made aware of within-horizon exposure to loss. Such knowledge can eliminate the surprise of a significant loss during the investment period and prevent investors from misinterpreting it as unduly deviant. Moreover, the knowledge allows investors to consider whether a more conservative investment strategy is warranted.

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