

Probability and time trade-off

By accounting for the trade-offs between uncertainty, outcome, and time, a new model offers the hope of a clearer understanding of investment behavior.

September 14, 2012

Most of the investment decisions people make involve some element of future risk. For example, in the choices we make regarding savings, pensions, consumption and health, we generally face a trade-off between a more immediate and/or more certain reward and a delayed and/or rather uncertain reward.

In essence, investors make decisions that involve not only an outcome — i.e., a reward — but also elements of uncertainty and time.

Yet almost all financial models that seek to explain investment choices and their possible outcomes tend to treat the relationships between probability and outcomes (for decisions made under risk) and time and outcomes (to establish the time value of money) on a separate basis.

In their paper, "[Probability and Time Trade-Off](#)," published in *Management Science*, Prof. Manel Baucells, of Pompeu Fabra University, and IESE [Prof. Franz H. Heukamp](#) present an axiomatic model of preferences that formalizes the connection between probability and time in investment choices, while also accounting for magnitude effects.

Probability and time: A much-ignored trade-off

Countless economic models have sought to explain how investors trade probability and outcome. Put simply, the greater the uncertainty associated with a given investment, the higher the rewards investors expect to accrue.

Depending on an investor's risk aversion, some investments will be considered attractive while others are not.

Economists can fall back on a multitude of models of economic behavior to help explain why this occurs.

Likewise, numerous models already exist to explain how investors trade time and outcome. The relationship between the two, often described as the monetary discount rate, is clear: The longer an investor has to wait to get a return on his or her investment, the more he or she expects to receive in terms of financial gain.

For example, a long-running bond will typically have to yield a higher return than a bond that matures earlier.

What all these models lack, however, is a clear representation of the interaction between the time dimension and uncertainty.

The authors fuse the two dimensions, taking into account the trade-off between time and probability, as well as between time and outcome, and between probability and outcome.

To do so, they devised a model that can provide a clearer explanation of the dynamics driving investment decisions.

As Heukamp puts it, "It's akin to moving from a two-dimensional model of investment behavior to a three-dimensional one."

The magnitude effect

One of the most important applications of the new model is in providing confirmation and a clear explanation for the magnitude effect.

Long and widely observed by economists, the magnitude effect describes the process by which the greater the sum of money a person invests, the lower the rate of discounting generally applied.

Most economic models fail to account for the existence of the magnitude effect, with some economists actually viewing it as an anomaly. Yet by taking into account the trade-off between time and probability, the authors' model actually illustrates exactly why it should happen.

Sowing seeds for future research

The authors' probability and time trade-off model lays the foundations for a whole new body of research, which should allow for much greater clarity and insights into the way investments behave.

As Heukamp says, if an investment manager is helping prepare a client for retirement by, say, allocating a broad mix of bonds, stocks and options, "they cannot just compare time, probability and outcome variables separately; they must consider the interrelations between all three of them."

Unifying the two dimensions of time and probability into one dimension — what the authors refer to as "psychological distance" — should allow for an accurate view of the exchange or transformation rate between the two variables — what they call the "probability discount rate."

Ultimately, as new research is built upon the foundations laid by these two authors, a more nuanced understanding of investment behavior should emerge — something the investment world is clearly in need of during these testing times of uncertainty.

www.iese.edu/insight