
Defined Contribution Outcomes Model Technical Appendix

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Technical Appendix

The Morningstar Center for Retirement and Policy Studies' Defined Contribution Outcomes Model, or DCOM, is a quantitative framework to evaluate retirement outcomes for defined contribution, or DC, plan participants. DCOM produces a distribution of financial outcomes for each plan participant included in a model run. Plan participant inputs consist of datapoints that are commonly recorded by recordkeepers, such as age, gender, 401(k) balance, and wages. DCOM also incorporates plan-level data to better inform the model's contribution estimates. Note that we generally assume a baseline retirement age of 65.

The model projects retirement outcomes for each plan participant across 1,000 independent scenarios with the projection going to age 120. To be clear, death ages are modeled stochastically. The model can simulate death occurring based on Social Security cohort life tables and mortality tables published by the Society of Actuaries. DCOM is also able to leverage a time inhomogeneous Markov chain to simulate possible health statuses, which include specific states for long-term care. Lastly, DCOM can be configured such that death occurs at a specified age (in other words, a fixed retirement time horizon). DCOM leverages Morningstar salary curve methodology or plan-specific age wage curves to estimate both forward- and backward-looking real wages. DCOM includes levers to simulate job change, cashouts, and retirement plan access and participation upon starting a new job, though these features are not always used in the analyses.

DCOM incorporates realistic investor behavior into the simulation process. The best example is the contribution module. Instead of assuming a static savings rate, DCOM simulates the contribution rate based on plan participant factors (such as age, wage, and job tenure) and plan-level features (including auto vs voluntary enrollment, auto escalation, default contribution rates, median plan contribution rates, and plan match formulae). We are able to use 41 distinct plan-design prototypes to predict contribution rates. However, DCOM can also be configured to consume plan-specific contribution prediction statistical models.

DCOM forecasts assets within DC investment accounts (which include any pretax, post-tax, and Roth monies) to grow based on stochastic portfolio returns from Morningstar Investment Management's Time Varying Model. The model incorporates current market conditions in its forecast (for example, valuations and interest rates), which influence returns in the first 20 years of the projection. After that, the model's forecasts are based on unconditional, long-run return assumptions.

When it comes to asset allocation, DCOM is highly configurable. The framework can predict asset allocations for target-date fund investors, do-it-yourself investors (who allocate to the plan lineup themselves), and managed account investors. Moreover, the model can be set up to simulate asset allocations on a plan-specific basis. In general, these regression models account for plan and plan participant-level data in the estimation process.

Like other variables within DCOM, fund fees and solution fees (for example, the fee for a managed account) are highly configurable.

DCOM can calculate expenses in retirement any number of ways. For example, the model can estimate expenses as a function of the plan participant's take-home pay at retirement age. As another example, the model can predict expenses based on statistical models derived from the Health and Retirement Study.

Social Security benefits are estimated for each plan participant. The model uses the estimated historical wages along with the individual's birth year, claim age (which is assumed to equal retirement age), and other Social Security data to calculate Social Security benefits. We assume status quo for Social Security unless otherwise specified. Namely, we assume Social Security will be able to pay out full benefits in the future.

Every year in retirement, the Model adds up the guaranteed income from Social Security and any annuities and deducts it from expenses. The investments, which grow based on the Time Varying Model's stochastic rates of return, are used to fund any leftover amount. The model calculates both state¹ and federal income taxes, which are added to the next year's required expenses. The model also accounts for required minimum distributions.

The projected income, wealth, and expense cash flows are converted from a nominal basis to an inflation-adjusted, or real, basis. DCOM can output a variety of metrics based on the cash flows that are tracked by the program.

¹ The state of Virginia is used for the analysis. We used Virginia because it is somewhere near the middle when it comes to ranking states by taxes paid.

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