ORTEC FINANCE

Ortec Finance

A Goal Based Plan Deserves More Than A Standard ‘Monte Carlo’

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Introduction

After you print the financial plan, it dies

Most financial advisors agree that a financial plan is a critical tool for them to truly engage clients and build deep trustful relationships with them. It helps them get insights into the complete financial situation of their clients. More importantly, the financial plan helps redirect focus from short term market volatility to the clients' long term financial objectives. This positions the advisor as a trusted partner who is strategically involved in their client's major financial decisions.

At the same time, most financial plans use very basic assumptions to support the investment decisions of the client, possibly leading to unrealistic client expectations. Also, most financial plans are static documents that use assumptions and data based on a single point in time. As one advisor put it, "after you print the financial plan, it dies".

A financial plan can quickly become outdated for a variety of reasons such as new tax regulations, more ambitious goals, disappointing investment returns, unforeseen expenses or a surprise financial windfall. For the plan to stay alive and relevant, it needs to be monitored and updated on a regular basis. This allows the advisor and client to adjust the plan as a clients' personal situation, their portfolio, the markets or world affairs change over time.

A one-off financial plan is insufficient to help clients achieve their financial goals. For a financial plan to stay alive and relevant, it needs to be regularly updated and continuously monitored.

Keep the plan alive

The challenge is to use appropriate tools to actively monitor hundreds of clients, and potentially thousands of goals, on a daily basis, while taking into account the updated financial situation and market conditions. The good news is that these tools exist in the form of scenario analysis and Monte Carlo engines. These tools have been developed and deployed with wealth management firms and pension funds in Europe for several years now.

In this paper we outline the added value of scenario analysis and Monte Carlo simulations. However, most simulation engines, do not take into account the updated return expectations, portfolio values and multiple other factors created by an ever-changing market. In order to keep a financial plan alive, we will demonstrate that not just any Monte Carlo simulation engine is appropriate. In this paper we explain how the quality of the simulation engine is important not only for preparing a financial plan, but also for monitoring the plan continuously. As a result, this enables advisors to keep their clients' plan alive and relevant.

Why scenario analysis?

Financial planning tools enable advisors to analyze future cash flows and plan future spending requirements of their clients. Some tools even provide advanced functionality to create tax optimization strategies. These tools are advanced and provide insights into the financial situation of the client at a detailed level. At the same time, we notice that the return assumptions for the investment portfolio that will fund all these future plans are often extremely basic.

For example, a common basic assumption for a Balanced Growth portfolio is a straight-line 6% return for the next 20 years. It is safe to say that this constant and steady return is simply not realistic and does not reflect the experience of the client during his or her investment horizon. This is clearly illustrated in the graphs in Figure 2.

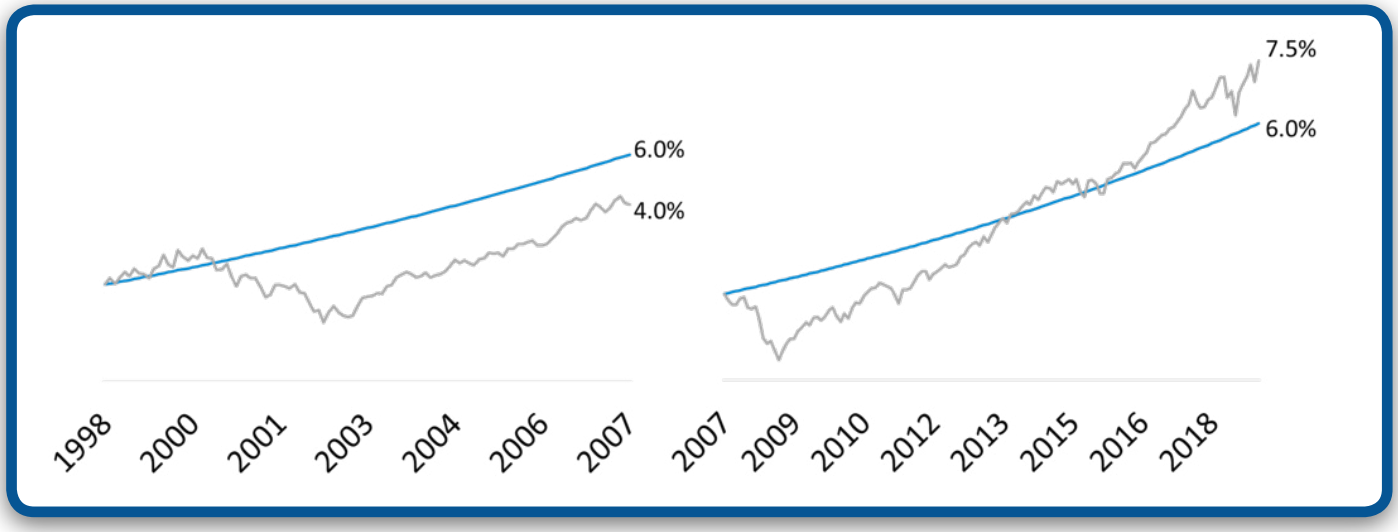


Figure 1: Two examples how a 'Balanced Growth' portfolio performed in the past (grey line), using benchmark data for US equity and bond returns, relative to a straight line 6% assumptions. An investor who started in 1998, had dealt with strong losses in the beginning of the 00's and ended up with an annualized return of only 4% after 10 years. The second example shows an investor who dealt with even heavier losses in the first 2 years, but actually would have made a higher annualized return than 6% if he held his portfolio up until 2018.

Figure 1 highlights the necessity of using scenario analysis to support clients and advisors in making investment decisions. Using a Monte Carlo simulation to generate a range of possible future scenarios for investment returns already improves the traditional fixed return assumption. Instead of a straight-line 6%, each future scenario will be a random but plausible sequence of annual investment returns based on a number of core input parameters.

Monte Carlo simulation enables an advisor to calculate the probability of successfully reaching investment goals instead of a simple yes/no answer. This should paint a more realistic picture and, therefore, improves management of clients' expectations. Moreover, this enables advisors to rerun the calculations and keep track of this probability of success over time. Monte Carlo, therefore, enables monitoring of client's goals in a financial plan.

The commonly used straight-line return assumption is unrealistic and may lead to poor investment decisions. High quality projections are therefore fundamental for the quality of any financial advice.

Monte Carlo '101'

A Monte Carlo simulation engine essentially generates a range of possible and realistic outcomes of future scenarios for investment returns. The engine can generate thousands of potential return series and then capture the statistics – mean, average, correlation, maximum, minimum, quantiles, etc. – for the returns or development of capital. The scenarios represent several thousand "futures" for the portfolio – not a prediction, but a range of possilbe outcomes?.

The range of possibilities is defined by three important input parameters:

1. Expected Rate of Return (mean)
2. Volatility of Returns (standard deviation or variance)
3. Correlation of Returns

The engine then creates a large number of different investment futures – such as illustrated in Figure 2 – and can be used by the advisor to illustrate the range of probable investment outcomes. The expected scenario functions as the basic assumption for developing the financial plan. Often, this corresponds to a straight-line fixed return assumption, for example 6%.

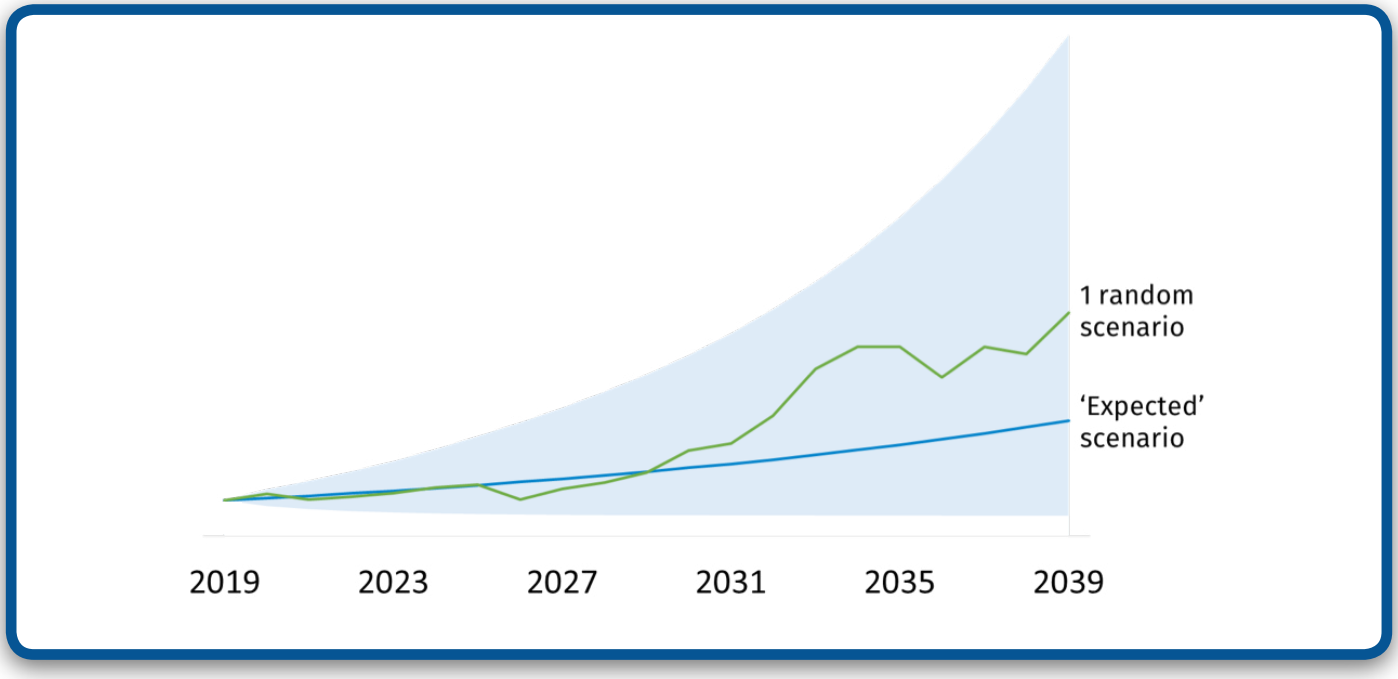


Figure 2: Example of a 'Monte Carlo' simulation of scenarios for capital development of an investment portfolio, based on a large number of random scenarios, illustrated by the green line. The blue line shows 'expected' amount of capital at each point in time. The light blue area shows the range of possible outcomes based on a certain probability, e.g. 95%.

Monte Carlo simulations in practice

The fundamental idea behind using a Monte Carlo engine is to develop a statistical model to estimate the probability of meeting specific return targets and supporting financial planning assumptions. While being a valid approach, in practice, there are often critical flaws in the execution.

Most Monte Carlo engines simply provide a range of probability around the same straight-line 6% return assumption we mentioned before. The expected result shown from a typical Monte Carlo simulation, which often has a 50% probability of success, is essentially the same result as the straight-line return assumption.

It is quite possible to monitor a client's goals using this basic Monte Carlo method. However, the straight-line return assumptions that are input for the expected scenario in a Monte Carlo simulation will barely change over time. If interest rates fall or markets decline or rise significantly, standard Monte Carlo simulations will still be based on similar forward-looking assumptions as before. For example, if we would consider the past 15 years as representative for US government bond returns, we would assume a 4% annual return for the entire simulation of a clients' financial plan, even though today's yields are at all-time lows. This approach then does not reflect the current state market conditions. When preparing or monitoring a financial plan, this does not make sense and leads to unrealistic expectations or poor investment decisions.

Summarizing, most Monte Carlo simulation engines are built upon a statistical normal distribution (bell curve), which requires input parameters for the mean, standard deviation and correlations. Those assumptions are often based on a fixed or regularly updated historical window. But past performance of returns are no guarantee for future performance. Those are words every investment professional knows by heart. The question then is why is it still a common practice to only use historical average return assumptions for financial plans? And would not all financial advice improve by taking this knowledge into account?

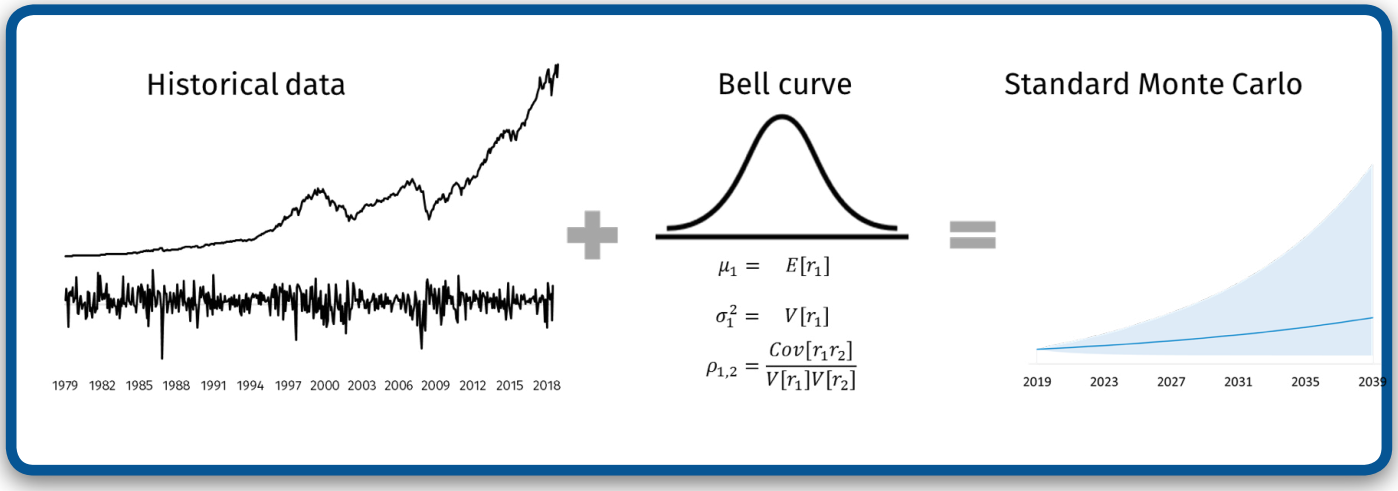


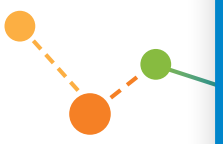
Figure 3: An illustration how most Monte Carlo simulations work. Based on a certain window of historical data, for each asset class, parameters for the expected return, risk and correlation are determined. These are then input for a simulation based on a normal distribution, which assumes these parameters to be fixed over time.

Weather forecasts

All simulation models have a foundation based on historical data. In that sense, simulating investment returns is basically not very different from the simulations that are used for the weather forecasts. Based on a statistical model, historical weather patterns and recent meteorological data, meteorologists will generate forecasts throughout a 24 hour cycle. The weather forecasts evolve based on new data, assumptions and inputs. Also the weather models themselves are constantly updated based on how well they predict the actual weather events.

Monte Carlo simulations engines for investment returns are usually far less rigorous in the way they use recently updated historical data and the way they take into account current market conditions. If these models were used to forecast the weather in Toronto for the start of July, they would simply take the average daily temperature for Toronto, calculate the standard deviation for the data and run 10,000 Monte Carlo simulations. This would give a minimum temperature of **-25°C**, a maximum of **48°C** and an average, or expected temperature of **12.9°C**[1].

This does not make a lot of sense as the model does not take into account enough information or patterns within the data. For example, current weather conditions will most likely influence the forecast model. If temperatures today are well above 25°C, it will be highly unlikely that the day after they will drop below -25°C. Also, ignoring seasonal fluctuations in the data means that the -25°C and 48°C are possible on any given day throughout the year. The model then would suggest it could be 48°C in mid-January but also -25°C in July. In order to build a reliable forecast, you should not only rely on historical data, but also incorporate seasonality, current conditions and additional data such humidity, air pressure, jet stream location and speed, and multiple additional atmospheric weather models.



Past performance of returns are no guarantee for future performance. Therefore it is not sufficient to only use historical average return assumptions for a financial plan.

[1] -49°F, 118.4°F and 55.2°F

Four essentials components for quality advice

Although we believe historical data provide useful information for investment risk and return projections, we are convinced that these models require additional information and more robust statistical analysis. Over the past 30 years we have developed a model that incorporates this additional information. We believe that in order to build a high quality Monte Carlo simulation engine, at least four essential components should be incorporated for a truly dynamic approach to simulate future scenarios of investment returns:

1. Current market conditions

2. Realistic models and stylized facts

3. Long term assumptions

4. Market information not captured by data.

This input leads to high quality and up-to-date risk and return characteristics of asset classes to provide realistic projections of the investment products that are available to the client. The methodology allows to tailor the projections to align as much as possible with the product shelf, benchmarks and views of the advisor's organization.

The necessity of a high quality Monte Carlo simulation engine has been recognized by the institutional market for a long time already. As a result, our methodology has been globally implemented, tested and has proven its added value for pension funds, insurance companies and sovereign wealth funds. This enables banks and advisory firms to leverage the institutional quality to the retail market.

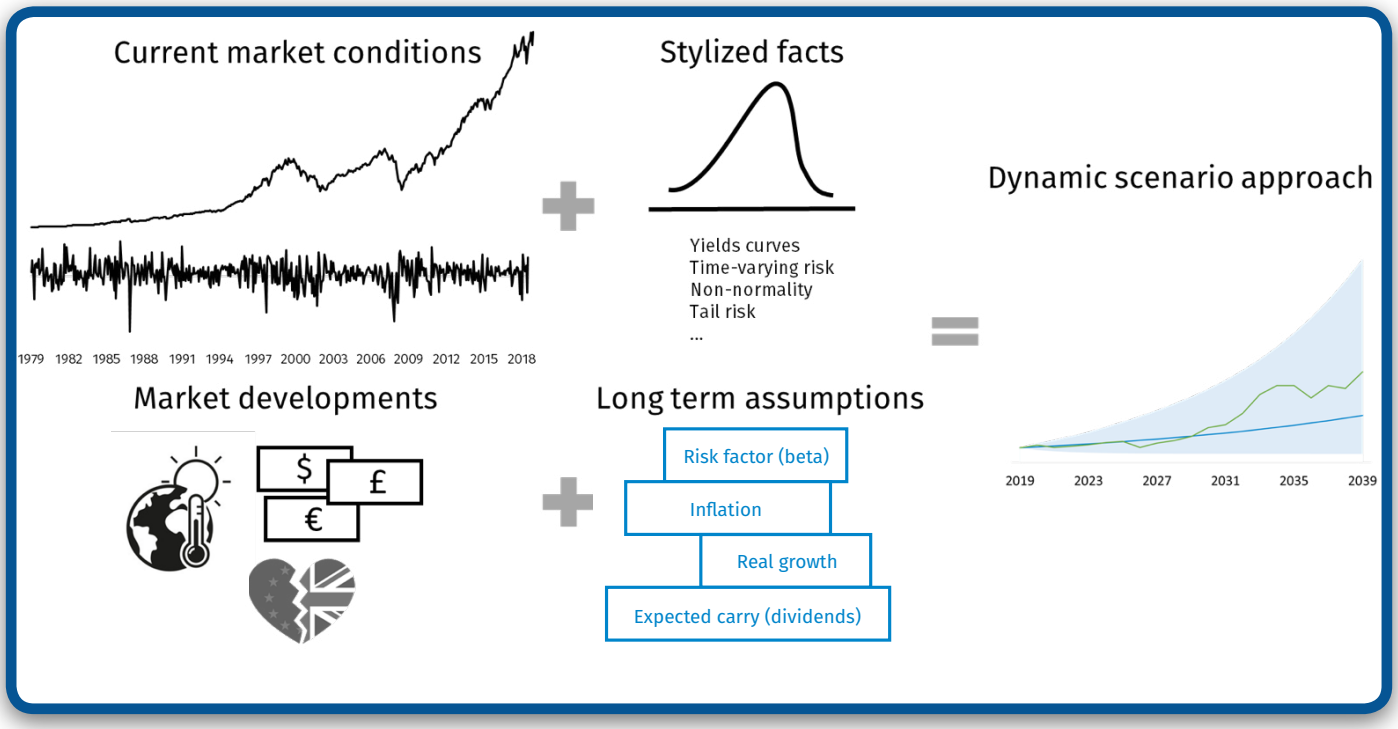


Figure 4: Instead of relying purely on historical data and very basic assumptions for risk and return, Ortec Finance developed a dynamic methodology to simulate future scenarios of investment returns, that is built upon four essential components: 1) current market conditions, 2) realistic models that take into account well-known stylized facts, 3) a framework to determine long-term assumptions and 4) market developments not captured by historical data.

1. Current market conditions

When applied to financial markets, most Monte Carlo simulations use the same risk-and-return assumptions for short, medium and long term. However, Ortec Finances also believes that for clients with long term investment goals, it is very important to take into account the current market situation.

For example, at the moment of writing this paper, global bond yields are at an all-time low. In the past, yields declined over a long time, leading to positive returns for bond portfolios. However, this situation will not last indefinitely and if yields are starting to increase, this may even lead to negative bond returns in the near future. Assuming an average annual 4% portfolio return for the entire investment horizon is therefore not realistic, as we illustrate in Figure 5

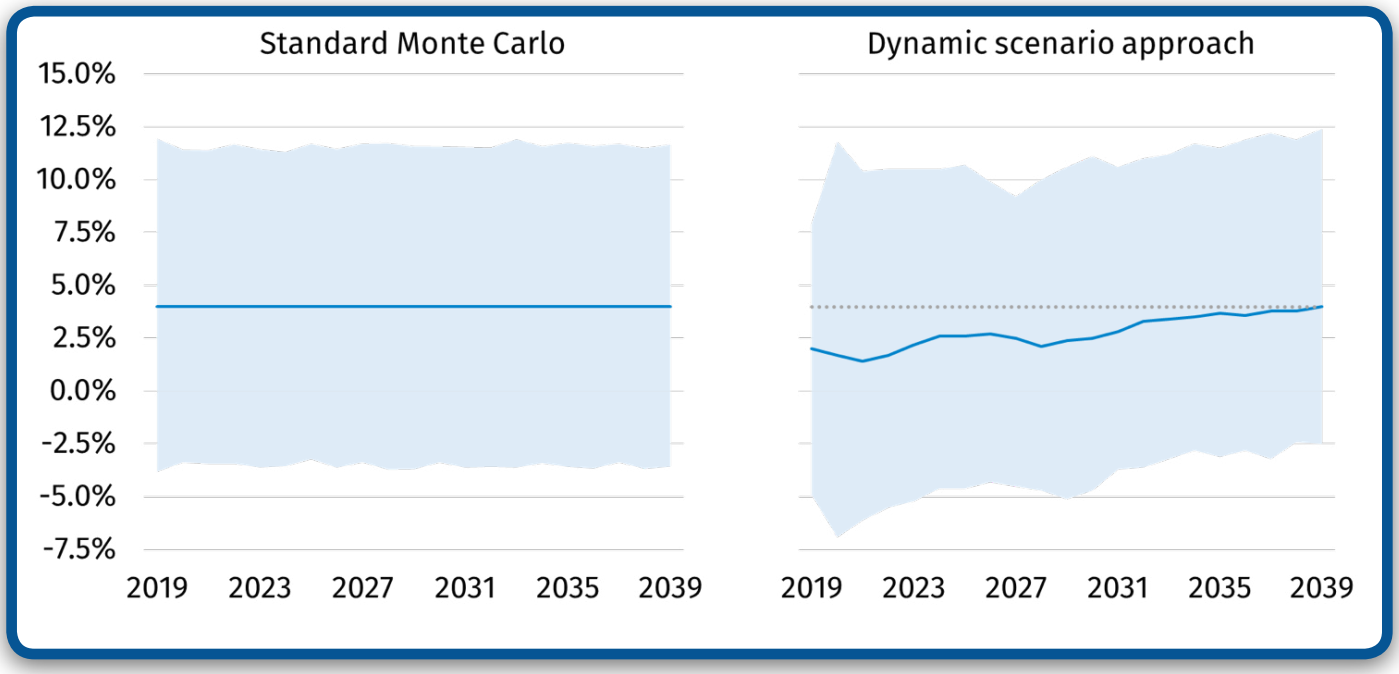


Figure 5: Example of two simulations for US government bond returns calibrated with data up until 2019. The first one is based on a standard Monte Carlo simulation, while the second one is based on a dynamic scenario approach. Because current market conditions are taken into account in the second approach, expected returns are much lower due to current low yields (<2.0%), as compared to the grey-dotted line, which is standardly used for Monte Carlo simulations. Also, we don't expect a smooth path to 4% as bond returns are negatively impacted by the potential of increasing yields.

Quality risk and return projections are not static, but take into account that market conditions change over time.

Let us consider another example - the long term assumption for equity returns of a Monte Carlo simulation is typically 8% annually. As equity markets have performed very well with a number of back-to-back +15% returns annually, the probability of a market correction increases. This well-known effect is called "return-reversal" and is – next to "return momentum" – one of two main characteristics of short-term returns. Taking into account this increased risk and possibly lower medium-term return expectations is more realistic and helps clients to make better informed investment decisions and also to manage client expectations. For example, if a client would have withdrawn their investments after the downfall in 2008, he or she would have missed the "return reversal" that led to strong back to-back returns afterwards. Projections that reflect current market conditions enable clients to have realistic assumptions that fit their investment and planning horizon, whether it is on the short, medium or long term.

2. Realistic models and stylized facts

As mentioned earlier, most Monte Carlo simulation engines are built upon a statistical normal distribution. There is extensive academic research available that, in practice, investment returns do not reflect the Normal Distribution or 'bell curve.' Nevertheless, the traditional 'bell curve' is still often the cornerstone for constructing projections of risk and return. This simplified representation of reality does not take into account well-known, observable patterns in historical data, so-called stylized facts.

Ortec Finance has developed a simulation engine that uses advanced econometric models, which embrace, rather than ignore, these stylized facts. Below, we list a number stylized facts that are currently being captured by our models:

- Risk and return vary over time: Depending on the stage of the business cycle, a short and medium-term outlook can be either more positive or negative than the outlook for the long term. Also, current yields strongly influence the expected return and risk for fixed income portfolios.

- Risk and return depend on the investment horizon: The relation between risk drivers is not constant over time. For example, there may be no correlation between inflation and equity returns on a one year horizon, but there may be over a long term investment horizon.

- Returns follow non-Normal distributions: Strong negative returns occur more often than strong positive returns (negative skewness). In addition, they occur more often than is expected according to standard normal distributions (fat tails).

Other examples of stylized facts are time-varying volatility, yield curve shapes and tail risk. For a comprehensive overview of all stylized facts that are captured, we refer to our white paper 'Ortec Finance Scenario Approach.' Using one or multiple of the individual scenarios, advisors can use a positive, average and poor result scenario to educate clients how markets can be volatile and show what a realistic future scenario may look like.

Stylized facts	Standard Monte Carlo	Dynamic scenario approach
Risk and return vary over time (yields, business cycles etc.)	✗	✓
Risk and return depend on the investment horizon	✗	✓
Diversification decreases in bear markets (tail risk)	✗	✓
Returns follow non-Normal distributions	✗	✓
Yield curve movements drive fixed income returns	✗	✓

Figure 6: This table shows a comparison between simulation models based on whether well-known stylized facts are taken into account. Standard Monte Carlo simulations don't take into account most of these stylized facts and as a result don't provide realistic projections to clients.

3. Long term assumptions

Most economic and statistical models converge to a steady state or equilibrium situation. Let us use the weather analogy again to illustrate what this means.

Assume we want to forecast the weather for July 1st ten years from now. Today's weather conditions have very limited value for this particular forecast. Based on general long term trends and historical averages for the most important factors, such as temperature and humidity, we may be able to provide a rough estimate of the weather on this day in the future.

Going back again to projections of investment returns, the same principle holds. To determine plausible assumptions for the long term steady state, Ortec Finance developed a consistent and scalable framework, based on a large-scale academic research. This framework is based on general building blocks such as economic growth, inflation, real rates, maturity spreads and risk premiums.

This structures the approach because it enables one to include all forces that might affect the long-term expectations, rather than assuming a long term average based on a historical window of data. As a result, this building-block approach enables us to leverage an intuitive framework to more than 700 economic and financial variables, while ensuring consistency at the same time.

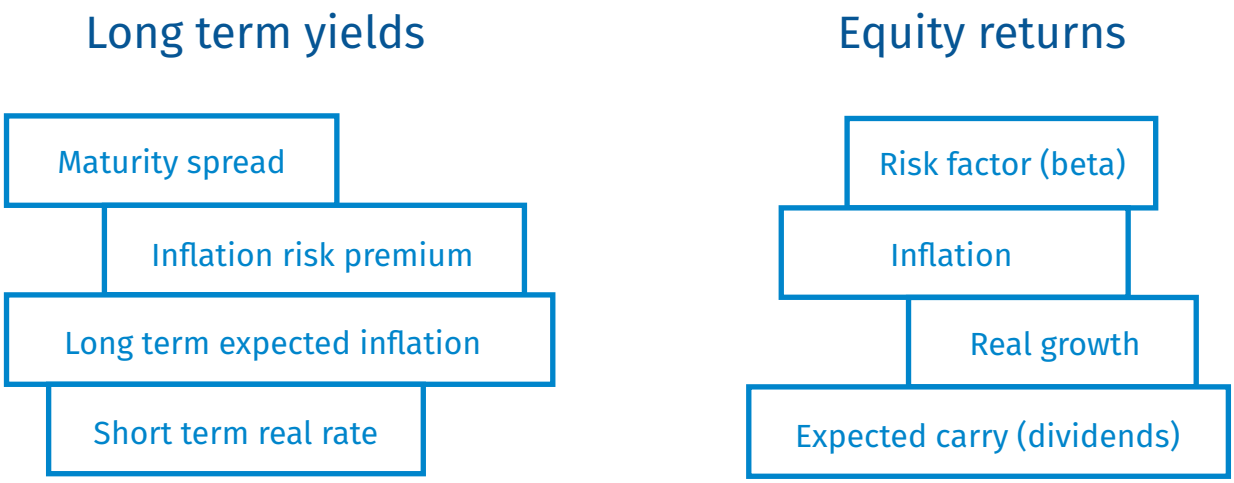


Figure 7: Illustration of the building block approach for long-term yields and equity returns. For all regions that are being covered for these asset classes, steady-state values have been determined for the underlying building blocks. As a results, changing assumptions in one of these building blocks can easily be implemented throughout all dependencies.

Frequent reviews of the validity and plausibility of the long-term expectations ensures the actuality and quality of assumptions. For example, we found that central bank targets are the most reliable estimates for long-term inflation. If a central bank changes its target, this then should be adjusted accordingly and consistently to all dependent variables through the building-block approach.

4. Market information not captured by data

Most of the components that we described above are still based on the assumption that historical data contains all the information that is relevant for generating realistic scenarios. Regardless of how realistic we manage to make these models, however, we should not forget that that they remain models.

Any model is by definition a simplification of reality and we should therefore never see them as “the truth” but instead constantly be critical in our evaluation of how realistic the scenarios that they produce are. Seen from this perspective, we should not avoid intervening if we deem the scenarios or certain economic variables of asset classes unrealistic.

One very obvious example in today’s economic and financial market environment is the unprecedented monetary stimulus as provided by central banks. Around the world they attempt to stimulate economic growth and increase inflation. Another example is how climate change will affect risk and return in the future. Climate change will not only affect companies on the individual level but will also fundamentally impact how the economy performs as a whole.

These effects are not well-represented in the historical data, but have a very large impact. Expectations for interest rates going forward will be affected, and perhaps also economic growth and returns on financial assets.
This information therefore needs to be integrated in the models and scenarios as consistently as possible.

Consistent methodological framework

Broad and global coverage

Another major challenge with economic modelling in general is the complexity of dealing with hundreds of economic variables and risk drivers simultaneously. In the end too many model parameters and estimates diminishes the quality of the projections, for example due to 'overfitting'. As a result, traditional Monte Carlo simulation engines cannot deal with a large number of asset classes at the same time. On the other hand, the investment universe is extremely large and client portfolios can contain all of these different asset classes for different regions. As each asset class, region and even investment style has its own characteristics, the methodological framework has to deal with this challenge. Including the fact that risk and return of each of the multiple asset classes across different regions must be consistent with each other.

Serving a global client base with institutional clients that invest in hundreds of different asset classes and regions simultaneously, Ortec Finance has developed a framework that is scalable and consistent at the same time. Through this approach it is relatively easy to add new asset classes for new regions for different investment styles.

Multiple iterations

As outlined earlier it does not make sense to build a model once, run the projections and act on the same simulation results using possibly outdated return assumptions. Circumstances and conditions change, leading to an updated, more accurate outlook. Just like a weather forecast it's important to update the projection of risk and return frequently, to account for the recently changed market conditions. To enable this, Ortec Finance publishes a monthly update of its projections based on recent market realizations.

By incorporating changing circumstances and conditions Ortec Finance supports financial institutions to monitor their investment plans using realistic and up-to-date assumptions for the future. The probability of success of an investment plan changes over time, as portfolio values change, asset allocations deviate or when the client makes unexpected contributions or withdrawals. In addition, market situations and as a result the market outlook change over time as well. Ignoring the latter is basically assuming the straight-line 6% assumption regardless of what happened recently in financial markets.

Our methodology enables retail investors to make use of the same high-quality projections that meet the highest standards of institutional investors.

Back-testing and forecasting

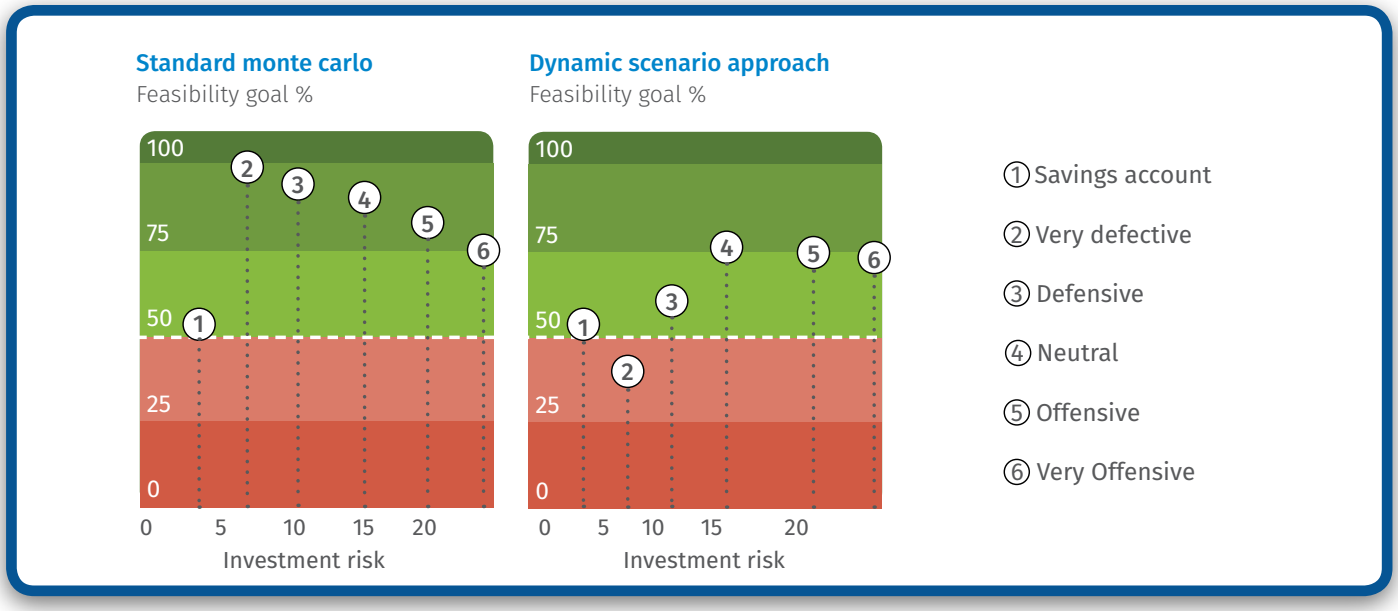
Simulation engines should not only be validated based on how well they represent past characteristics. In the end, these models are used to provide realistic projections of future investment returns. Out-of-sample back-testing research is commonly practiced and in which we challenge and improve the quality of the dynamic scenario approach used at Ortec Finance. This enables a direct comparison of the projections of risk and return relative to the realizations. In our most recent blog, we highlight the latest results of our back-testing research.

We compare the quality of our dynamic forecasts to that of a static Monte Carlo simulation on 3 month, 1 year, 3 year and 5 year horizons for more than 240 global economic and financial market variables. Combined across all economic variables and asset classes, we obtain forecasts which are some 10% better than those of the benchmark model. We noticed that the forecasting power is strongest for a medium term horizon of around 3 years. This indicates that taking into account current market circumstances such as yield curve behavior and business cycle models, indeed lead to better projections of investment returns.

Illustrative example

To illustrate how a dynamic scenario approach actually leads to better investment decisions than a standard Monte Carlo simulation, take the following example: your client has a capital of $100.000 and want to invest this for a period of ten years. His goal is to maintain this capital in real terms, in order to be able to fund the renovation of his house.

In the two graphs you see five model portfolios displayed including the short-term investment risk in combination with the long-term risk, or the feasibility of your goal. The first graph uses a standard Monte Carlo simulation with fixed returns and fixed volatility. The second graph shows the results based on a dynamic scenario approach as described in this article. The analysis with the standard Monte Carlo simulation shows that the more defensive model portfolios result in a higher feasibility of your goal. Based on the current interest rates however, this representation is not realistic. The current low interest rates influence the expected return of a bond portfolio in the short term, but also greatly impact the development of returns in the long term. Low interest rates thus result in a much lower feasibility of goals when investing in defensive portfolios. The analysis based on the dynamic scenario approach illustrates this strongly.



The comparison between the analysis in the two graphs therefore shows that not taking into account all these methodological essentials in the end leads to a different and unrealistic financial advice and even poor investment decisions. In order to keep your plan alive by actively monitoring its feasibility, it requires realistic updates of this analysis.

Summary

Most financial advisors understand and realize the importance of a financial plan. The quality of a financial plan largely depends on the methodology used for the underlying assumptions. Still, even though the one-time quality is high, the value of any financial plan diminishes as soon as it is printed out and reality catches up. An essential tool to keep the plan alive is the ability to monitor the plan and the feasibility of the clients' goals. With continuous monitoring, advisors can proactively keep track of their clients' goals and redirect focus from short term market volatility to the clients' long term financial objectives. For this, scenario analysis or a Monte Carlo simulation provides a powerful tool.

This article not only explains how Monte Carlo simulations are applied in practice but also how the underlying methodology can be improved to increase the quality preparing the plan while adding more relevance to the monitoring of the plan. Instead of a standard Monte Carlo simulation, a dynamic scenario approach takes into account current market conditions, broadly supported stylized facts on economic and financial market behavior and considers market conditions that are not captured by historical data. Such an approach improves the often applied straight-line return assumptions by enabling different expected returns for multiple time horizons. By capturing these components the overall quality of financial advice improves significantly, leading to better informed and more satisfied clients.

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About Ortec Finance
Ortec Finance is the leading provider of technology and solutions for risk and return management. It is Ortec Finance's purpose to enable people to manage the complexity of investment decisions. We do this through delivering leading technologies and solutions for investment decision making to financial institutions around the world. Our strength lies in an effective combination of advanced models, innovative technology and in-depth market knowledge.

Headquartered in Rotterdam, Ortec Finance has offices Amsterdam, London, Toronto, Zurich and in Hong Kong.

- 20+ countries represented
- 500+ customers
- 96% retention rate
- 3 trillion euro total assets managed by our clients.

Speak to one of our experts

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