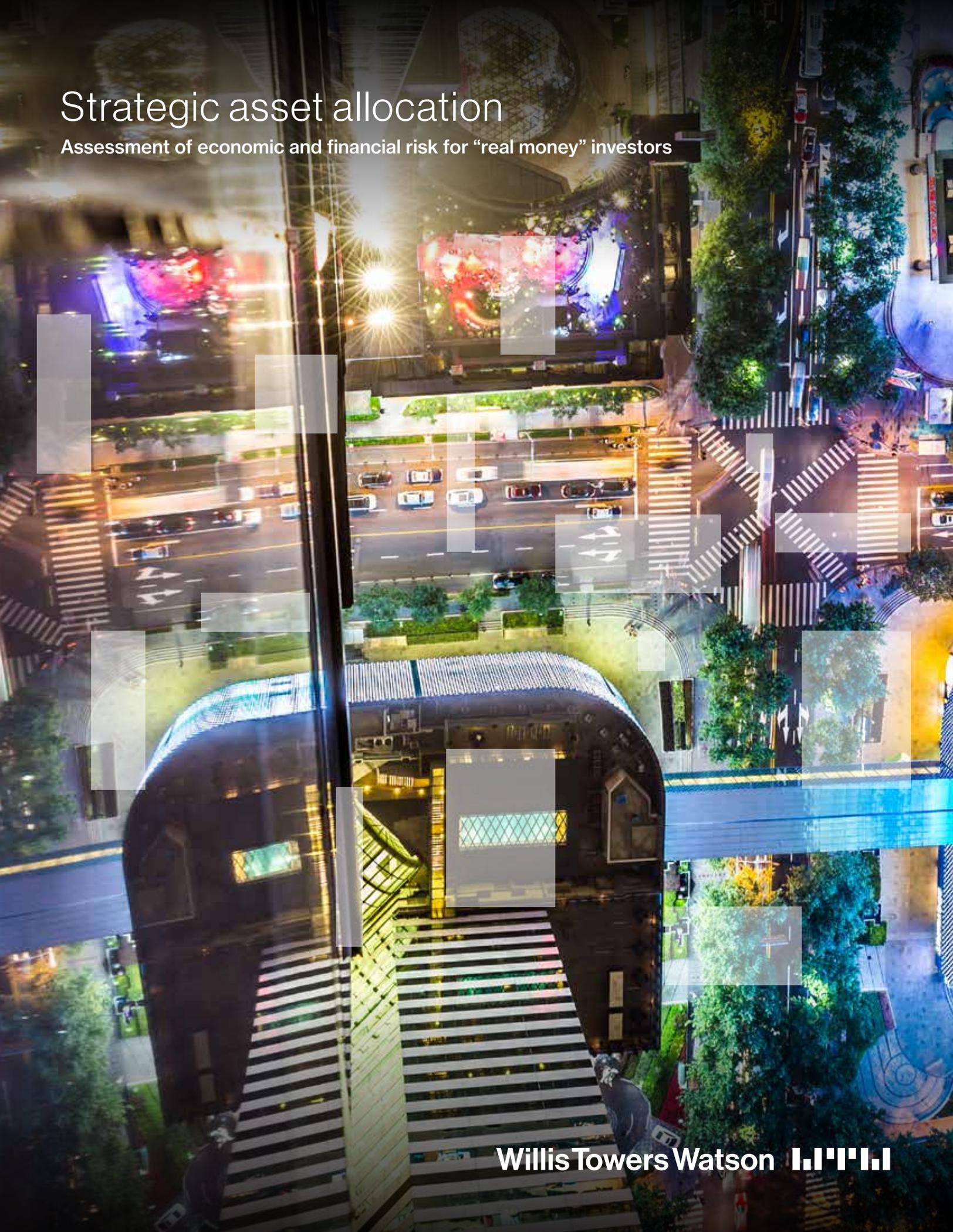


Strategic asset allocation

Assessment of economic and financial risk for “real money” investors





Willis Towers Watson's STAR library is a suite of tools designed to support financial services firms with strategic asset allocation (SAA) and the assessment of economic and financial risk. STAR works by coherently simulating a wide range of possible economic and financial outcomes that drive market risk.

From a philosophical perspective, STAR has been designed to help give control to the client. As models attempt to capture ever greater degrees of economic realism, the mathematics inevitably grow in complexity. Therefore, as part of the STAR suite we provide a mechanism that helps clients take back control, providing the necessary infrastructure and support to ensure that the STAR risk framework can be easily embedded into the risk management process.

From a technical perspective, the STAR library focuses on three key criteria: realism, intra-series coherence and dependency; and the full distribution of returns, both centrally

and also in the tails. STAR is intrinsically time zero market consistent (in that time zero valuations are consistent with market prices), and the evolution is real world.

Given these aspects, and particularly the consistent alignment of scenarios with client expectations, risk models fed by STAR scenarios strive to provide greater insight and realism over previous technologies.

The STAR process

The STAR modeling process can be broken down into four key stages.

Stage 1: Base economic modeling

In this phase, the client generates a set of economic scenarios that reflects the base calibration as provided by Willis Towers Watson. This base set is calibrated to market data, yet reflects certain fundamental economic overlays consistent with the company's Global Investment Committee. Moreover, Willis Towers Watson can provide a range of alternative base calibrations reflecting specific economic global events (such as a European sovereign debt crisis, a slowdown in emerging market growth or the onset of deflation in developed markets). This uses economic analysis carried out by Willis Towers Watson.

Stage 2: Alignment to views

Clients may consider the base economic scenarios as not fully aligned with their own economic analysis, which is where REVO (Relative View Overlay) can be used. REVO is a stochastic alignment tool that looks to allow clients to overlay their economic views in an easy, intuitive manner. This tool applies the mathematics to readjust the simulation output automatically without the need to re-parameterize the underlying economic scenario generator (ESG).

Stage 3: Asset modeling

Next, clients specify the universe of assets to be modeled. In contrast to some other frameworks, STAR values assets at each time-step, using the ESG drivers. Rather than calibrate asset returns to the index series (and rely purely on the correlation to drive the relationship between asset returns and the economic scenario), STAR values the assets at each time-step under each specific scenario, and then strives to generate returns that move coherently with the economics.

Historically, the weakness of the economic framework and inability to value assets resulted in low credibility output. We believe the combination of improved economic realism and the ability to value assets directly has greatly improved the quality of the downstream analysis.

Stage 4: Strategic allocation and risk modeling

Finally, the economic and asset return series are passed into the portfolio modeling and risk management engines. Fundamentally, these engines handle reinvestment and rebalancing rules, portfolio cash flow management (reinvestments, redemptions and defaults) and external cash flow management (both inflows and outflows). In addition, these modules reflect the accounting conventions and tax regimes to produce financial statements.

Technologically, the SAA and portfolio engines have been developed to run very quickly. The risk and return characteristics of multiple portfolios can be compared, and this is supplemented with numerical techniques to determine the optimal portfolio. Therefore, STAR can support manual or numeric approaches to portfolio construction.

Technology aspects

STAR is deployed as a library module built on the Willis Towers Watson Igloo platform. Igloo was originally developed to handle the many complex models used by the general insurance industry when assessing the statistical risks they face. Igloo has since been optimized to handle highly demanding stochastic simulation environments and is ideally suited to economic and asset modeling. Although STAR works efficiently on laptops, desktops and servers, it has also been written to take advantage of any computation grid that may be available.

Economic calibration

STAR ESG focuses on economic realism, both in regard to the direct economic items modeled and how these measures subsequently impact movements in asset series returns. Several of our models have been developed in house, often extending existing modeling frameworks including the important interest rate, credit modeling and dependency arenas.

The STAR ESG calibration is focused on the full distribution of results, including the tails, average levels and volatilities, considering both one-year and multiple year time horizons. This ability to model both short-term and long-term risks via the same modeling framework strives to support the coherent assessment of companywide risk as advocated by modern enterprise-wide risk management.

Acknowledging that there are limitations to how far history can inform the future, an ESG calibration needs to combine quantitative fitting to data with a qualitative judgmental overlay. Although historical data are useful for guiding the assessment of volatility and correlations, they are less helpful when considering the mean path that markets may take. Conceptually, an ESG is essentially a model that starts at today's market values and evolves these levels to a long-term steady state. Relying on history too much can be misleading, so a qualitative assessment is essential.

Willis Towers Watson's economic forecasts are drawn from our in-house Investment Assumption Committee, a group of academic economists, asset managers and other financial market practitioners, whose output directly affects assets totalling over US\$4 trillion globally.

This team is responsible for setting the economic targets that drive our fiduciary asset management responsibilities, as well as our strategic advisory and consulting activities across the full range of Willis Towers Watson's services.

In relation to STAR, the views from this committee are automatically embedded into the ESG base calibration; they can be removed to create a raw historical-only ESG, if required.

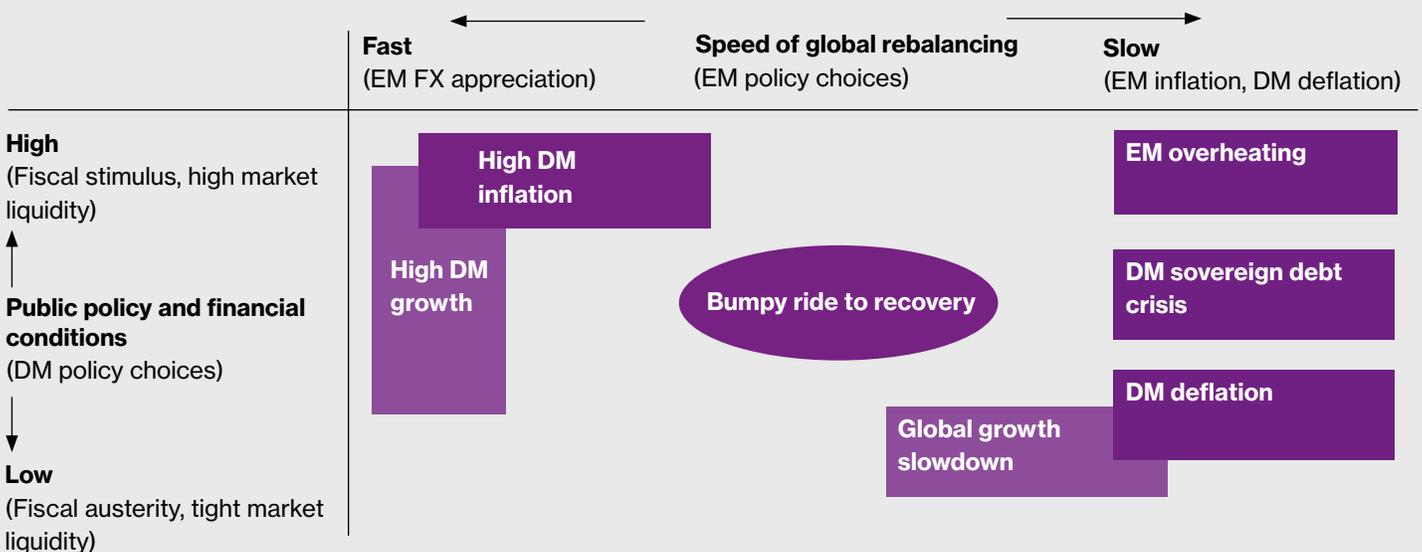
Alternative ESG calibrations

The central ESG calibrations are supplemented with a number of alternative economic world scenarios, which have been derived by the Investment Assumption Committee. These are particularly useful for supplementing a central view of risk assessment given the current macroeconomic uncertainty.

We believe that in current market conditions, one of the largest macro-uncertainties is the speed of policy change in developed and emerging markets. The economic consequences of such changes are displayed in *Figure 1* below.

Where our clients are exposed to material risk, it would be advisable to quantify the impact of such alternative scenarios on portfolio returns. Although such scenarios would look to be captured within the full distribution of the core calibration, it can be difficult to ascertain what effect they have had. Consider that our central view is that inflation in developed economies will, on average, remain positive but low, although a plausible case can be made for either deflation (akin to Japan in the 1990s) or a surge in inflation.

Figure 1. **Consequences of policy change in developed markets (DMs) and emerging markets (EMs)**



For illustrative purposes

Figure 2. Available asset classes

Fixed income	Derivatives	Equities	Alternative beta	Others
Government bonds	Mortgage-backed securities	Large cap	Reinsurance	Hedge funds
Corporate bonds	Commercial mortgage-backed securities	Small cap	Commodities	Private equity
Floating rate note	Delta gamma	Emerging market	Loans	Global property
Linkers	Swap		High yield	Infrastructure
Municipal bonds	Swaption		Emerging market debt	Gold
	Equity derivative		Emerging market currency	Timber

REVO – user control of the ESG

To use an ESG for strategy setting, users need to be able to control and buy in to the results. The STAR library provides considerable flexibility for users to tailor the ESG scenario set to their view of market risk.

First, the model structure and parameters are fully transparent and every line of code is visible. Our clients have the option to view and edit every ESG parameter as well as update the starting yield curves and rates. However, it may often be difficult to control the ESG by individual parameter control since there are over 2,000 parameters driving the ESG, and many of these are deeply embedded in a complex mathematical formulation.

Alternatively, the STAR suite includes the REVO module – an intuitive, easy-to-use tool that our clients use to blend their views into the ESG calibration. REVO works by reweighting the ESG output simulations, transforming the series toward the target view. It is possible to set targets for multiple items across multiple time periods, which is far simpler than adjusting the ESG calibration parameters directly. More importantly, it allows coherent adjustment of the ESG. For example, specifying a view on U.S. equities will automatically adjust returns on the other equity markets and all other economic series.

REVO can be used for multiple tasks. Clients can use REVO to bring expected asset returns into line with their in-house views. Our clients’ forecasted average level of rates and other series is likely to differ from any ESG provider, and REVO offers an easy means to realign the economic series. REVO also supports stochastic stress-test testing, which assesses the impact of user-defined, extreme “what if” scenarios such as a sharp global economic slowdown or a period of stagflation.

Asset return generation

The STAR library contains a broad suite of generic asset class models. These allow clients to model asset returns at any level of granularity, from broad bond or equity indices down to individual securities. Asset returns are explicitly generated from the interest rate, spread and other economic drivers simulated in the ESG, enforcing a strong, driver-based correlation between the assets that would otherwise be lost if links between asset returns were driven purely by correlations.

The asset model strives to generate a realistic assessment of risk. Client assets can be modeled as benchmark indices, through a proxy of reference securities or even as individual securities. Regardless of the level of aggregation, credit risk is modeled at an individual bond level, simulating migrations and defaults for every bond in an index. Migrations are determined with reference to the stochastic transition matrix generated by the ESG. This simulates periods of relatively high and low levels of bond defaults, as has been observed historically. If bond defaults are assumed to be average through time, this generates unrealistically high levels of return when credit spreads widen and does not adequately capture the aggregation of credit losses in stressed economic conditions. The asset model also provides the capability to reflect dynamic reinvestment rules, duration, credit profile and liquidity management.

STAR also models a number of alternative series, including the full range of HRFI series, private equity and commodity indices. These can be tailored to clients’ specific holdings by representing them in terms of their alpha and beta relative to the underlying index. The asset classes available as standard are shown in *Figure 2*.



SAA

We believe investors can be broadly categorized into two camps. In the first case, there are those who expect strong inflows to the fund for a number of years and are able to hold a long-term view of risk. In this instance, the fund is primarily used as a mechanism for allowing flexibility between the timing of receipts and payments. Typically, a high (and stable) allocation to risky assets is adopted in the hope of improving the long-term feasibility of the fund.

In the second group, income bolstering the fund (if any) is dwarfed by payments out or the group has to consider its solvency position. In this case, the aim is to manage the fund to a position where there is a degree of certainty that the obligations will be paid without needing to draw down materially on the available funds. Such funds may be looking to transition to a lower-risk investment policy over time and will need to consider the following three factors:

- **Risk need.** The ability to sustain payments given the available cash flow profile and accumulated funds, and the consequent return target
- **Risk tolerance.** How the risk buffers vary over time given the cash flow profile
- **Risk attractiveness.** The prospective risk/return trade off from all assets

Typically, a high (and stable) allocation to risky assets is adopted in the hope of improving the long-term feasibility of the fund.

The SAA module looks to support the strategic asset decision for both fund types, quantifying the impact of different strategies over a multiyear time horizon. The risk and return characteristics for each strategy can be compared side by side over any time horizon. This is supplemented with an optimization algorithm (if needed) to search for the optimal portfolio given the fund's objectives and constraints. Comprehensive reporting allows risk to be defined in terms of value at risk, tail value at risk, standard deviation, tracking error, shortfall probability or any other measure, since the reports are easily customizable by the user to their individual requirements.

One of the most important features is the flexibility for specifying how the portfolio evolves over time. This can capture the decision to hold assets to maturity to potentially maximize taxation and accounting advantage, apply liquidity constraints to prevent assets being sold and reflect static decisions to evolve the risk profile. The portfolio management can even be extended to implement dynamic rules for changing the asset allocation to take tactical advantage of market mispricing or to purchase additional downside protection when the available funding is constrained.

Licensing issues

The STAR suite is provided under an annual license with the following components:

Standard components

- One user Igloo Express run time
- STAR library – ESG projection modules, asset modules and portfolio risk modules
- STAR ESG calibration files (quarterly, semiannually or annually)
- Documentation – up to actuarial and regulatory standards
- Training – two days per annum inclusive

Optional components

- STAR SAA module
- STAR REVO module
- Additional training
- Tailored implementation and model development

Further information

For further information, please contact your local Willis Towers Watson consultant or email software.solutions@willistowerswatson.com.



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