AXA IM Glide Path: Efficient and flexible design towards retirement

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Key points

- The shift from DB to DC plans is a major trend in global pension markets. Target-date strategies, the default investment solution for most DC plans, will be subject to heavier saver protection regulations and will be expected to meet an increasing need for individual customisation. An efficient 'glide-path optimiser' should be flexible enough to incorporate these factors.
- AXA IM's multi-period optimisation model is a response to this. It integrates regulatory and individual factors into a capital market simulation engine. The resulting investment solutions are designed to offer investors an optimal balance between portfolio diversification, changing risk profiles and outside constraints.
- Under this new framework, we can design the optimal glide paths for different risk profiles. Each of them will seek to offer the best expected wealth at retirement while controlling the risk of principal loss.
- An investor's risk profile changes over time according to their needs. We believe our glide path solution is a superior answer to this problem compared to the traditional constant-mix.

The changing face of pension markets

Pension schemes are under pressure. Not only have funding ratios been playing catch-up since the global financial crisis, but the triple threat from rising life expectancy, declining birthrates and long-term lower interest rates has made the road back far more difficult. At the same time, the regulatory response to the 2008/2009 crash has quickened the pace at which occupational defined contribution (DC)[1] plans and personal saving plans are gaining prominence over defined benefit (DB)[2] plans across the world. This environment has been reflected by three key responses in the market:

- Risk has been transferred from institutions to individuals (the switch from DB to DC).
- Tax incentives have been used to encourage early, long-term investment through DC plans to participate in economic growth and enhance future retirement income.
- Governments have encouraged the use of voluntary "third pillar" personal-saving schemes to ease the pressure on state pensions and second pillar occupational pensions, and to build up complementary income sources for retirement.

[1] A **Defined Contribution** sees the employer, employee, or both make contributions on a regular basis. Individual accounts are set up for participants and future benefits are based on the amounts credited to these accounts plus any investment earnings.

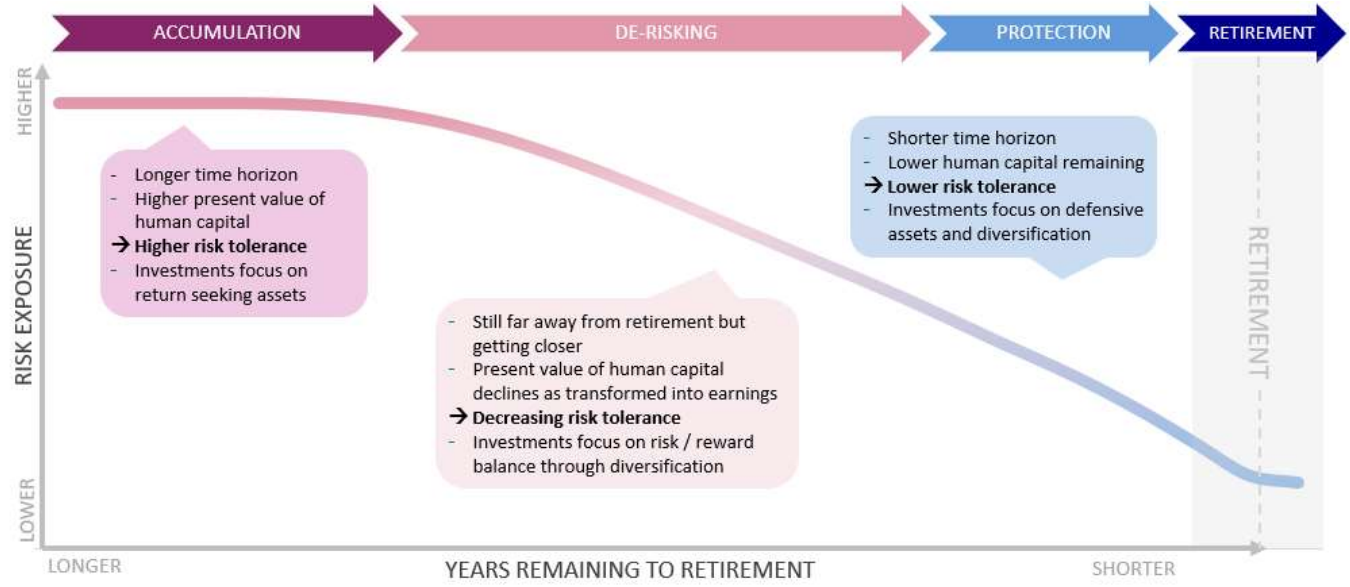
[2] In a **Defined Benefit** pension plan, the employer/sponsor promises a specified pension payment, lump-sum or combination thereof on retirement that is predetermined by a formula based on the employee's earnings history, tenure of service and age, rather than depending on investment returns.

We have seen this trend in recent pension system reforms, including Norway's introduction of a new individual pension scheme in 2017 and France PACTE law in 2019. Outside of Europe, Japan loosened restrictions on individual DC plans in 2017, and China launched its own individual pension reform a year later.

Target-date strategies – widely used but a weak design

Target-date strategies have been used as a default investment option in a majority of occupational DC plans, as well as in some personal plans. They are designed to capture the falling risk tolerance of participants as the "target date" approaches by gradually reducing exposure to risky assets and reallocating to defensive assets according to a pre-optimised de-risking path – or 'glide path' (Figure 1). Solutions can be focused on the pre-retirement part, if the target date corresponds to an investor's retirement date, or focused on the post-retirement part if they have savings objectives beyond retirement. This 'autopilot' solution helps to deal with common investor behavior biases – such as procrastination and status-quo – and has quickly become prevalent in the market.

Figure 1: Target date strategy - glide path design based on investors' needs



Source: AXA IM Quant Lab. For illustrative purposes only.

Nevertheless, compared to the investment solutions for DB plans, the design of target-date strategies is still weak, and lacks normalisation in the market. The design might look straightforward and effective, but behind it lies a multitude of problems:

- What is the investment goal?
- Who is the investor? How can we adapt the solution to meet their personal needs?
- In which country is the solution regulated? How can we make sure all regulatory constraints are satisfied?
- Under all the constraints we have, what would be the long-term optimal asset allocation?

Common practice is to define the correct risk profile for the beginning and end points, and then the de-risking rate. Recent pension reforms also show signs of increasing attention paid to product design, with detailed and precise regulatory constraints to reframe what a good glide path should look like. For example, France's PACTE law defined a minimum exposure to defensive assets with respect to each time horizon, and each risk profile.

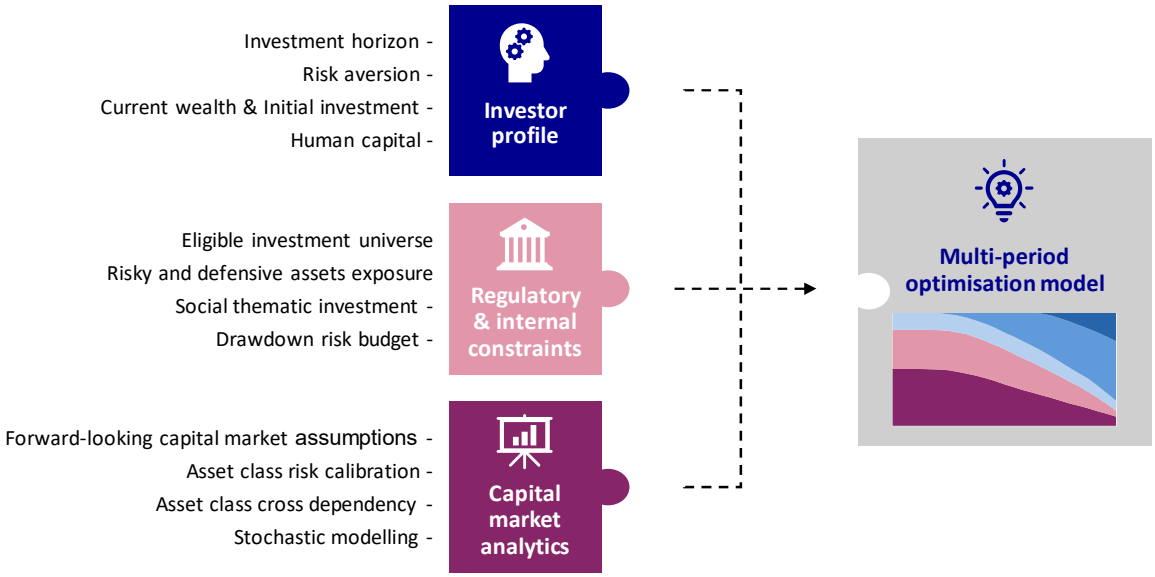
An efficient glide-path optimiser should be flexible enough to incorporate various factors

To address these diverse criteria, we have developed an internal multi-period optimisation model. The model is flexible enough to incorporate complex regulatory and internal investment constraints, alongside investor-profiling elements such as investment horizon, risk aversion, current financial capital, and human capital (the present value of expected future income). Based on these profiling elements, we can quantify an investor's risk tolerance, assess their overall risk profile, and their evolving risk profile over time.

These constraints are inputs to our capital market simulation engine, used to solve the final optimal glide path, as illustrated in Figure 2. The strategic allocations at each point in the glide path are not necessarily the optimal ones in each specific period. However, the path seen in its entirety is an

optimal solution for the whole investment horizon, balancing between portfolio diversification, an investors' profile and external constraints.

Figure 2: A flexible and robust optimisation engine allows to incorporate various factors into consideration



Source: AXA IM Quant Lab. For illustrative purposes only.

In this paper, we focus on the "To" glide path leading up to a retirement date to demonstrate how the multi-period optimisation model works. The investment goal of a "To" solution is to accumulate as much capital as possible for retirement while minimising the loss of principal, according to an investor's risk profile.

Efficient frontier: Designing the glide path for a range of risk profiles

The efficient frontier concept developed in modern portfolio theory[3] can be extended to multi-period optimisation for glide path design. Instead of showing the best return portfolios on the efficient frontier for each volatility or VaR (value-at-risk) level, we present the optimal glide paths on the efficient frontier, in terms of a customised pair of risk/return indicators defined below:

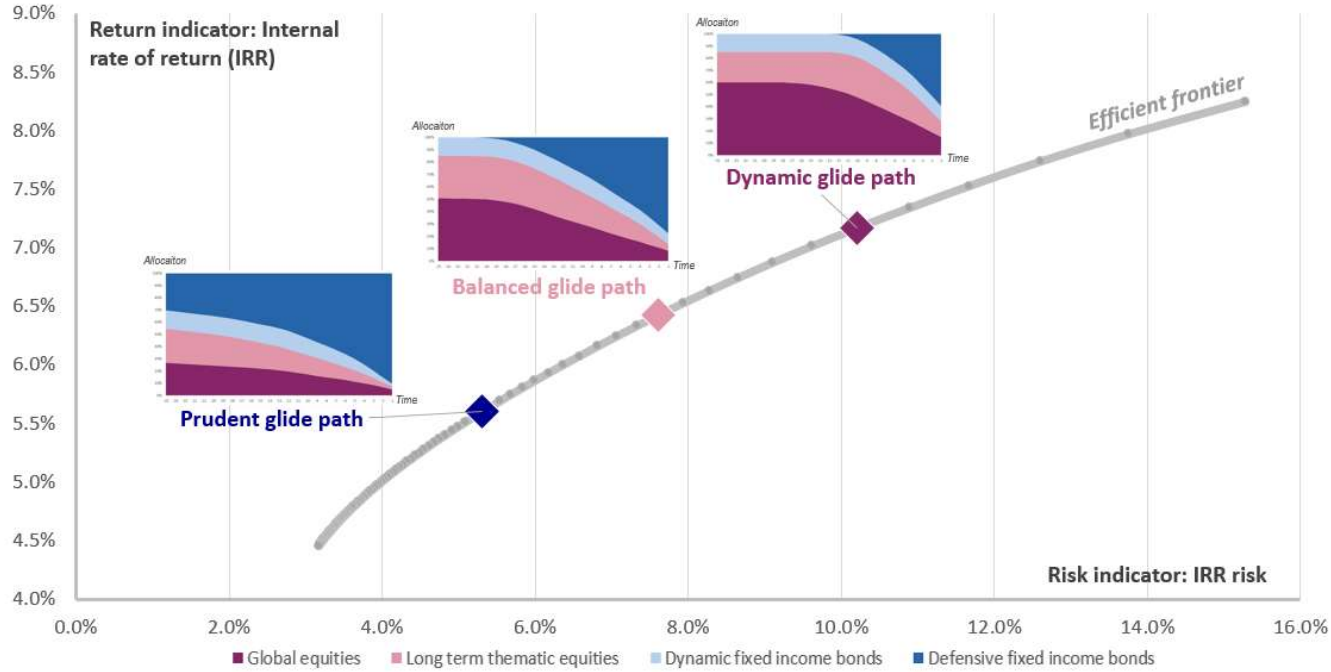
- Return indicator: Internal Rate of Return (IRR). The annualised return assuming regular premium investments during the whole period.
- Risk indicator: IRR risk, a proprietary time-weighted risk measure taking the dynamics of the accumulated capital into account during the whole investment horizon.

Investors with a higher risk profile can choose to invest in a glide path that offers higher expected IRR and IRR risk. This optimal investment solution will be more concentrated on risky assets compared to a solution with a lower risk/return profile, the de-risking starting point is also later so that the investment can benefit from longer risk premium accumulation. We selected three optimal glide paths on the efficient frontier, named Prudent, Balanced and Dynamic, to illustrate how risk profiles would affect asset allocations in each case (Figure 3).

We can translate the glide path indicators to traditional ones by observing the annual return and volatility of each allocation on the glide path. Figure 4 illustrates the logic of consistency behind our glide path construction - the glide paths with higher risk profiles display higher volatilities and higher expected returns over time than glide paths with a lower risk profile.

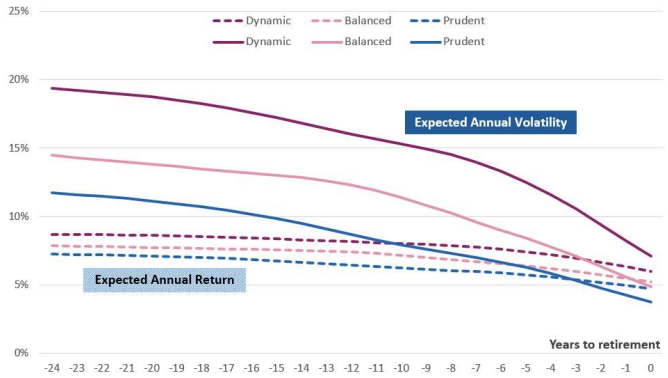
[3] The efficient frontier is the set of optimal portfolios that offer the highest expected return for a defined level of risk or the lowest risk for a given level of expected return. Portfolios that lie below the efficient frontier are sub-optimal because they do not provide enough return for the level of risk. Portfolios that cluster to the right of the efficient frontier are sub-optimal because they have a higher level of risk for the defined rate of return. The efficient frontier theory was introduced by Nobel Laureate Harry Markowitz in 1952 and is a cornerstone of modern portfolio theory.

Figure 3: Glide paths' efficient frontier



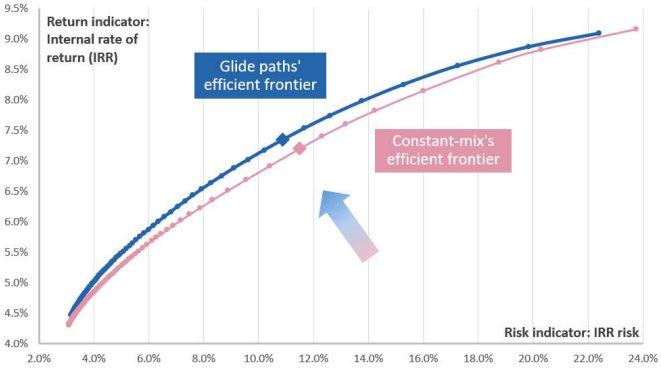
Source: AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal optimisation and simulation tool. The reference interest rate curve used is the USD swap curve as of Q4 2019. For illustrative purposes only.

Figure 4: Selected optimal glide paths' annual risk and return evolution over time



Source: AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal optimisation and simulation tool. The reference interest rate curve used is the USD swap curve as of Q4 2019. For illustrative purposes only.

Figure 5: Static constant-mix is not an optimal solution for this problem



Source: AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal optimisation and simulation tool. The reference interest rate curve used is the USD swap curve as of Q4 2019. For illustrative purposes only.

As explained above, even though each investor has an overall risk profile during the life cycle (such as Prudent, Balanced or Dynamic), this risk profile is not constant over time. It is a combined function of the time horizon, financial and human capital, and the investor's specific risk aversion at each time point in the glide path. Traditional static constant-mix solutions tend to offer sub-optimal efficient frontier under same constraints.

Structuring an optimal glide path

The mix between risky and defensive assets is affected by market factors and by an investor's individual needs:

Investment horizon: Younger investors should have a higher risk profile, and therefore more exposure to risky assets. This is because they expect more human capital (future labour income) than older investors, which gives them a greater ability to take risk at the beginning of their career.

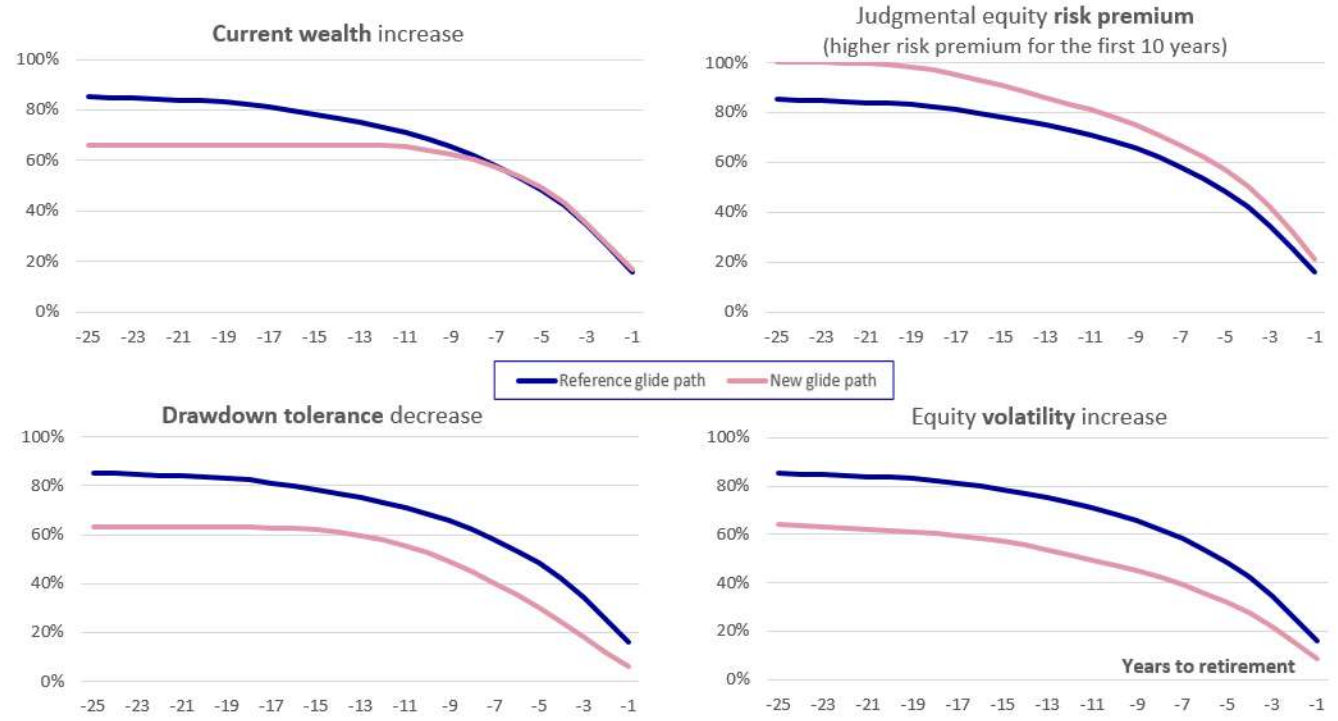
Current wealth and future regular premiums: The portion of risky assets will be lower if current wealth is high compared to future income. Similarly, higher future income, and thus higher regular premiums, will lead to a greater acceptance of risk.

Risk aversion: This measures investors' willingness to take risk, and includes assessing an investor's drawdown tolerance – the maximum loss allowed by the investor over a certain time period.

Market asset volatility and risk premiums: Higher risk premiums for risky assets make them more attractive than other assets. If their volatility increases, the portion in an optimal solution will decrease as the Sharpe ratio[4] drops.

Asset class correlations: Higher correlation impedes the diversification benefit among asset classes under the same risk profile. The portion of capital that can be invested in risky assets will decrease.

Figure 6: A glide path's exposure to risky assets is altered when one of the underlying parameters changes



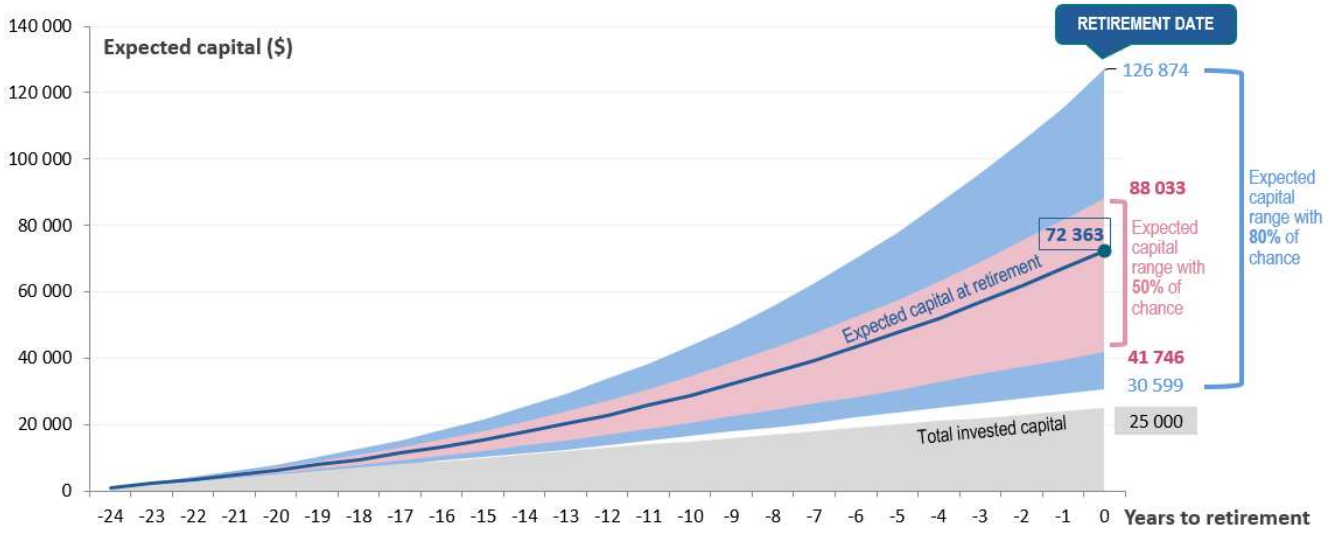
Source: AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal multi-period optimisation tool. For illustrative purposes only.

Our goal: Maximise the expected capital while minimising loss at retirement for all risk profiles

Our capital market simulation tool is a proprietary economic scenario generator based on our forward-looking capital market views. It can simulate the prospective behaviour of a large universe of assets, taking into account their dependence structure. Using this tool we can display how the proposed solution would perform over time and how much capital would be available at retirement, with a certain confidence level. The expected wealth at retirement, worst-case loss, and probability of reaching a wealth target are typical indicators that are helpful to investors.

[4] The Sharpe ratio measures the performance of an investment (e.g. a security or portfolio) compared to a risk-free asset, after adjusting for its volatility.

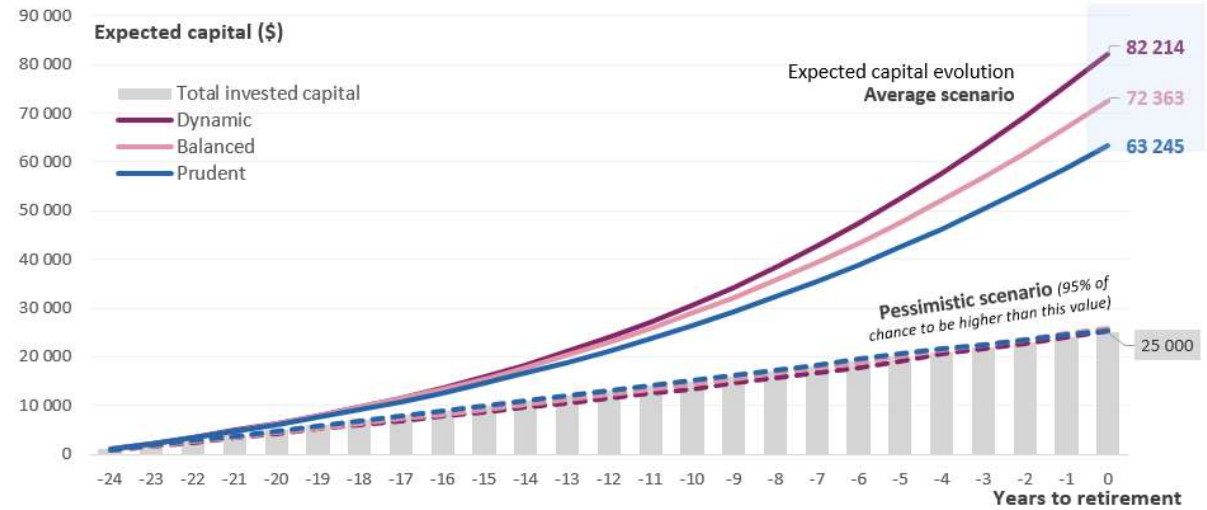
Figure 7: Balanced glide path - the evolution of expected capital over an investment horizon



Source AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal simulation tool, assuming annual premium of 1000$. The reference interest rate curve used is the USD swap curve as of Q4 2019. For illustrative purposes only.

Beyond regulatory and individual factors, we also include risk mitigation at retirement in the glide path design principles. We believe it is important to control the principal loss risk, regardless of risk profile. To this end, we define a risk measure to be carefully controlled for all the risk profiles we propose to end-investors, in collaboration with plan sponsors or advisers. A common approach is to use the 95% VaR as a pessimistic scenario. Figure 8 illustrates that the Dynamic glide path tends to offer higher expected capital at retirement than the Prudent, however the pessimistic scenario at retirement for each risk profile is not significantly different, and they are all higher than the principal value.

Figure 8: The evolution of expected capital (average scenario) and pessimistic scenario over time



Source AXA IM Quant Lab. Prospective analysis over 25 years horizon based on AXA IM internal simulation tool, assuming annual premium of 1000$. The reference interest rate curve used is the USD swap curve as of Q4 2019. For illustrative purposes only.

Bottom line

In the long run, we believe the shift from DB to DC plans will remain a major trend in global pension markets. Pension product design will be subject to heavier saver protection regulations, and will be expected to meet increasing demand for individual customisation. How to address these complex issues in a straightforward manner will be a key concern for solution designers. Our flexible multi-period optimisation model is a response to that. It integrates regulatory and individual factors into a capital market simulation engine to create investment solutions that seek an optimal balance between portfolio diversification, changing risk profiles and external constraints. Our goal is to create a model that responds best to investors' needs.

Our Research is available on line: http://www.axa-im.com/en/insights

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