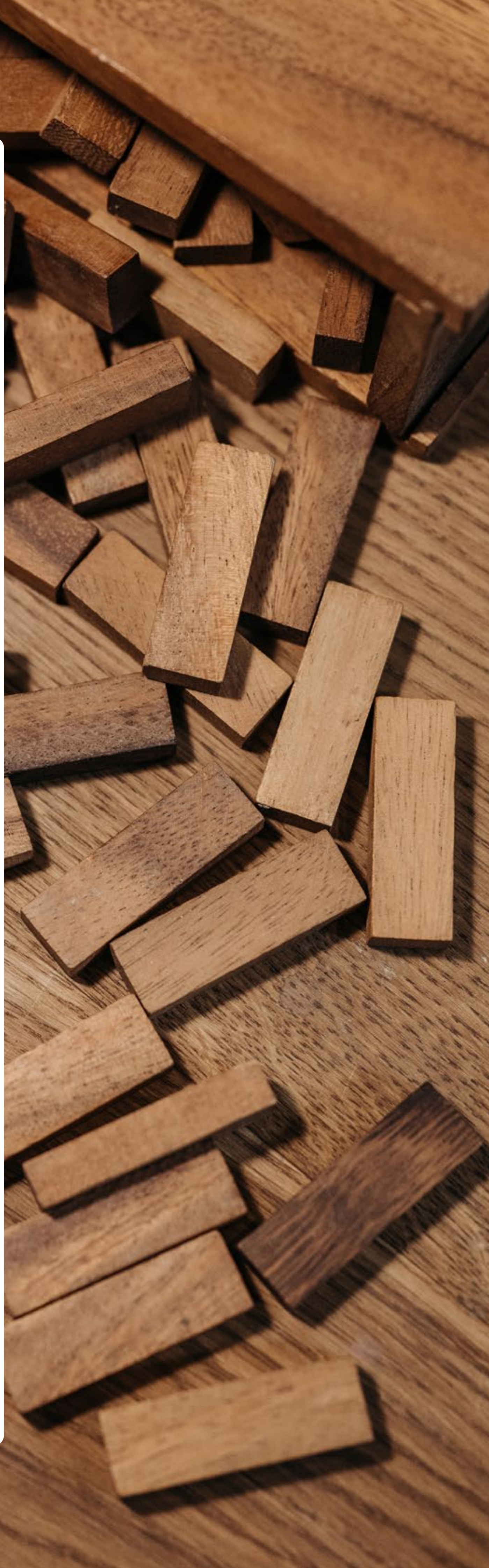
CANDRIAM
A NEW YORK LIFE INVESTMENTS COMPANY

Portfolio Insights

Introducing illiquid assets into a global multi-asset portfolio

Olivier Clapt
Head of Multi-Asset
Quantitative Research

FEBRUARY 2022



About the author

Olivier Clapt

Head of Multi-Asset Quantitative Research

Olivier Clapt, has been Head of Multi-Asset Quantitative Research at Candriam since 2019.

He began his career as a quantitative analyst at Dresdner Kleinwort Benson, focusing on equity derivatives. In 1999 he joined Candriam as quantitative analyst dedicated to alternative investment, and in 2010 became Head of Alternative Investment Quantitative Research.

Olivier is graduated from the Institut National des Sciences Appliquées (INSA, Rouen), with a specialization in Applied Mathematics.

Table of contents

Executive Summary

We demonstrate the building blocks for investors who may either be considering allocating to illiquid assets for the first time, or who want to gain a greater understanding of how much capital they should invest in illiquid assets.

For long-term investors, there are multiple benefits of introducing illiquid assets into an investment portfolio. These include an **expanded investment opportunity set, improved diversification** and a **lower equity beta**, **greater potential return** in comparison to listed assets, and a potential **inflation hedge** in the case of real assets. Moreover, during periods of market turmoil, illiquid asset classes may avoid some of the downside price pressures.

However, **sizing the optimal share of investments in illiquid assets can be quite challenging**. To address the allocation sizing, we show the results of a simple Mean-Variance framework and describe some adjustments to make its results more robust. Nevertheless, determining an appropriate portfolio allocation in a particular instance means **having a view on expected returns**, **considering uncertainty**, accessing **hidden risks,** and understanding an **investor's individual constraints and objectives**. We demonstrate one method of addressing the concern of infrequent valuation data.

Relying on our own market return projections as a first scenario, we show that from an European investor's perspective **adding illiquid assets significantly improves the portfolio's risk-adjusted return**, not only by providing an extra source of return, but also by mitigating the overall portfolio's risk (*volatility*, *VaR*, *CVaR*).

Expanding to encompass different risk scenarios, we present conservative, balanced, and aggressive risk profiles and find that the optimal share of investments in illiquid assets lies between 5-25%.

I. Distinctly different investments need a distinctly different approach

Illiquid assets offer several benefits to long-term investors when included in a broader investment portfolio. Some key benefits include:

- **Larger investment opportunity set,**
- **Better diversification/lower equity beta,**
- **Greater potential value added compared to listed markets, and**
- **Inflation hedge potential, in the case of real assets.**

Yet **determining the appropriate allocation to illiquid assets can be challenging**. There is no clear consensus on an asset allocation model which can both incorporate the specificities of illiquid assets and accommodate individual investor preferences.

To address the issue of allocation, we adapt the classic mean-variance framework. Nevertheless, determining an appropriate portfolio allocation should be informed by a few considerations: **having a view on expected returns, taking uncertainty into account, accessing hidden risks**, and understanding the **investor's specific objectives and constraints**.

Data availability is an additional complexity for illiquid assets. The **lack of data** for the main risk drivers, the **absence of well-recognized benchmarks**, the **heterogeneity of return indicators** (*Internal Rate of Return vs Total Return*), the valuation method of the benchmark (*appraisal-based vs transactions-based*), all **increase the challenge of modelling illiquid assets**.

The first task is to gather relevant indices from different providers in order to **propose one of the most detailed classification of illiquid assets** by asset class and region.

We demonstrate our approach to illiquid assets data challenges, in particular, **low-frequency data and artificially smooth returns**, which **cause underestimation of the variance of returns (risk)** and may also produce an **irrelevant correlation matrix** if the data are not properly adjusted.

II. How should investors determine an allocation to illiquid assets?

Sizing the optimal share of investments in illiquid assets is quite challenging, since there is no clear consensus on an asset allocation model capable of incorporating the several unique characteristics of illiquid assets and aligning with investor preferences.

We rely on the classic mean-variance framework[1] to generate a range of optimal weights. This approach benefits from relative simplicity and wide acceptance. To make our approach relevant to illiquid asset classes, we made four adaptations:

• We developed robust volatility and correlation estimates of illiquid asset volatilities to generate the correlation matrix, as detailed subsequently.

• Asset volatility was adjusted for tail risk (*negative skew*) using our internal model.

• A maximum weight constraint for illiquid assets was incorporated in the mean-variance optimization (MVO).

• Uncertainty of expected returns was accounted for through a resampling technique[2] to develop a more diversified optimal portfolio.

We focus on the Hedge Funds, Private Equity, Private Debt, and Real Estate asset classes in addition to traditional asset classes (*equities and bonds*) to demonstrate our results. The expected return and volatility matrix is presented from the perspective of a European investor, but figures can be easily adjusted for all investor types. We applied an investment horizon of ten years.

Figure 1: MVO Model Assumptions

Expected return assumptions by asset class, as of 21 Dec 2021

	Asset Classes	10 Y expected returns	Vol10Y proxy
TRADITIONAL	Equities US	4.26%	MSCI USA Net TR EUR Index
	Equities EMU	6.60%	MSCI EMU Net TR EUR Index
	Equities EMG	8.91%	MSCI Emerging Markets Net TR EUR Index
	Equities Europe ex-EMU	8.54%	MSCI Europe ex EMU Net TR EUR Index
	Equities Japan	4.32%	MSCI Japan Net TR EUR Index
	Govies Europe	-0.07%	ICE BofAML 1-10 Year Euro Gvt Index
	Govies US Hedged EUR	0.59%	J.P. Morgan BGI US TR Index Hedged Euro
	Credit IG Europe	0.70%	ICE BofAML 1-10 Year Euro Corporate TR Index
	Credit IG US Hedged EUR	1.49%	Barclays US Corporate TR Index Value Hedged EUR
	Credit HY US Hedged EUR	1.98%	Barclays US High Yield 2% Issr Cap TR Index Value Hedged EUR
	Credit HY Europe	1.37%	ICE BofAML BB-B Euro High Yield Constrained Index
	EM Debt (HC) Hedged EUR	2.92%	J.P. Morgan EMBI Global Diversified Hedged EUR
ILLIQUID	Hedge Funds	3.75%	HFRX Global Hedge Fund EUR Index
	Private Equity Europe	10.00%	**Candriam proxy**
	Direct Lending Europe	4.75%	**Candriam proxy**
	Real Estate Europe	5.25%	**Candriam proxy**

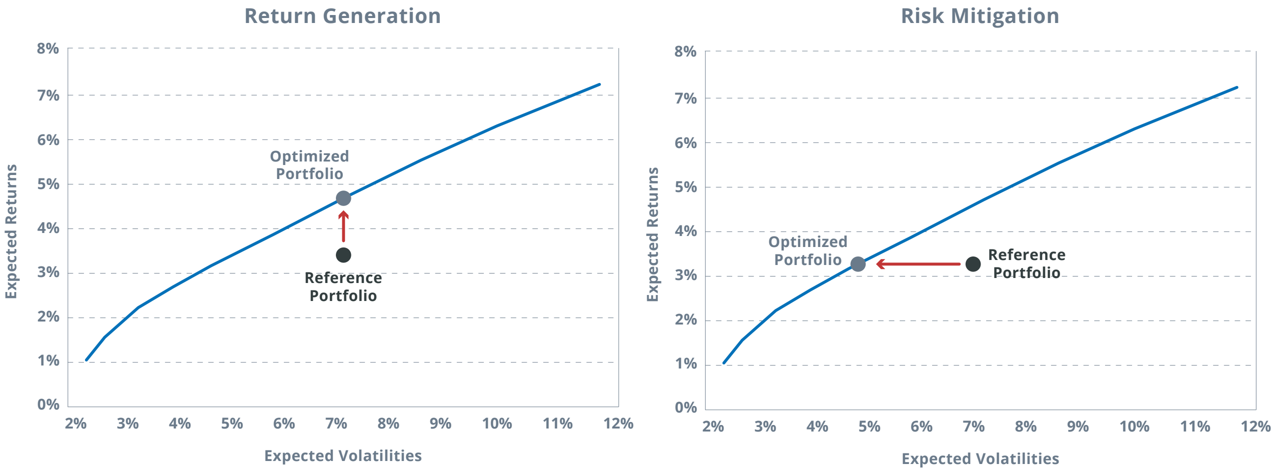
Source: Candriam, as of December 2021.

The quantified objective presented in this document is based on the achievement of market hypotheses set by Candriam and does not constitute in any case a guarantee of future returns or performance.

For our scenarios, we use expected return projections from Candriam's Strategic Asset Allocation Committee. The expected return assumptions for the traditional asset classes are updated monthly, incorporating both macroeconomic forecasts such as GDP growth, and financial variable forecasts, such as expected equity dividend yields. The expected return assumptions for *illiquid* assets combine our internal expertise plus an external expertise. That is, we combine expected return assumptions from our internal Multi-Management Team with those of our strategic partners Kartesia and Tristan, who are leading specialists in Private Debt and Real Estate.

Mean-Variance Optimization (MVO) results are shown for two different goals, **Return Generation**, where the portfolio's return is improved while maintaining the same risk budget, and **Risk Mitigation**, in which the portfolio's volatility is minimized while maintaining a single specific return target.

Figure 2: Schematic (Theoretical) Representation of Return versus Risk Optimization models



Source: Candriam

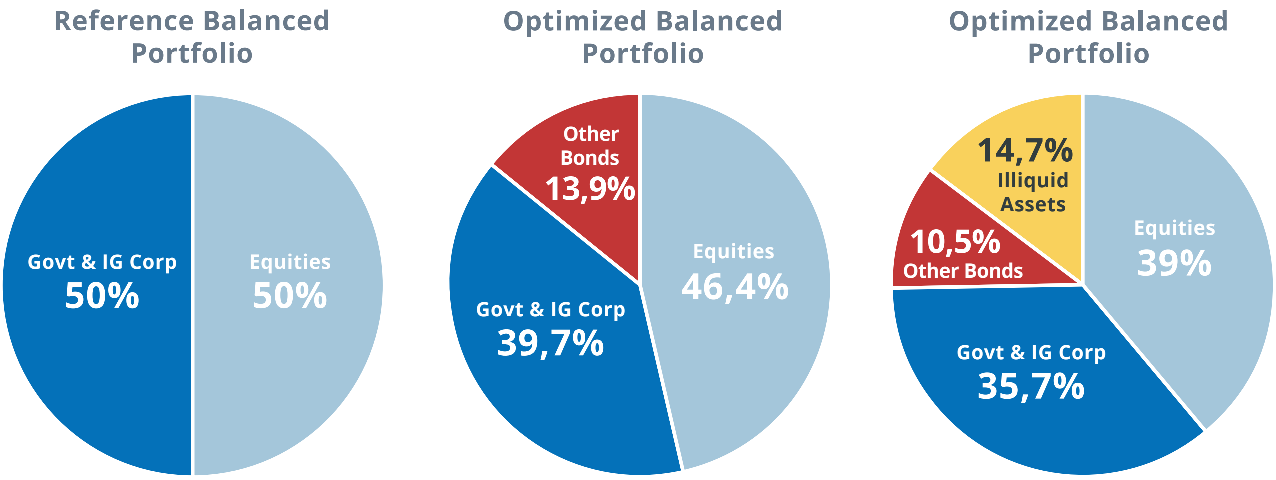
The quantified objective presented in this document is based on the achievement of market hypotheses set by Candriam and does not constitute in any case a guarantee of future returns or performance.

For a base case, we use a balanced portfolio of *50% equities and 50% bonds* as the reference portfolio. We define this as **equities equal *50%*** ** (40% MSCI USA + 20% MSCI EMU + 20% MSCI Europe ex EMU + 15% MSCI EM + 5% MSCI JP)* ***plus bonds equal 50%*** ** (65% Bloomberg Barclays Euro Government 1-10Y + 35% Bloomberg Barclays Euro Corporate 1-10Y)*.

We expand this universe first, with "**other bonds**" (High Yield bonds and Emerging debt) and next, with both "**other bonds**" and **alternative assets** (*Hedge Funds, Private Equity, Direct Lending, and Real Estate*). Figure 3 clearly demonstrates how the introduction of illiquid asset classes significantly alters the composition of the optimized portfolio – in this scenario, the optimal share of illiquid assets is around 15%. Consequently, the **introduction of illiquid assets can help to diversify equity risk, which tends to dominate the risk sources within the reference balanced portfolio**.

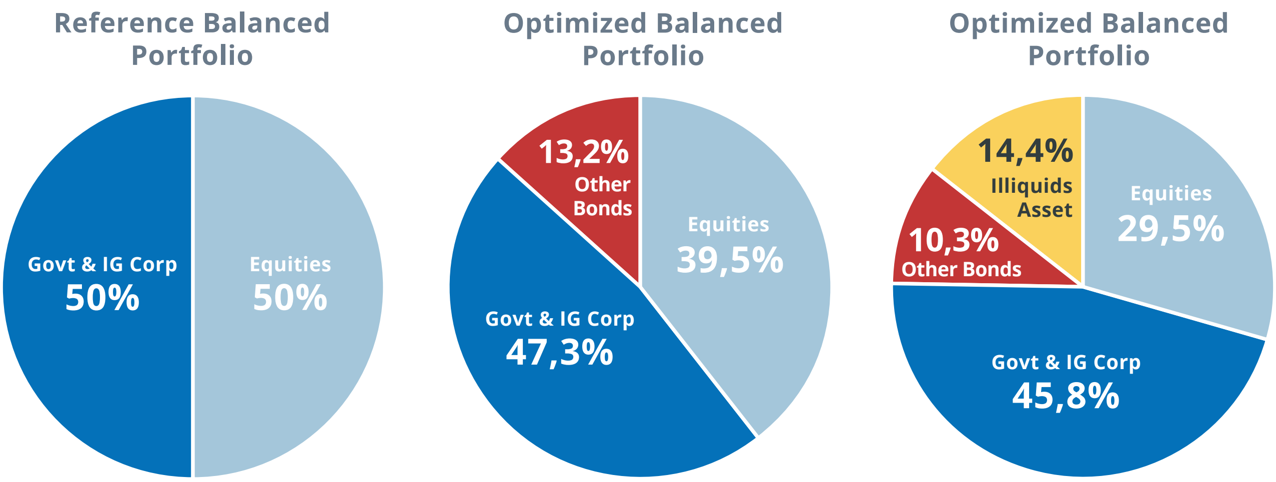
Figures 3a and 3b also imply that whether optimizing return or risk mitigation, the portfolio mix is enhanced by the addition of illiquid assets (and, of course, 'other bonds').

Figure 3A: MVO – Return Generation Portfolio Allocation



Source: Candriam (as of 21 Dec 2021)

Figure 3B: MVO – Risk Mitigation Portfolio Allocation

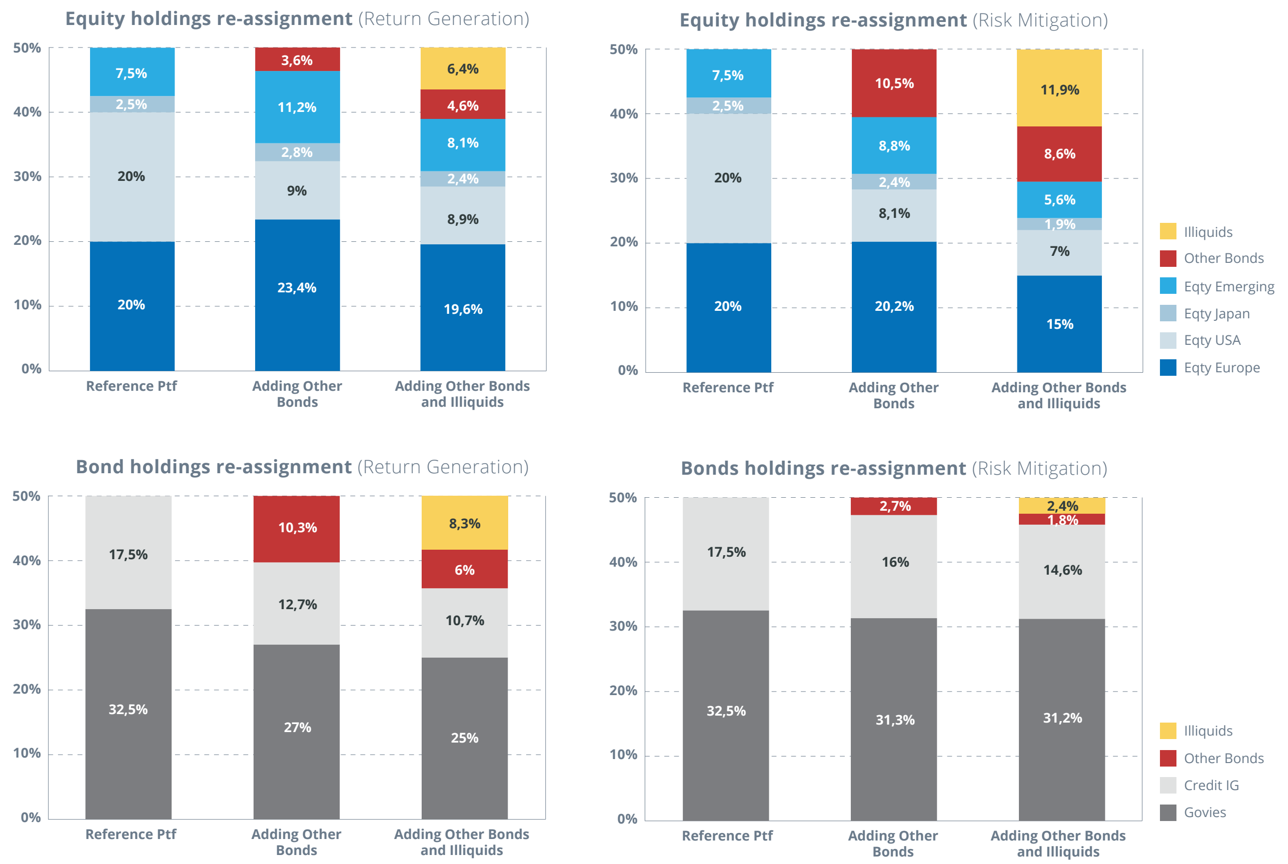


Source: Candriam

The risk mitigation optimization (Figure 3B) illustrates a striking reduction in equity holdings, replaced in this scenario by the addition of other bonds and illiquid assets.

Figure 4 details the breakdown of each optimization, and shows the reallocation of equity and bond holdings and sectors within each of these two asset classes from the reference portfolio.

Figure 4: Reference Portfolio Optimization – Detailed Asset Allocation



Source: Candriam

To illustrate the strength of the value added by integrating illiquid assets, in Figure 5 we first optimize **return generation**, holding volatility constant, then optimize for **risk mitigation**, holding return constant.

When we constrain for a specific level of risk, here a target of expected volatility of 7.02%, and optimize the return, the results show that **allocating 14.7% of the portfolio to illiquid assets improves portfolio return by 17 bps** when compared with the optimized portfolio without liquid assets (*from 3.75% up to 3.92%*).

Figure 5A: Optimized Portfolio – Projected Return Scenarios

Basic metrics	Reference Portfolio	Optimized Portfolio excluding Illiquids	Optimized Portfolio with Illiquids
Expected Return 10Y	3.24%	3.75%	**3.92%**
Volatility 10Y	**7.02%**	**7.02%**	**7.02%**
VaR @95% 1M	2.70%	2.91%	**2.60%**
CVaR @95% 1M	4.48%	4.52%	**4.22%**

Source: Candriam (as of 21 December, 2021)

The quantified objective presented in this document is based on the achievement of market hypotheses set by Candriam and does not constitute in any case a guarantee of future returns or performance.

When we target expected return, here 3.24%, and optimize for risk mitigation, the results show that a portfolio allocation of **14.4% in illiquid assets reduce the expected portfolio volatility by 0.28%** when compared with the optimized portfolio without illiquid assets (reduced from 6.21% to 5.93%).

Figure 5B: Optimized Portfolio – Projected Risk Scenarios

Basic metrics	Reference Portfolio	Optimized Portfolio excluding Illiquids	Optimized Portfolio with Illiquids
Expected Return 10Y	**3.24%**	**3.24%**	**3.24%**
Volatility 10Y	7.02%	6.21%	**5.93%**
VaR @95% 1M	2.70%	2.53%	**2.22%**
CVaR @95% 1M	4.48%	4.02%	**3.54%**

Source: Candriam (as of 21 December, 2021)

The quantified objective presented in this document is based on the achievement of market hypotheses set by Candriam and does not constitute in any case a guarantee of future returns or performance.

Further, the introduction of illiquid assets significantly reduces the *Value-at-Risk* (*VaR*), and the *Conditional Value-at-Risk* (*CVaR*) of both optimized portfolios, demonstrating the ability of illiquid assets to provide some downside risk protection. In particular, during periods of market turmoil, while panicked investors may rush to sell listed assets and drive prices down, private assets may avert some of the downside price pressures that result from liquidation.

The optimal weights of alternative assets for both optimization scenarios are shown in Figure 6. In both cases, the optimizations allocate more than 3% each to Hedge Funds, Private Equity, and Direct Lending. Allocations to Real Estate are also positive, but lower because Real Estate is penalized by its higher volatility (higher autocorrelation and higher tail risk).

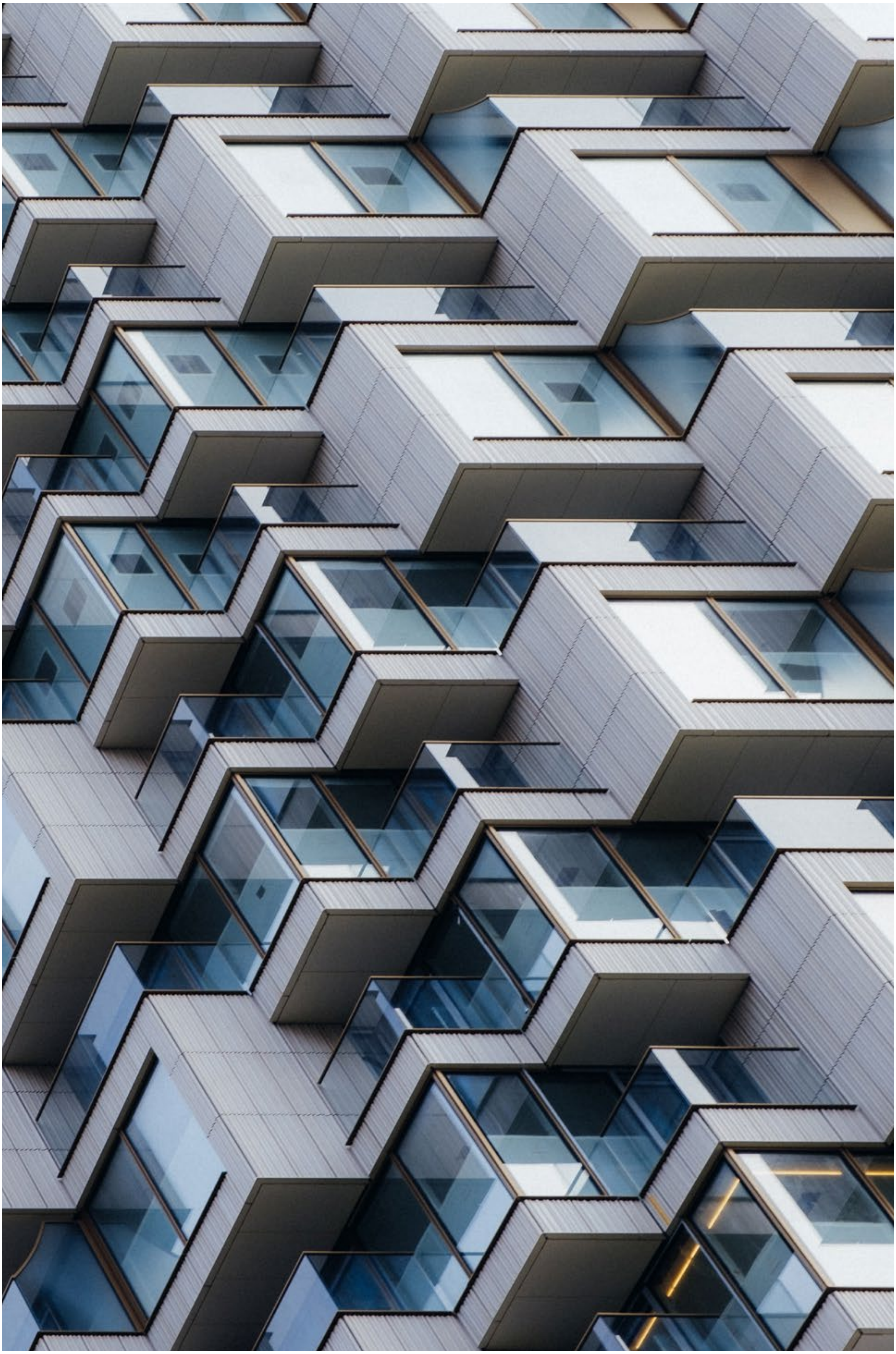
Figure 6: Each Illiquid Asset Class Modelled Enhances Risk and Return

Asset	Optimized Return Portfolio Allocation to Illiquid Assets	Optimized Risk Mitigation Portfolio Allocation to Illiquid Assets
Hedge Funds	3.8%	3.6%
Private Equity Europe	3.3%	3.2%
Direct Lending Europe	6.3%	6.3%
Real Estate Europe	1.3%	1.3%

Source: Candriam

Because expected returns are a key input in Mean-Variance Optimization, and because it is quite difficult to quantify precisely even the historical volatility of illiquid assets, we examine how positive or negative tilts in expected returns and volatilities may alter the MVO results.

Continuing with the same reference portfolio (a balanced portfolio of *50% equities and 50% bonds*), we test whether the optimal share of investments in illiquid assets is significantly impacted when tilting expected returns and volatilities.



The grid in Figure 7 displays the impact on the capital allocated to alternative assets when we stress our model assumptions, either in terms of expected returns (+100bp, -100bp, unchanged), or in terms of expected volatilities (+25%, -25%, unchanged), while expected return and volatility of traditional asset classes are remained unchanged. Results are shown from a return generation optimization process.

Figure 7: Sensitivity to Volatility and Return Expectations

Balanced profile

		Expected return change								
		-100BP			+0BP			+100BP		
		Volatility change			Volatility change			Volatility change		
	Assets	**-25%**	**0%**	**+25%**	**-25%**	**0%**	**+25%**	**-25%**	**0%**	**+25%**
ASSET BREAKDOWN	Hedge Funds	2,8%	2,8%	2,6%	3,5%	3,8%	3,0%	4,6%	4,1%	3,7%
	Private Equity	5,4%	3,2%	2,4%	5,5%	3,3%	2,7%	5,3%	3,7%	2,8%
	Direct Lending	6,7%	5,6%	4,4%	6,9%	6,3%	5,1%	7,0%	7,4%	5,8%
	Real Estate	1,5%	1,3%	1,2%	1,5%	1,3%	1,2%	1,5%	1,3%	1,2%
	Total Illiquid Assets	**16,4%**	**12,9%**	**10,6%**	**17,5%**	**14,7%**	**12,0%**	**18,4%**	**16,4%**	**13,6%**
	Equities	40,4%	40,0%	39,7%	40,2%	39,0%	38,4%	40,0%	38,3%	37,3%
	IG Bonds	33,9%	36,9%	39,2%	33,3%	35,7%	38,8%	32,4%	35,1%	38,3%
	Other Bonds	9,3%	10,2%	10,6%	9,0%	10,5%	10,7%	9,2%	10,2%	10,8%
Δ RETURNS & RISKS	Δ (ER10Y)	0,8%	0,5%	**0,3%**	1,0%	0,7%	0,4%	**1,2%**	0,9%	0,6%
	Δ (VaR @95% 1M)	0,0%	-0,1%	-0,1%	0,0%	-0,1%	-0,2%	0,1%	-0,1%	-0,2%
	Δ (CVaR @95% 1M)	-0,1%	-0,2%	-0,3%	-0,1%	-0,3%	-0,4%	-0,1%	-0,3%	-0,4%

Source: Candriam (as of 21 December 2021)

The quantified objective presented in this document is based on the achievement of market hypotheses set by Candriam and does not constitute in any case a guarantee of future returns or performance.

The results show that for any combinations of tilts, **portfolio return when illiquids are included is always higher than for the reference balanced portfolio** (positive ER10Y differences), and **VaR and CVaR are reduced for both portfolios** (negative differences). Further, optimal weights in illiquid assets are quite consistent, between more than 10% in the worst scenario (*ER-100bp, Vol+25%*), to almost 20% in the best scenario (*ER+100bp, Vol-25%*).

III. Data collection

Analysing illiquid investments raises another concern for investors, that is, data availability, collection, and consistency. Identifying data for illiquid asset classes remains a well-documented difficulty, requiring treatment for inherent biases (back-filling and survivorship bias).

Several elements increase the challenge in modelling illiquid assets:

- The **lack of data** representing the main **risk drivers**
- The absence of well-recognized **benchmarks**
- The **heterogeneity of return indicators** (Internal Rate of Return vs Total Return)
- The **index valuation** (appraisal-based vs transactions-based)
- **Infrequent pricing** and the scarcity of available datasets

All these specificities make it very challenging to model illiquid assets. For these reasons, identifying data for illiquid asset classes remains a well-documented difficulty, requiring treatment for inherent biases.

Because the starting point for any statistical analysis and model development is the definition of appropriate time series data, our first hurdle was to gather relevant indices from different providers (such as MSCI, Preqin, Edhec, Cambridge Associates, Cliffwater, etc). Figure 8 outlines these indices by asset class and region.

Figure 8: Alternative indices by asset class and region

	Global	US	Europe	Asia-Pacific
Direct Lending	1. PrEQIn Private Debt Index	1. Cliffwater Direct Lending Index (CDLI)		
Private Equity	1. PrEQIn Private Equity Index 2. PrEQIn Buyout Index	1. Cambridge Associates US PE Index (de-smoothed)		
Infrastructure	1. MSCI Global Quarterly Private Infrastructure Index 2. PrEQIn Infrastructure Quarterly Index			
Infrastructure Equity	1. EDHEC Private Infrastructure Equity Index (INFRA300)			
Infrastructure Debt	1. EDHEC Private Infrastructure Debt Index			
Real Estate Equity		1. NCREIF NPI (NPPITR) 2. NCREIF OCDE (NPPIOCDE) 3. NCREIF OE 4. MSCI US Quarterly Property Index 5. MSCI/PREA US ACOE Quarterly Prosperty Fund Index	1. MSCI Continental Europe 2. MSCI US Pan-European Property Fund Index (PEPFI) 3. INREV	1. ANREV All Funds Index 2. MSCI Asia Annual Property Index
Real Estate Debt		1. Giliberto-Levy Commercial Mortgage Performance Index (G-L 1) 2. Giliberto-Levy High Yield CRE Debt Index (G-L 2)		
Natural Ressources	1. PrEQIn Natural Ressources Index	1. NCREIF Timberland TR Index (TMBERLND) 2. NCREIF Farmland TR Index (TMBEFARM)		

Source: Candriam

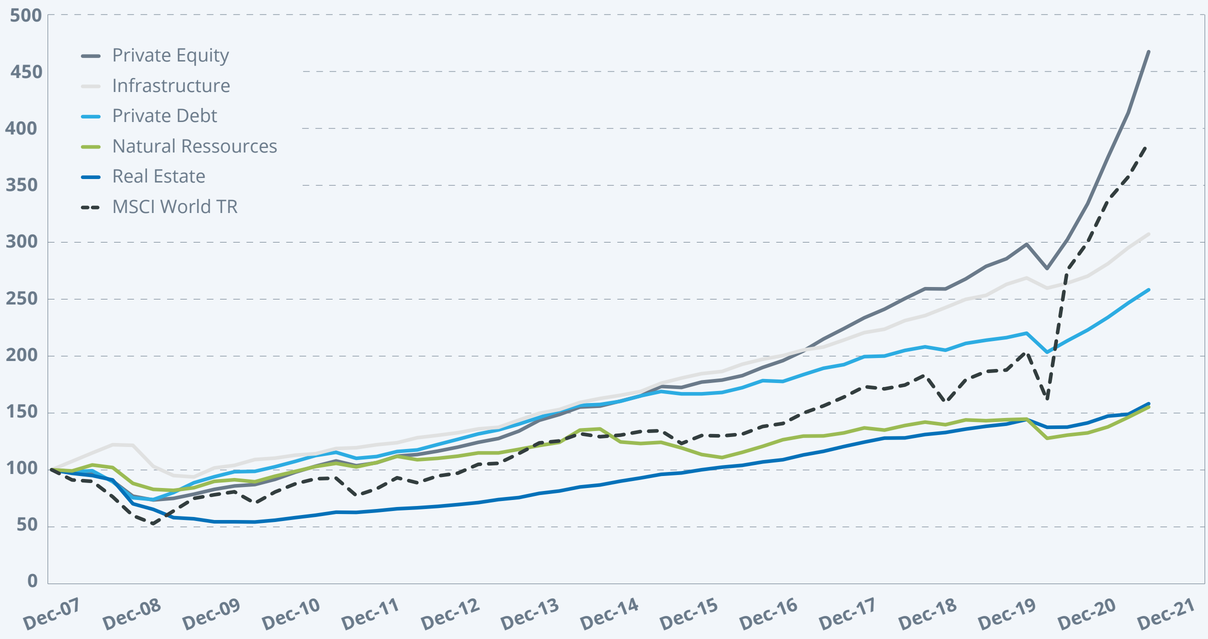
The figure demonstrates the difficulty in finding relevant indices for each asset class, especially in certain regions. For our study we have used indices from *Preqin* because the ability to source data for the main indices (private equity, private deb, infrastructure, real estate, natural resources) from the same provider offers some level of consistency of method. Moreover, the time series have a long track record which allows us to more accurately estimate the different risk indicators for each asset class (the starting date is Dec 2007).

IV. Data adjustments

The growing interest in illiquid assets means that allocators must carefully evaluate its risk and return.

The challenge is that modelling illiquid assets is not straightforward, due to a lack of high-quality data and artificially smooth returns, as illustrated by the monthly data shown in Figure 9. For asset allocation purposes, this data issue has to be seriously addressed as it leads to a severe underestimation of the variance of returns and their correlation with other assets.

Figure 9: Private Capital indices (*Preqin*)



Source: Private Capital indices (*Preqin*)

Fortunately, we can rely on statistical methods to "unsmooth" the less-frequent reporting of illiquid asset returns, [3,4] and thus obtain a better estimate of their volatilities.

Figure 10 shows the difference between adjusted and reported volatilities for several illiquid assets.

Figure 10: Adjusted vs reported volatilities

Illiquid Asset Category	Non-adjusted Volatility	Adjusted Volatility
Private Equity	9.3%	16.6%
Direct Lending	4.0%	5.2%
Real Estate	9.8%	13.6%
Infrastructure	7.1%	18.3%
Natural Resources	8.8%	12.9%

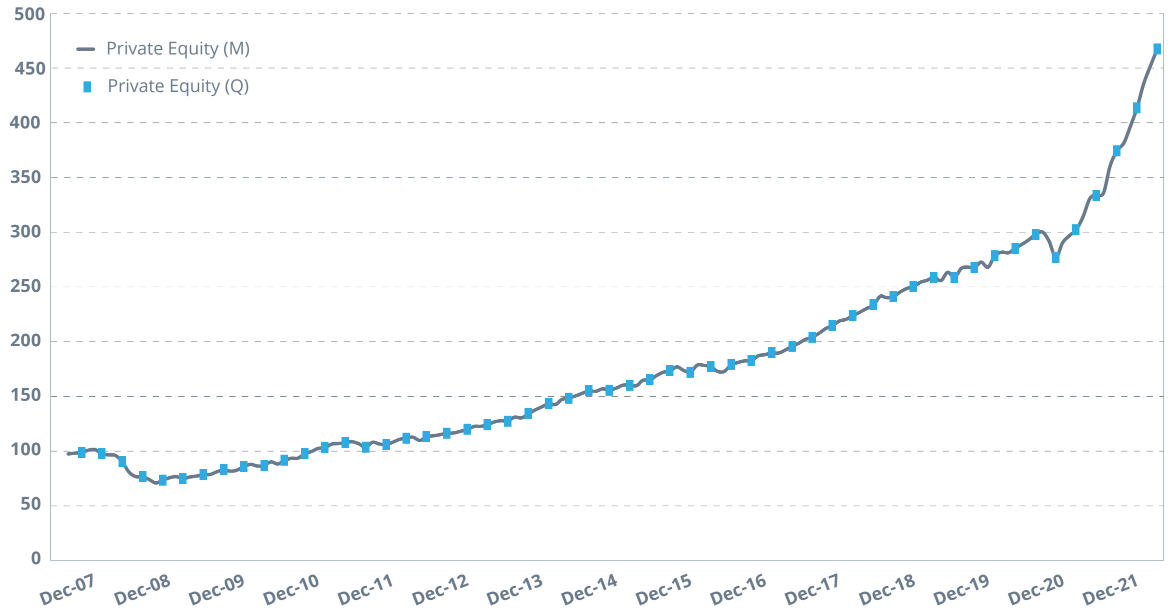
Source: Preqin data, Candriam calculations (as of December 2021)

The increased volatility of each illiquid asset class after adjustment is striking (Figure 10). The *extent* of the statistical adjustment indicates that the historical returns are positively auto-correlated. The volatility adjustment affects some asset classes more than others -- for instance, while Private Equity and Natural Resources have roughly the same level of volatility before adjustment (*9.3% vs 8.8%*), the adjusted volatility of Private Equity is much greater than the adjusted volatility of Natural Resources (*16.6% vs 12.9%*). This means that the returns of Private Equity are far more smoothed than those of Natural Resources, that is, Private Equity serial correlation is much greater.

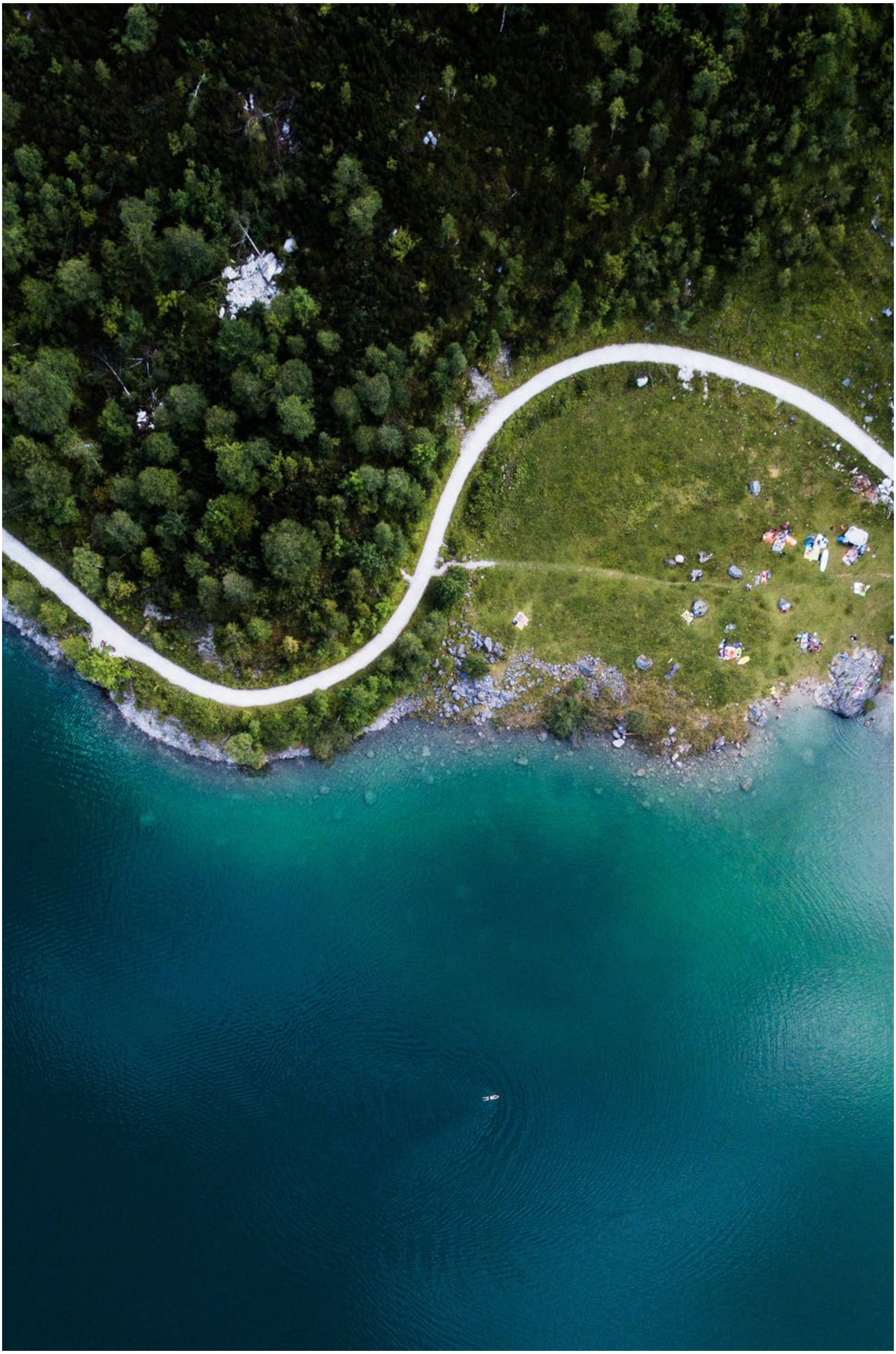
Many conventional portfolio allocation tools such as **risk contribution analysis** and mean-variance optimization (MVO) require an estimation of the correlation matrix of asset returns. However, estimating correlation matrix from low-frequency data such as quarterly returns is not statistically robust, in particular if the total number of assets is large (>15) while the number of observations is small (<50).

A common solution is to infer higher-frequency data by **using temporal disaggregation techniques to "fill" the missing data**. There are two categories of statistical methods. The first interpolates the missing data from the initial time series by using methods with differing levels of complexity (for example, linear interpolation, cubic spline interpolation, or Kalman filter). The second estimation approach relies on proxy assets with similar behaviour to that of the target asset. The main goal of this second types of approach is to create a new time series that is consistent with the low-frequency data, while maintaining the short-term behaviour of the higher-frequency indicator series. For our work, we use one of the second type of approach, because we find it more robust than a basic interpolation. We use the Chow-Lin method[5] which is capable of inferring monthly returns from quarterly data using a proxy asset with correlation at least 0.25. Figure 11 shows the monthly Private Equity returns inferred from reported quarterly Private Equity returns by using the Chow-Lin method, using the MSCI World TR Index as the proxy asset (*pairwise correlation = 74%*).

Figure 11: Adaptation of Quarterly Private Equity Returns to Estimated Monthly Returns
Illustration of the Chow-Lin method



Source: Preqin data, Candriam estimates



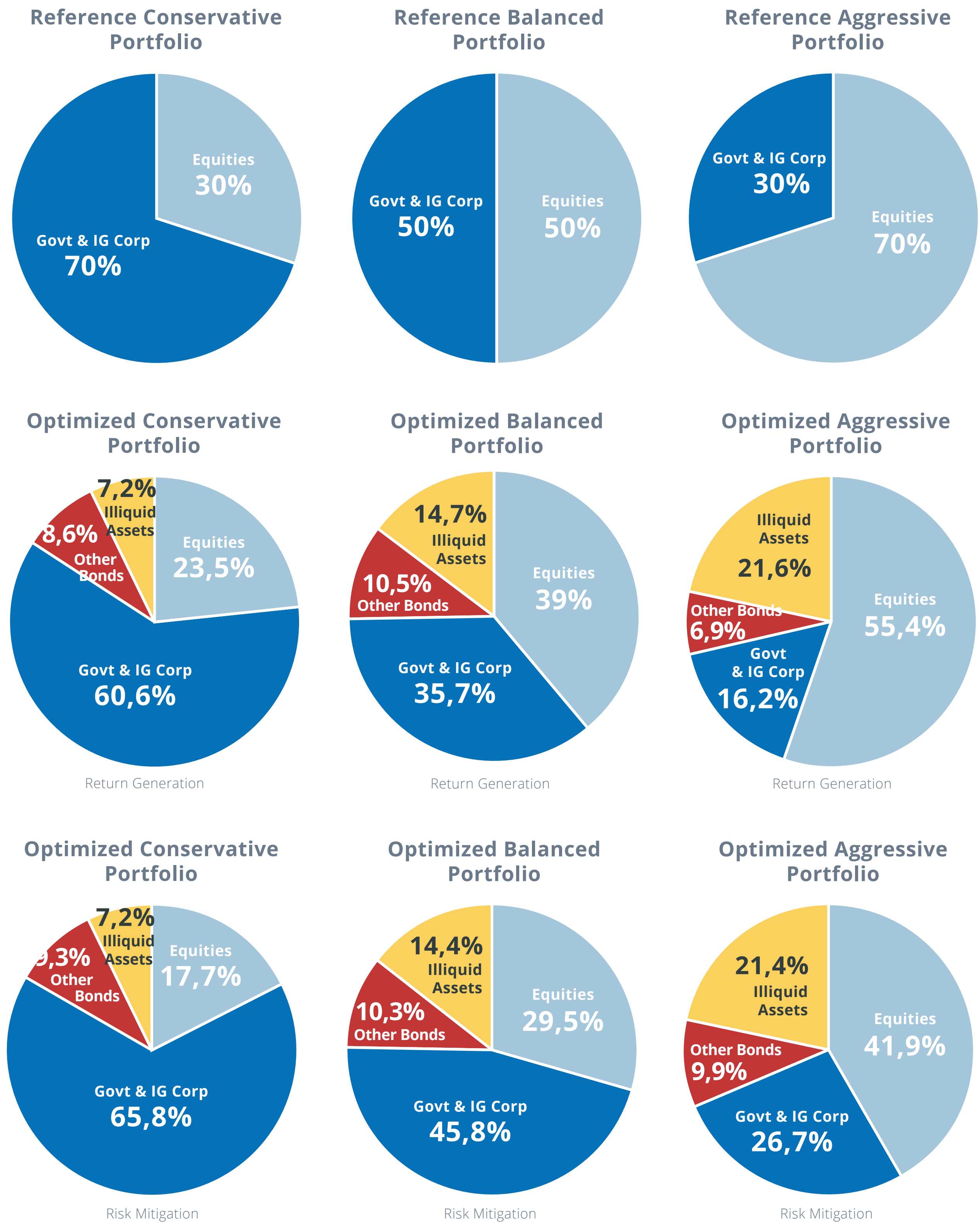
V.Introducing illiquid assets into your portfolio

The purpose of all these mathematical exercises is of course to introduce the 'right' illiquid assets, in the 'right' allocations, to a specific portfolio. The closest we can come on this printed page to adapting your particular portfolio allocation is to present some scenarios.

To extend our understanding of how the approach applies to real-life asset allocations, we extend the balanced 50/50 equity/fixed income reference portfolio to two additional scenarios, a more conservative and a more aggressive portfolio.

The charts in Figure 12 compare the optimal portfolio allocation when introducing illiquid asset classes into these three risk profiles -- *conservative*, *balanced*, and *aggressive*. Across this spectrum, our models show **an optimal share of investments in illiquid assets lies between 5-25%**.

Figure 12: Extending the Optimization Approach to



Source: Candriam

VI. Conclusion – Graduating to a more diverse allocation

Introducing illiquid assets to a diversified portfolio significantly improves long-term risk-adjusted return. The great surprise of the 2007/2008 Great Financial Crisis was how correlations among asset classes actually increased during times of market stress.

The GFC underscored that modelling illiquid allocations is no easy feat. Some problems were unique to that situation and those lessons have been learned. Crucially, the investment industry has worked hard since then to advance asset allocation techniques. Today, investors in illiquid assets have a broader range of tools at our disposal.

In this paper, we looked at many different features that can be incorporated **across a wide range of asset class breakdowns, portfolio types and client circumstances**, that should allow investors to gain a more complete picture of their risks and opportunities. We examined how illiquid assets allocations can be adopted according to clients' circumstances and requirements, risk/return expectations, levels of volatility tolerance and initial portfolio breakdowns between different asset classes.

Walking through the scenarios can be terrifically informative for investors who may be **considering allocating to illiquid assets for the first time**, or for those who want t**o gain a greater understanding of how much of their portfolio they should allocate illiquid assets**. Working the scenarios can help them move from *knowing* that illiquid assets can be advantageous, to *understanding* these dynamics.

Illiquid asset classes provide portfolio exposure to return drivers and to differentiated risks which are not accessible through listed asset classes. Breaking down the calculation into component parts demonstrates that illiquid asset classes not only provide this extra source of expected return, but reduce the overall portfolio risk in terms of volatility, VaR, and CVaR.

One further advantage to introducing illiquid asset classes can not be demonstrated with our simple single return forecast model and long-term approach. During periods of market turmoil, while panicked investors may rush to sell listed assets and drive prices down, illiquid asset classes may avoid some of the downside price pressures that results from rapid liquidation.

You may now go to the head of the class!

Once the methodology is in place, investors can insert their own asset allocation rather than the theoretical reference portfolio, their own views on expected returns and volatilities, and forecast the risk/return sensitivities of an allocation to illiquids in their own individual circumstances.

References

[1] H. Markowitz, “Portfolio selection” 1952.

[2] R. Michaud, “Efficient Asset Management: A practical guide to Stock Portfolio Optimization and Asset Allocation”, 1998.

[3] D. Geltner, “Estimating Market Values from Appraised Values without Assuming an Efficient Market”, 1993.

[4] M. Getmansky, A. Lo et I. Makarov, “An econometric model of serial correlation and illiquidity in hedge fund returns”, 2004.

[5] G. C. Chow and A.-L. Lin, “Best linear unbiased interpolation, distribution, and extrapolation of time series by related series”, 1971.

€150 B
AUM as of 30 June 2021

570
Experienced and committed professionals

25 years
Leading the way in sustainable investing

CANDRIAM. INVESTING FOR TOMORROW.
WWW.CANDRIAM.COM

CANDRIAM
A NEW YORK LIFE INVESTMENTS COMPANY