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Asset Allocation at Official Institutions: Three Critical Steps

Investors have spent 2023 adjusting their capital market assumptions to the new era of higher inflation, higher rates and shorter cycles.

In the midst of the transition last year, we urgently set out new asset allocations for a range of Official Institutions, whose existing portfolios were, in many cases, highly exposed to the low-yielding, long-duration investments that appeared most at risk.

Those suggestions would have helped preserve capital—but there is still a lot to do. Recovering from the market shock of 2022 may take a long time, given the unfavorable economic outlook, which means squeezing as much estimated return as possible from every unit of risk an investor is able to take. Our model optimizations suggests three critical steps to achieve that: embracing less-liquid markets, exploring a fuller credit universe, and thinking globally. We believe there are opportunities away from the broadly owned passive exposures—some of them potentially short-lived—that can help Official Institutions recover from 2022 and meet their longer-term objectives.

Executive Summary

- Many Official Institutions endured portfolio losses during 2022, often on top of demands for emergency cash flow and investment through the COVID-19 pandemic.
- With bond yields having risen but equity markets well above their lows, these investors are looking to prepare their portfolios for the new era of investing—but their economic and market outlooks are often cautious, weighed down by expectations of stagflation.
- We have created optimized hypothetical portfolios for an illustrative Reserves Fund, Public Pension Fund and Sovereign Wealth Fund—preserving the same asset volatility, duration and fixed income credit rating as their current portfolios, with some additional investor-specific constraints.
- We find that a cautious approach may not be optimal, identifying three critical steps that Official Institutions could take to enhance their risk-adjusted estimated returns:
 - **For Reserves Funds:** Consider a more meaningful role for slightly less-liquid but high-quality, high-yielding, cash-generative asset classes—if necessary, by creating separate “Liquidity” and “Investment” portfolios
 - **For Sovereign Wealth Funds:** Lean into the attractive estimated returns now on offer from credit spread products: liquid, semi-liquid and illiquid
 - **For Public Pension Funds:** Domestic duration is needed for liability matching, but more exposure to less-liquid, more credit-oriented and more global assets appears optimal
- We also believe that the new investing environment raises some key points for consideration on active management: the role of tactical asset allocation; flexibility in fixed income strategies; equity-index concentration; the outlook for quantitative strategies; and the links between public and private markets.

Midway through 2022, we published a paper urging Official Institutions to rethink their strategic asset allocations (SAA).¹ The first half of last year brought profound macroeconomic change, especially the return of high inflation, which had triggered the start of a broad re-pricing of virtually all financial assets. Official Institutions’ three traditional objectives of real-terms capital preservation, return generation and liquidity maintenance increasingly looked like an “impossible trinity”: capital preservation was less likely to be achieved with government bonds; return targets appeared increasingly unattainable, given current valuations and the economic and inflation outlook; and some of the most liquid assets were also the most at risk of a valuation correction.

Our suggested asset allocations focused on three changes. First, easing out of core government bonds and into assets that could sustain low correlation with equities but continue to offer a positive total return outlook—including leaning into credit and liquidity risk in fixed income, rather than duration. Second, favoring private equity over public equity, rather than public non-domestic and emerging markets over domestic markets. And third, paying more attention to inflation hedges.

All three changes would have helped preserve capital and sustain returns over the past 12 months without taking excessive liquidity risk.

But with bond yields peaking and equity markets well above their lows, what should these Official Institutions be doing now?

¹ Jahangir Aka, Ziling Jiang and Joe McDonnell, *Switching Gears for an Uphill Ride: Combining Capital Preservation, Return Potential and Liquidity for Official Institutions* (July 2022) at <https://www.nb.com/en/gb/insights/whitepaper-switching-gears-for-an-uphill-ride>

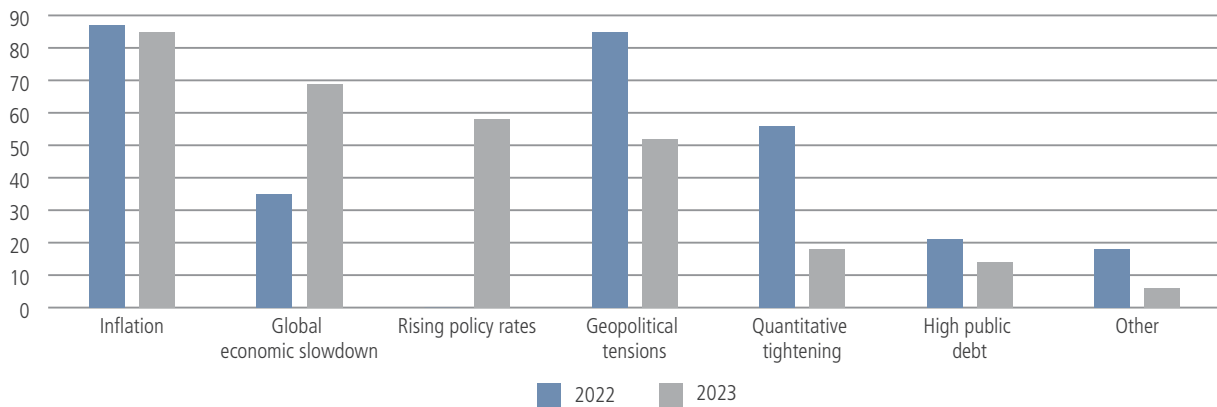
The Context: A Cautious Outlook

The latest annual survey of the member of the Official Monetary and Financial Institutions Forum (OMFIF) offers some context concerning current investor outlooks and attitudes, much of which concurs with what we are hearing from clients.

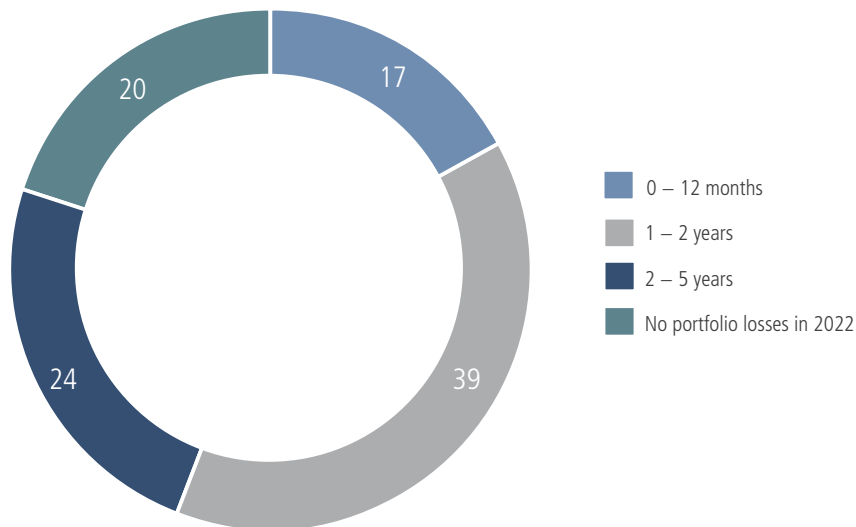
Concerns about inflation haven't gone away, but they are now joined by concerns about slowing growth. That is affecting return expectations, which is leading to gloomy expectations as to how long it will take to bounce back from the losses incurred in 2022.

FIGURE 1. OFFICIAL INSTITUTIONS' BLEAK ECONOMIC OUTLOOK LEADS TO LOW RETURN EXPECTATIONS

What are the three most important economic challenges affecting your investment approach over the next 12 – 24 months? (Share of responses, %)



How long do you anticipate that it will take to recover any portfolio losses from 2022? (Share of respondents, %)



Source: OMFIF, survey of members, 2023.

In this paper, we do not seek to persuade Official Institutions to take more portfolio risk. Indeed, we recognize that the higher yields now on offer from government and high-quality corporate bonds may allow some to achieve their objectives with these asset classes alone.

That said, we do believe there are opportunities to squeeze more estimated return out of the volatility, liquidity, duration and other risk constraints that Official Institutions typically have—and that this often involves favoring credit-spread asset classes such as the asset-backed securities (ABS) and corporate bonds over “core” government bonds.

In this year’s OMFIF survey, less than 5% of net respondents expect to add to ABS or corporate bonds to their asset mix, compared with around 10 – 20% in 2022 and 2021. However, the optimizations we set out below suggest this may well be one of the best courses of action.

The Reserves Fund: The Liquidity Trade-Off

We have created optimized hypothetical portfolios for three different types of institution—a Reserves Fund, a Sovereign Wealth Fund and a Public Pension Fund—and will discuss them in ascending order of risk appetite.

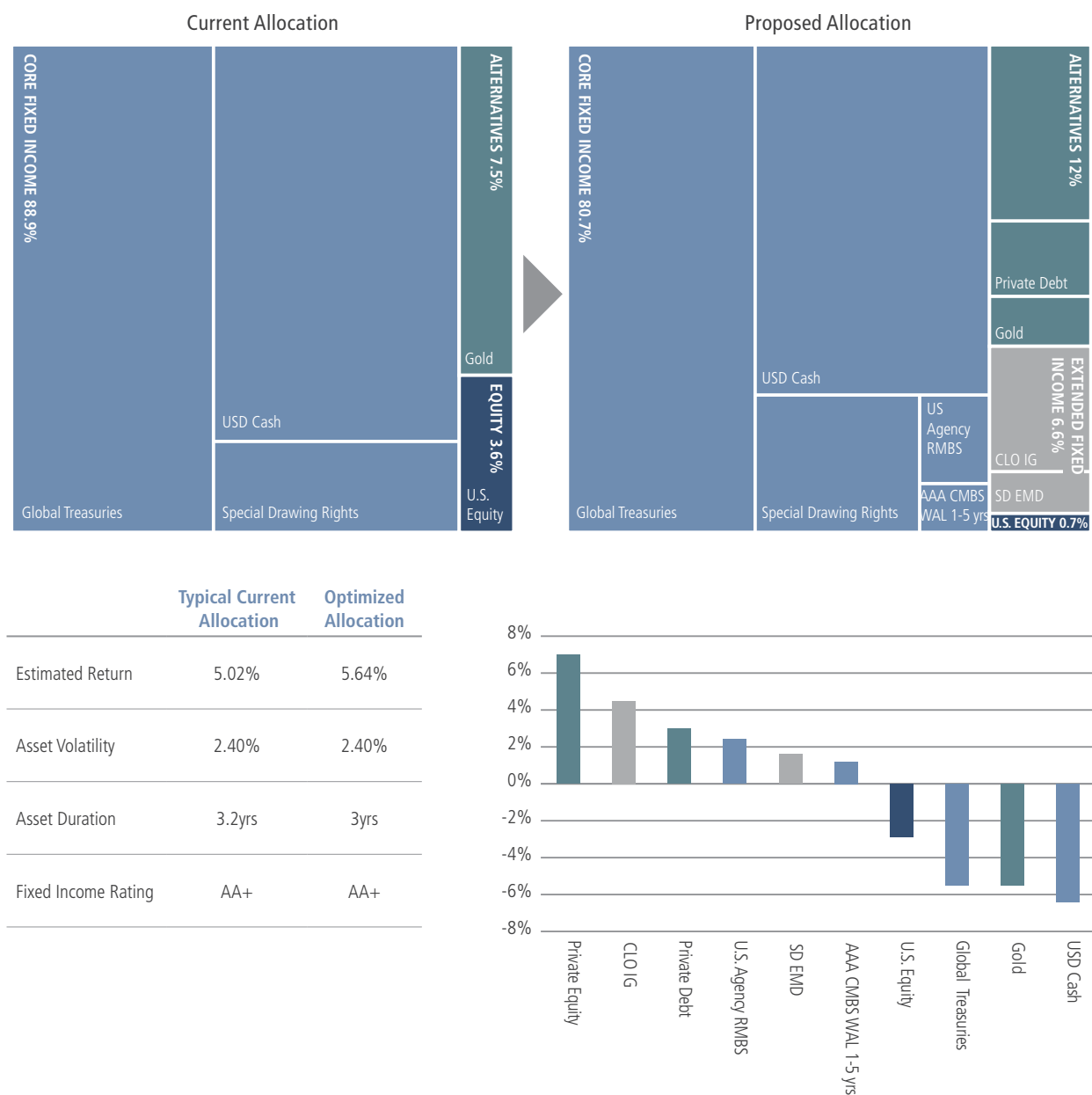
In each case we present an illustrative asset allocation, based on our own observation of the market, and then an asset allocation optimized for the same asset volatility, duration and fixed income credit rating—with some additional investor-specific constraints.

For all three optimizations we limited portfolio turnover relative to the current portfolio to 30%, to limit transaction requirements.

For our illustrative Reserves Fund, we applied minimum allocation constraints for U.S. dollar cash (30%), Special Drawing Rights (the current allocation of 8.9%) and gold (2%), all of which are important to this investor’s operational mandate. We also capped any newly introduced asset classes at 10%.

Given the liquidity requirements of this investor, we decided to apply a meaningful hurdle to the inclusion of potentially illiquid assets, to try to ensure that this risk would be very well compensated before it made it into the proposed asset allocation. We think the High Quality Liquid Assets (HQLA) factors set out in the Basel III framework for liquidity risk measurement in the banking sector are a reasonable proxy for such a hurdle. These factors impose a penalty on the valuation of certain asset classes that reflects an assumption that the investor will be unable to sell some or all of the allocation during a period of market stress, or would incur severe losses in doing so: we applied those valuation haircuts to the asset classes in our selection universe and capped the aggregate haircut at 20% of total portfolio assets. Cash and core government bonds had no haircut, U.S. residential mortgage-backed securities (RMBS) incurred a 25% haircut, corporate bonds, emerging markets debt and public-market equities all incurred a 50% haircut, while other less liquid or lower-quality assets incurred a 100% haircut. In addition, we capped CLO exposure at 5%, and specified that 30% of any new private assets portfolio must be allocated to cash-flow generating private debt.

FIGURE 2. RESERVES FUND OPTIMIZATION: ADDING LIQUIDITY RISK



Source: Bloomberg, JP Morgan, Cambridge Associates, Credit Suisse, Neuberger Berman. Data as of June 2023.

IMPORTANT: The performance and risk projections/estimates are hypothetical in nature and reflect the Neuberger Berman's Capital Market Assumptions. The estimates do not reflect actual investment results and are not guarantees of future results. This material is for educational purposes only and nothing herein constitutes investment advice or an investment recommendation. Asset classes are represented by benchmarks and do not represent any Neuberger Berman investment product or service. Estimates are shown gross of fees which do not reflect the fees and expenses associated with managing a portfolio. If such fees and expenses were reflected, estimates shown would be lower. Please see disclosures at the end of this material for additional information regarding Neuberger Berman's Capital Market Assumptions.

Two of the main changes to this portfolio are a complete rotation out of the modest allocation to public-market equities (where liquidity is offset by relatively low estimated return and high volatility, given lower earnings growth expectations across multiple geographies); and a notable rotation out of the large allocation to cash and government bonds (where liquidity and low volatility is offset by relatively modest yield and concentrated risk).

Government bonds and cash are relatively attractive asset classes in our latest capital market assumptions, due to higher yields and inverted yield curves, and some investors may be able to meet their objectives with these new estimated returns. However, in our view, the lack of diversification in the current portfolio simply is not optimal.

While the proceeds of those rotations out of cash and government bonds are shared widely through the optimized portfolio, there is an underlying theme that comes through despite our stringent liquidity constraints: taking some liquidity risk. Within core fixed income, 3.3% goes to mortgage-backed securities (MBS). A full 5% goes to investment-grade tranches of collateralized loan obligations (CLO), hitting our self-imposed cap. And 10% is directed to private equity and debt.

Liquidity is important for a Reserves Fund. Reserves are held to finance imports and pay foreign-currency debt obligations, and to provide a buffer against capital flight and sudden portfolio outflows—they are resources that may need to be deployed at short notice. Some investors will be unable to follow us all the way into asset classes such as private equity.

As we argued in a previous paper, however, many countries hold more assets in Reserves Funds than they need, creating an opportunity to consider separating portfolios into “Liquidity” and “Investment” tranches, with the latter given more freedom to seek higher returns and lock up some capital.² Moreover, we think it is important to be aware of how much more potential there is for liquidity in private markets today, relative to a decade ago. Products and strategies are now available with much shorter life cycles than the traditional, seven-year-plus buyout fund: they can deliver more cash flow and faster distributions, while still offering attractive estimated returns, by tilting to private debt and more mature holdings in private equity co-investments and secondaries. The depth of today’s secondaries market also means that early liquidity from private equity funds is now often available at little or no discount.

The Sovereign Wealth Fund: Credit Where It’s Due

No two Sovereign Wealth Funds look the same. Few, if any, are “pure” investors, tasked only with finding the maximum returns from a global opportunity set, and the other economic objectives they are given can vary widely. Some are primarily tasked with diversifying their country’s wealth into other countries and regions, or into something other than the country’s dominant industry, or both. Some have to focus on investing to diversify their own country’s industrial base, or simply on local development in general. Others are charged with stewarding assets that the sovereign can draw upon in times of need, as a counter-cyclical stimulus. All are having to rethink their mandate in the context of a post-pandemic, de-globalizing world economy.

Our illustrative Sovereign Wealth Fund has a dual mandate to diversify national revenues with return-seeking investments while also financing domestic infrastructure projects and strategic businesses.

It therefore has a set allocation to “Local Projects” and local private equity venture and growth investments.

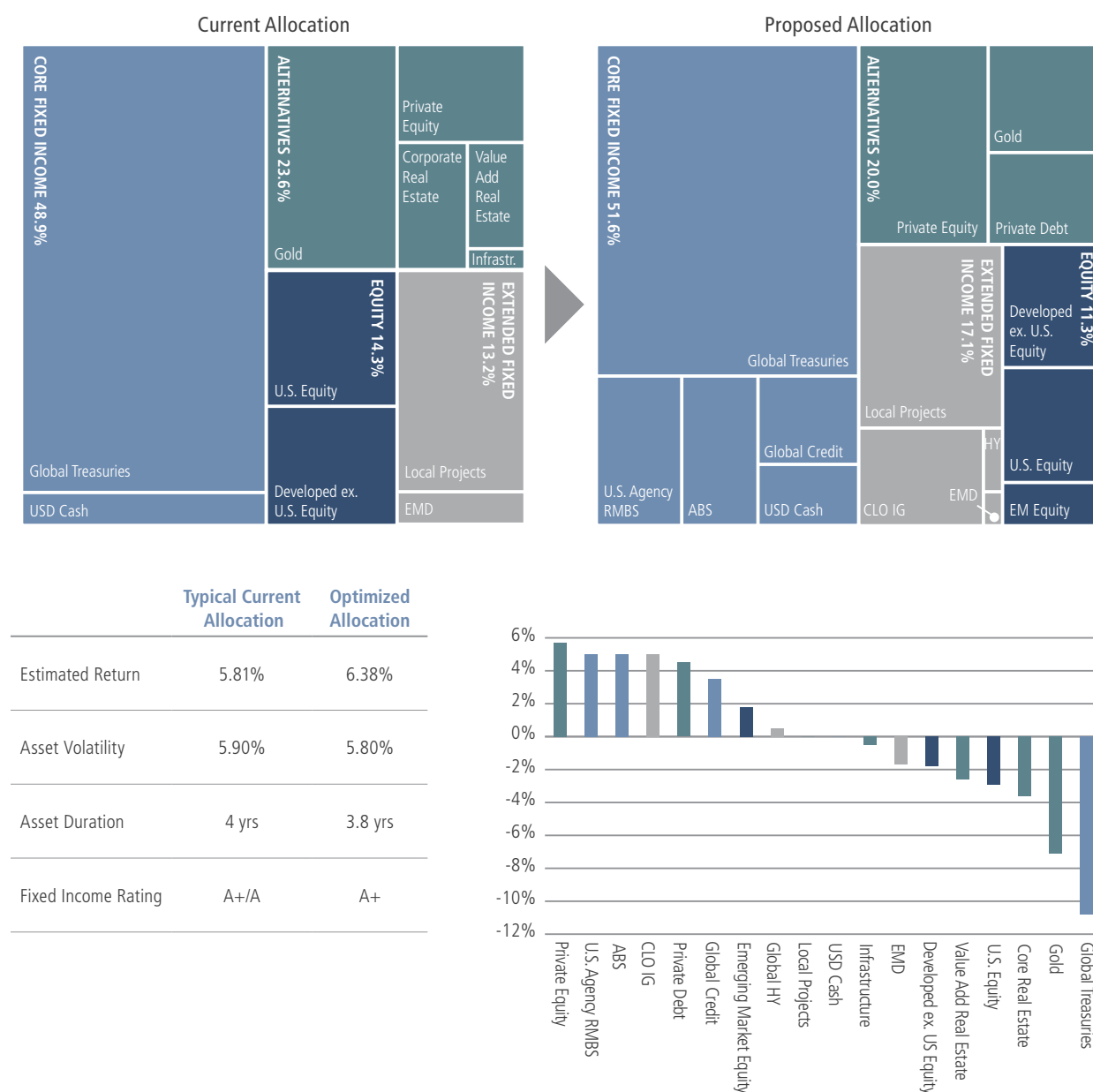
In addition, we froze U.S. dollar cash at the current allocation of 2.6% and applied a minimum allocation of 5% for gold, as both assets are important to this investor’s operational mandate.

To maintain reasonable portfolio liquidity, we capped ABS, MBS and CLO exposure at 5% and private assets at 15%, while specifying that 30% of any new private assets portfolio must be allocated to cash-flow generating private debt.

We applied the U.S. tax on Effectively Connected Income (ECI), which slightly reduced the favorability of private debt in the optimization, as our proxy for the asset class is focused on the U.S. market. It is notable that this did not prevent it from receiving a sizable allocation.

² Jahangir Aka, Jon Jonsson and Ziling Jiang, Could Your Beta Be Better? (April 2022), at <https://www.nb.com/en/gb/insights/could-your-beta-be-better>

FIGURE 3. SOVEREIGN WEALTH FUND OPTIMIZATION: ADDING CREDIT AND EMERGING MARKETS EQUITIES



Source: Bloomberg, JP Morgan, MSCI, NAREIT, NCREIF, HFRI, Cambridge Associates, Credit Suisse, Neuberger Berman. Data as of June 2023.

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The changes to the asset allocation echo those at the Reserves Fund, in some respects. Government bonds and gold are cut in favor of high-grade structured credit, MBS, ABS and CLOs, for example.

One difference is that this investor, with its more return-oriented mandate, is able to go much deeper into these credit asset classes, adding almost 15%—and it would have been higher without the limits on these allocations.

And while it adds more to private equity and private debt, like the Reserves Fund, some of that reallocation is funded by cutting back on equally illiquid but lower-returning assets such as real estate and infrastructure (which also have the disadvantage of doubling up on some of the risk inherent in the investor's Local Projects).

Unlike the Reserves Fund, the Sovereign Wealth Fund does not have to rotate out of public equities altogether, but it does benefit from the diversifying effect of shifting some of the allocation into emerging markets.

It is not quite so easy to boost the estimated return of this investor's portfolio, as it starts from a higher base, but we show that it can be done—even with a slight improvement in overall credit rating.

The Public Pension Fund: Thinking Globally

Our illustrative Public Pension Fund, like its counterparts in developing countries, relies on domestic investment-grade bonds and core real estate for both cash flow and liability matching. We therefore applied a limit of 5% to the amount that could be taken away from the allocations to domestic government bonds, corporate bonds and core real estate in our optimization.

Unlike many of its counterparts in aging developed economies, however, this investor has a mandate to grow its assets to meet the pension promises made to a largely younger, working population. Cash flow is currently quite tight, as advance drawdowns were allowed to help young savers get through the hardships of the pandemic, but this growth mandate remains a key determinant of this type of investor's asset allocation.

As such, while ABS, MBS and CLOs are capped at 5%, real estate is capped at 10% and private assets are limited to 15% to preserve portfolio liquidity (and 30% of any allocation must go to private debt), there is actually an 8% floor under the public-market equities allocation.

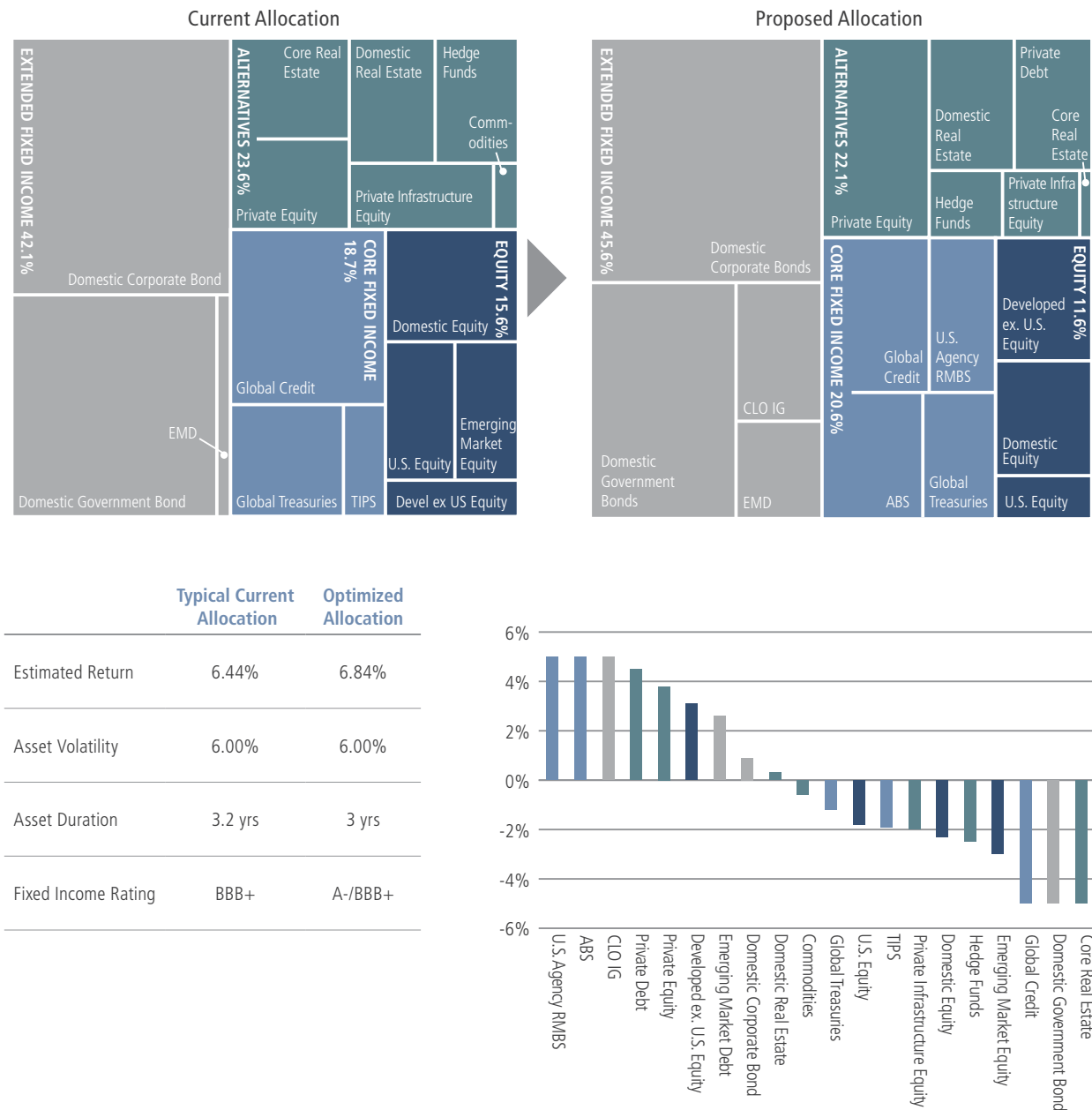
In addition, the application of the U.S. tax on Effectively Connected Income (ECI) slightly reduces the favorability of private debt (which is focused on the U.S. market) and U.S. real estate in the optimization.

Like pure Sovereign Wealth Funds, Public Pension Funds are often expected to provide capital for domestic infrastructure, and therefore we set a minimum allocation of 2% to private infrastructure equity.

Overall, the portfolio already exhibits the highest estimated return of the three, and its asset allocation is the closest to what our optimization would select.

That said, the results are eye-catching.

FIGURE 4. PUBLIC PENSION FUND OPTIMIZATION: GOING GLOBAL AND ALTERNATIVE



Source: Bloomberg, JP Morgan, MSCI, NAREIT, NCREIF, HFRI, Cambridge Associates, Credit Suisse, Neuberger Berman. Data as of June 2023.

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The strong themes in this optimization are liquidity risk and global diversification. More than 13% moves out of domestic government bonds and global credit and Treasuries (with their tilt to the U.S.) and into emerging market debt, ABS, MBS and CLOs.

As well as moving into structured credit, the old equities allocation, which was tilted to the domestic and U.S. markets, finds its way into developed ex-U.S. equities.

Alternatives also shrink a little to feed structured credit, and within that smaller allocation we see the now familiar concentration into private equity and private debt (despite the tax consideration). This comes at the expense of U.S. core real estate (where the ECI tax has a larger impact), and infrastructure (which is mostly domestic for this type of investor).

As with the Sovereign Wealth Fund, an already respectable estimated return can be boosted by these changes, even with a slight improvement in overall credit rating. Public Pension Funds are often regarded as critical sources of capital and liquidity for domestic bond, equity, infrastructure and real estate markets, but we think it is important to consider the evident trade-off between this role and the concentration risk and lower estimated return that it may imply.

Three Key Decisions—Plus One

We think our three optimizations suggest one key, relatively simple decision for each of our hypothetical investors:

- **For Reserves Funds:** Consider a more meaningful role for slightly less-liquid but high-quality, high-yielding, cash-generative asset classes—if necessary, by creating separate “Liquidity” and “Investment” portfolios
- **For Sovereign Wealth Funds:** Lean into the attractive estimated risk-adjusted returns now on offer from credit spread products, liquid, semi-liquid and illiquid
- **For Public Pension Funds:** Domestic duration is needed for liability matching, but the optimizer wants more exposure to less-liquid, more global and more growth-oriented assets—to take further advantage of these asset classes, more capital-efficient portfolio duration management, using derivatives, could help to marry these two objectives

All three optimizations lean into structured credit, as well as liquidity and complexity premia more broadly.

Finally, we see one other critical dynamic behind all the others: the increasing importance of active management after more than a decade of increasingly passive investment.

While equity market index valuations are more attractive than they were two years ago, the longer-term economic backdrop means that estimated “beta” returns are not particularly compelling, especially given the new hurdle of higher bond yields. And while bond yields are higher and credit spreads wider than they were two years ago, that reflects higher levels of inflation, credit stress and default risks.

We think all types of Official Institution should consider five points when it comes to active management:

- **Tactical Asset Allocation (TAA) is likely to become more important.** SAAs are often set with a five- or seven-year time horizon. This has suited the past 20 – 30 years quite well, when business cycles have grown longer and less volatile. In an environment of structurally higher inflation, less central bank intervention and “just-in-case” rather than “just-in-time” supply chains and inventories, the time horizons of shorter and more volatile cycles could begin to cut across SAA time horizons. The general rise in uncertainty is also likely to result in more periods of speculative exuberance and despair in markets, and unpredictable bouts of momentum—the strong performance of equity indices in 2023, driven by momentum in an exceptionally concentrated group of stocks, is a good example of how markets can run against investors’ medium-term outlooks for estimated returns.
- **Flexibility could be the key in fixed income.** We have long argued for a fully flexible approach to fixed income markets, which seeks opportunity across the widest possible range of markets based on apples-to-apples relative value judgments. In the years before 2023, this approach was critical to the search for yield. Today, yield is back, but finding yield that adequately compensates for higher inflation, credit stress and default risks calls for the same flexibility, sector rotation, tolerance for lower liquidity and security-selection skillset, in our view.
- **Some major equity indices are now highly concentrated.** Growth stocks outperformed value stocks for more than a decade leading into 2022, leading them to dominate the top positions in many equity indices—particularly U.S. and global large-cap

indices. While value stocks enjoyed a short-lived comeback through some of 2022, the rally by the so-called “Magnificent Seven” U.S. mega-cap technology stocks in 2023 has only heightened index concentration. A tilt to value, and active management in general, could help to prevent potential over-exposure to these dominant stocks.

- **Think twice before abandoning quantitative active management.** Like value investing, and for many of the same reasons, quantitative, factor- and style-oriented active equity management has struggled over recent years. We believe there are benefits to maintaining a diversified approach to active equity management, however, and that an environment of structurally higher inflation and rates and less central bank market intervention should be more favorable to many quantitative strategies. The broadening of equity market performance in the third quarter of 2023 may signal a shift into this new regime.
- **Remember the connections between public and private markets.** It is notable that all three of our optimizations recommend higher allocations to private markets, and to credit—liquid, semi-liquid and illiquid. We believe it is increasingly beneficial to think about investments across public and private markets as a liquidity continuum, and private credit and debt as a single ecosystem, rather than as completely separate allocations. Private companies become public companies, and *vice versa*. Returns to private debt are costs to private equity. Many companies borrow via both high yield bonds and loans. Private debt, ABS, high yield bonds and public and private loan markets increasingly compete for the same pool of capital. In our view, the complexity of the relative-value judgments between these markets raises the profile of asset managers that can offer skillsets and experience across all of them.

Recovering the losses of 2022 may take a long time, given the unfavorable economic outlook. That means squeezing as much estimated return as possible from every unit of risk an investor is able to take. Our model optimizations suggest three critical steps that Official Institutions can take: embracing less liquid markets, exploring a fuller credit universe, and thinking globally. Finally, we believe that applying an active-management mindset to each of these steps can enhance efficiency and raise the likelihood of meeting these investors’ varied objectives.

Special thanks to Flora Xu, Client Strategist, and Zhengyang Su, Institutional Solutions, who contributed to the analysis for this paper.

ASSET CLASS ASSUMPTIONS & ESTIMATES

Capital market assumptions used herein reflect Neuberger Berman's forward-looking estimates of the benchmark return or volatility associated with an asset class. Estimated returns and volatilities are hypothetical return and risk estimates generated by Neuberger Berman's Institutional Solutions Group. Estimated returns and volatilities do not reflect the alpha of any investment manager or investment strategy/vehicle within an asset class. Information is not intended to be representative of any investment product or strategy and does not reflect the fees and expenses associated with managing a portfolio or any other related charges, such as commissions and surrender charges. Estimated returns and volatilities are hypothetical and generated by Neuberger Berman based on various assumptions and inputs, including current market conditions, historical market conditions and subjective views and estimates. Capital market assumptions shown reflect Neuberger Berman's long-term (20+ years into the future) estimates and are reviewed and revised at least annually. Neuberger Berman also produces intermediate-term (5-7 years into the future) capital market assumptions. If Neuberger Berman's intermediate-term (5-7 years into the future) capital market assumptions were used, the results presented would be different. Neuberger Berman's capital market assumptions are derived using a building block approach that reflects historical, current, and projected market environments, forward-looking trends of return drivers, and the historical relationships asset classes have to one another. These hypothetical returns are used for discussion purposes only and are not intended to represent, and should not be construed to represent, predictions of future rates of return. Actual returns may vary significantly. Neuberger Berman makes no representations regarding the reasonableness or completeness of any such assumptions and inputs. Assumptions, inputs, and estimates are periodically revised and subject to change without notice. Estimated returns and volatilities should not be used, or relied upon, to make investment decisions.

Rate of Return Estimate: Rate of return or geometric return is a measure of average returns of an investment over a period of time. Geometric rate of returns are typically referred to as annualized compound rate of returns and are always less than or equal to the arithmetic mean return of the same time series. Geometric rate of returns are used for straight-line calculations within the analysis, for example, the cash flow calculations. In straight-line calculations, each year is represented as a gain, so the compound (geometric mean) rate of return is used to adjust for the amount needed to make up for a loss in a given year. For example, if you lose 5% in one year, and gain 5% the year after, you still have less than you started with at the beginning of year one.

Arithmetic Mean Estimate: Arithmetic mean or average return is calculated by dividing the sum of a series of numbers by the number of overall items. This is more typically thought of as an "average" of the data set. Arithmetic mean or average return ignores the impact of compounding in the context of analyzing investment returns and is the simple average of returns observed over a period of time. Arithmetic mean returns are used in this material and, if applicable, the Efficient Frontier, because, through randomization, losses and gains are being accounted for each year.

Standard Deviation: A statistical measure of the volatility based on the distribution of a set of data from its mean (average value). For example, a portfolio with an average return of 10% and a standard deviation of 15% would return a result between -5% and +25% the majority of the time (68% probability or 1 standard deviation), almost all of the time the return would be between -20% and +40% (95% probability or 2 standard deviations). If there were 0 standard deviation then the result would always be 10%. Generally, more aggressive portfolios have a higher standard deviation and more conservative portfolios have a lower standard deviation.

Index Definitions

USD Cash is represented by the **Barclays Benchmark Overnight USD Cash Index**, which measures the performance of a daily rolling money market deposit in USD.

Non-USD Cash is represented by the **SDR Currency Index**, which tracks the performance of the currencies in the International Monetary Fund's Special Drawing Rights basket against the USD, namely USD (41.73%), EUR (30.93%), RMB (10.92%), JPY (8.33%) and GBP (8.09%).

Domestic Government Bond and Global Treasuries are represented by the **Bloomberg Global Aggregate Treasuries Total Return Index** measures the performance, in USD, of Treasury bonds from the Bloomberg Global Aggregate Bond Index, a broad base, market capitalization-weighted bond market index representing intermediate term investment grade bonds traded worldwide.

TIPS are represented by the **Bloomberg U.S. Government Inflation-Linked All Maturities Index** includes publicly issued, U.S. Treasury inflation protected securities that have at least 1 year remaining to maturity on index rebalancing date, with an issue size equal to or in excess of \$500 million.

Domestic Corporate Bond and Global Credit is represented by the **Bloomberg Global Aggregate Credit Total Return Index**, which measures the performance, in USD, of corporate bonds from the Bloomberg Global Aggregate Bond Index, a broad base, market capitalization-weighted bond market index representing intermediate term investment grade bonds traded worldwide.

U.S. Agency MBS are represented by the **Bloomberg U.S. Mortgage Backed Securities Index Total Return Index**, which measures the performance, in USD, of fixed-rate agency mortgage backed passthrough securities guaranteed by Ginnie Mae (GNMA), Fannie Mae (FNMA), and Freddie Mac (FHLMC).

ABS and CMBS are represented by the **Bloomberg ABS+CMBS Index**, which tracks asset backed securities, agency mortgage backed pass-through securities, and investment grade commercial mortgage-backed securities.

CLOs are represented by the **J.P. Morgan Collateralized Loan Obligation Index**, which Tracks debt from broadly syndicated, arbitrage floating-rate U.S. CLOs.

Global High Yield is represented by the **Bloomberg Global High Yield Index**, which is a multi-currency measure of the performance of the global high yield debt market which brings together the Bloomberg U.S. High Yield, Pan-European High Yield, Emerging Markets Hard Currency High Yield Indices.

Local Projects are represented by the **ICE Bank of America U.S. High Yield Energy Index**, which tracks the performance of below investment grade, but not in default, U.S. dollar denominated corporate bonds publicly issued in the U.S. domestic market by companies in the energy sector, and includes issues with a credit rating of BBB or below, as rated by Moody's and S&P.

Emerging Markets Debt is represented by the **J.P. Morgan Emerging Markets Bond Index (EMBI) Global Index**, which measures total returns for traded hard currency debt instruments in the emerging markets; and the JPMorgan Corporate Emerging Markets Bond Index (CEMBI), which is a market-capitalization weighted index of corporate bonds issued by entities in emerging countries.

Developed Market ex-U.S. Equities are represented by the **MSCI World Ex U.S. Index**, which tracks the performance of large- and mid-cap stocks across 22 developed markets countries.

Emerging Market Equities are represented by the **MSCI Emerging Markets Index**, which tracks the performance of large- and mid-cap stocks across 24 emerging markets countries.

U.S Equities and Domestic Equities are represented by the respective **Bloomberg Equity Large & Mid Cap Indices**.

Domestic Real Estate, Core Real Estate and Value-Added Real Estate is represented by the **NCREIF Property Index**, which provides a historical measurement of unleveraged property-level returns and is comprised exclusively of operating properties acquired, at least in part, on behalf of tax-exempt institutions and held in a fiduciary environment. It is a market value-weighted index including apartment, hotel, industrial, office and retail properties.

Hedge Funds are represented by **HFRF Fund Weighted Composite Index**, designed to track the equal-weighted performance reported by the hedge fund managers listed within the HFR Database, which report in U.S. dollars monthly, net of all fees performance and assets under management, and have either (a) \$50 million assets under management or (b) at least \$10 million assets under management on the last reported month prior to the index rebalance, and have been actively trading for at least 12 months.

Commodities and Gold are represented by the **Bloomberg Commodity Index**, which is designed to be a highly liquid and diversified benchmark for commodities investments. The index provides broad-based exposure to commodities as an asset class, since no single commodity or commodity sector dominates the Index. This index is composed of futures contracts on 20 physical commodities traded on U.S. exchanges, with the exception of aluminum, nickel and zinc, which are traded on the London Metal Exchange (LME).

Private Equity is represented by their respective sectors in the **Cambridge Associates LLC U.S. Private Equity Index**, which tracks the pooled horizon return, net of fees, expenses, and carried interest, of 1,468 U.S. private equity funds (buyout, growth equity, private equity energy and subordinated capital funds), including fully liquidated partnerships, formed between 1986 and 2017.

Private Infrastructure Equity – Infrastructure/Other is represented by the **Cambridge Associates Infrastructure Index**, a horizon calculation based on data compiled from infrastructure funds, including fully liquidated partnerships. Private indexes are pooled horizon internal rate of return (IRR) calculations, net of fees, expenses, and carried interest.

Private Debt is represented by the **Credit Suisse Leveraged Loan Index**, which tracks the investable market of the U.S. dollar denominated leveraged loan market. It consists of issues rated "5B" or lower, meaning that the highest rated issues included in this index are Moody's/S&P ratings of Baa1/BB+ or Ba1/BBB+. All loans are funded term loans with a tenor of at least one year and are made by issuers domiciled in developed countries.

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