The Potential of Alternative Investments in Defined Contribution Plans

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THE POTENTIAL OF ALTERNATIVE INVESTMENTS IN DEFINED CONTRIBUTION PLANS

"Diversification is the only free lunch in investing." – Henry Markowitz

Abstract

This research seeks to understand if returns for employees' retirement plans can be improved by increasing the number of retirement investment options. Defined contribution plans typically only have access to traditional investments, such as stocks and bonds, but not alternative assets. Alternative assets are characterized by a low correlation of returns, low liquidity due to withdrawal restrictions, and less regulation compared to traditional investments. Their use is limited to what are known as accredited investors, individual investors typically must meet income and asset requirements. As such, most employees do not have access to alternative investments in their personal portfolios. This research will use optimization theory over a range of future return assumptions to assess the potential value alternative investments in different portfolios. The results will illustrate the risk-return tradeoff for including alternatives in DC portfolios. This strategy could lead to higher long-term average returns for employees, enabling them to successfully save for retirement.

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Introduction

The Motivation of the Work

From 1975 to today, Americans have moved from relying on Defined Benefit (DB) pension plans to almost exclusively relying on Defined Contribution (DC) plans. Much of the literature has focused on the impact of this change on the adequacy of retirement savings. The previous research covers how the onus of making financial decisions is placed on individuals from how much to save to how to invest. From that research, product and program innovations such as target-date funds, automatic enrollment, and employer feedback have addressed many of the issues in DC plans such as poor investment selection and inadequate savings. However, the literature has largely overlooked the shift in the types of assets that make up retirement savings and therefore the impacts on the efficient frontier available to individuals saving for retirement. DB plans have access to traditional investments, e.g., stocks and bonds, but also to alternative investment, a group of investments that have lower liquidity, low correlation to public markets, high heterogeneity of returns among managers, and less regulation and transparency than traditional investments. With the shift from DB to DC plans, individuals have lost access to this portion of capital markets, which are able to potentially improve risk-adjusted returns. This dissertation seeks to understand the potential impact of alternative investments on portfolios, strategies to effectively implement alternatives for individuals, and policy levers that would encourage adoption.

The Research Questions

The dissertation six research questions. These guide the research to establish whether adding alternatives to a portfolio could improve risk-adjusted returns. Then, if so, then how could these be implemented in a way that reaches individuals broadly.

1. What is an alternative investment and how do we characterize those returns?

This chapter will review common definitions of what is included as an alternative investment. It will then explore key aspects of each alternative investment such as the underlying principles of the investment, its risk-return characteristics, and its correlation to traditional investments.

2. Does adding alternative investments to DC portfolios generate superior risk-adjusted returns?

This chapter will use mean-variance optimization across six different sets of capital market assumptions from major financial institutions to compare a public only portfolio built with only traditional investments to an all-market portfolio that is unconstrained in its investment selection. The analysis uses six different sets of assumptions since each institution has differing forecasts that can lead to different results. Capital market assumptions are forward-looking expectations of returns across different asset classes including equities, fixed income, and alternative investments. After constructing the portfolios, the section will also compare results between the portfolios such as any improvements in risk and return.

3. What are barriers to individuals adopting alternative investments in their DC portfolios?

This chapter will explore the common issues with adopting alternative investments including investor literacy, liquidity constraints, high initial investments, and high fees. These are all significant

challenges for individuals to investing in alternative investments. In these challenges, the dissertation will also explore potential solutions to overcome these barriers.

4. How do other savings programs include alternatives in portfolios?

This chapter will explore two existing programs. PGIM, formerly Prudential Investment Management, and BrightStart, the Illinois 529 plan, both use structures that enable them to invest in alternatives or alternative-like investment strategies. By examining how they structure their investments, the dissertation will document potential solutions for policymakers to enable broader adoption.

5. How can DC plans promote access to alternatives?

By combining potential solutions to the barriers and investment structures, DC plans emerge as large pools of capital, where most household financial wealth is concentrated. The large pools of capital along with the inherent long investment horizon of retirement plans make them a natural fit for having exposure to alternative assets. This is also consistent with how DB plans were and continue to be major investors in alternative assets. This section will explore how DC plans can be structured and designed to include alternative asset classes for employees.

6. What are the policy implications and recommendations for including alternatives in DC portfolios?

This chapter will address the current policy within Employee Retirement Income Security Act of 1974 (ERISA) and guidance the Department of Labor (DOL) has provided around the use of alternative investments in DC plans. This section will also use the barriers to adopting alternatives to address the ongoing discussions at the Securities and Exchange Commission (SEC) regarding the accredited investor definition, which limits participation in private markets to banks, financial institutions, sovereign wealth funds, and individuals and couples, who have high net worth, high income, or securities licenses.

Literature Review

Prior work showing evaluating alternative assets in defined contribution plans has been limited to a recent whitepaper from Georgetown's recent whitepaper with Willis Towers Watson (WTW). (Antonelli, 2018) The paper examines the potential role of alternatives in a portfolio using WTW data, but that data is limited in its representation of alternatives and misses components such as private debt and infrastructure. Furthermore, the paper discusses the potential of alternatives in improving returns, but it does not discuss the potential ways to implement alternatives at scale. This dissertation will expand upon the work by taking account a broader set of capital market assumptions. This provides a more robust analysis on the potential improvement in risk-adjusted returns when adding alternative assets.

In the finance literature, there is prior work using optimization theory to design an optimal portfolio including alternative asset classes. The evidence supports the use of alternative asset classes in portfolios. One paper finds alternative assets are beneficial in improving risk-return characteristics of portfolios using a multi-factor model of returns. (Oderda, 2013) Since alternative assets tend to have a non-normal distribution of returns, other studies evaluate the impact of alternative assets by using higher moments beyond portfolio variance and finds alternatives improve risk-adjusted returns even

when accounting for the thick tails of alternatives. (Schweizer, 2008 and Fischer et al, 2009) Using historical hedge fund performance, another study finds adding these alternatives are beneficial in totality and particularly beneficial during extreme market conditions when there are extreme returns in the equity or fixed income markets. (Schneeweis et al, 2002) All these papers consistently find adding alternative asset classes as beneficial to traditional asset classes.

The novelty of the work is that it will evaluate the potential effects of adding alternative asset classes to the set of assets available, and examining the asset class broadly as opposed to specific investments like only private equity or hedge funds. In addition, the work will consider how firms could implement adding alternative asset classes to defined contribution plans. Today, only 4% of defined contribution plans include hedge funds in their DC plans and other alternative investments are not even considered in industry surveys. (Deloitte, 2019)

Value-Added Contributions

The dissertation will add two major components to the space. It will examine the potential role of alternative investments in portfolios compared to portfolios consisting of only traditional public assets. This will be done using capital market assumptions from six institutions ranging from investment banks to asset managers to investment consultancies. These different market views capture different segments of capital markets both traditional and alternative. The variation between institutions provide confidence in the analysis as they have significantly different views between asset classes and may not necessarily lead to a pareto improvement. The dissertation will also explore the challenges of including alternatives and explore a potential structure that will allow for wider adoption of alternatives.

Roadmap

The dissertation will achieve this through a range of approaches. First, it will explore the definition of alternative assets. Second, it will use the data from the different institutions to compare portfolio returns using mean-variance optimization of all-market portfolios including alternatives and traditional investments versus a traditional-only portfolio. Third, it will explore the barriers and risks to adoption. Fourth, it considers how other savings programs are structured to include alternatives and how those approaches can be expanded to retirement savings programs like 401(k) plans.

The purpose of this research is to evaluate the potential risk-return tradeoffs of including alternatives in portfolios. This section will present the data used, the theoretical underpinnings of using optimization theory, and the results and conclusions of the analysis. The results will then directly inform the relevance of alternative investments in a range of portfolio needs.

Defining Alternative Investments

What are alternatives

Alternatives investments are a group of investments that have uncorrelated with traditional assets allowing them to improve risk-return characteristics to portfolios. They are a loosely defined group of investments that share several key characteristics in that they are less liquid than traditional investments, have high heterogeneity in returns across mangers, less regulation and transparency, less available historical return and volatility data. They are often only available in private markets, which make them less accessible to the public. Even if they were not in private markets, their high

minimum investment thresholds and long investment horizons make them inaccessible to individuals. Although the group would be beneficial to a portfolio, their inaccessibility makes them difficult to implement for most people.

Alternatives provide diversification to traditional assets across multiple factors. Hedge funds and other liquid products provide diversification from public equities and fixed income. Private equity provides enhanced performance to public equities. Similarly, private credit improves yield versus fixed income. Real estate and infrastructure are inflation hedges since demand for their service is inelastic and prices have automatic adjustment mechanisms. (Williams, 2023)

Traditional assets represent publicly available stocks and bonds. Stocks include domestic equity markets often measured by the S&P 500, representing the 500 largest companies in the United States, or the Dow Jones Industrial Average, representing 30 major companies in the United States. Markets exist for small firms often represented by the Russell 2500, which includes 2,500 of small and medium-sized companies. Equity markets exist outside of the United States. These are often divided by developed and emerging markets. Developed markets include most of the United States, Canada, Western Europe, Israel, and portions of the Pacific such as Japan, Australia, Singapore, Hong Kong, and New Zealand. (MSCI World, 2024) Emerging markets include China, India, Taiwan, South Korea, Brazil, and others. (MSCI Emerging Markets Index, 2024) Bonds represent the other half of the investable universe for individuals. These can also be divided by geographies like stocks, but they are also divided by the issuer. Bonds are different from equities in that they can be issued by companies, but also by national governments and state and local governments. These markets have become more accessible over time as capital markets have globalized allowing for more investors to access these markets without living in their respective places.

As shown in Table 1 below, what qualifies as an alternative asset is inconsistently defined. The table shows how BlackRock, PIMCO, Chartered Alternative Investment Analyst Association (CAIA), and Chartered Financial Analyst Institute (CFA) define alternatives. CAIA and CFA Institute are professional organizations that provide professional accreditation to individuals in the field of alternative investments and investment management, respectively. While BlackRock and PIMCO are major financial institutions that manage assets on behalf of investors including both traditional and alternative asset classes. Yet none of them are aligned in what is an alternative investment and furthermore, definitions tend to overlap such as real estate and credit.

	BlackRock	PIMCO	CAIA	CFA
Private Equity	X	X	X	X
Private Debt	X	X	X	X
Infrastructure	X			X
Private Real Estate	X	X	X	X
Hedge Funds	X	X	X	X
Other Real Property		X		X
Natural Resources				X

Table 1: What each institution considers an alternative asset

Alternatives continue to grow as a share of the investible global market. From 6% of the investable market in 2004, it doubled by 2018. That growth has only accelerated, and the market is forecasted to double once more by 2025 going from its first doubling in 14 years down to 7 years in its next

doubling. (Williams, 2023) The growth of private markets has also displaced public markets, where both listed companies and total value of equity markets have continued to shrink. The US has half the number of listed firms from the early 2000s and for a third consecutive year the value of equity markets have shrunk. (Charlton, 2024)

A primer on each alternative

As mentioned in the previous section, there is no singular definition as to what an alternative asset is. This section will not try to develop a singular definition, instead it will describe major asset classes within the alternative asset universe. Investors can access all these asset classes through funds, where managers raise capital from accredited investors to deploy on their behalf. This section will provide an overview of private debt, commodities, private real estate, infrastructure, hedge funds, private equity, and all else.

Private Debt

Private debt funds invest in non-public debt securities. They exist outside of regular channels like bank lending or public debt markets. Private debt funds will provide capital to non-public firms but could include other lending channels such as peer-to-peer lending. They are privately negotiated loans to corporate borrowers or when companies acquire debt from non-bank lenders and are no issued in an open market and is not readily traded. Private credit is roughly 30% of the corporate debt market in the US. (Elsabee, 2023)

Private credit is often divided into four main categories: direct lending, distressed & special situations, real estate and infrastructure debt, mezzanine, and others. Direct lending is when a lender, a private credit fund, and borrower negotiate financing directly with each other. These are often small-to-mid sized firms that used to borrow from banks, where post-Global Financial Crisis has found better terms through private credit than traditional banking channels. Distressed debt is when lenders negotiate with entities ranging from sovereign countries to firms that have defaulted on their loan, in bankruptcy, or nearing either scenario. They are significantly riskier since these entities are often in bankruptcy or being re-capitalized. Real estate debt and infrastructure debt is private debt for the development of either real estate or infrastructure. Lastly, mezzanine debt is private credit that is subordinate in the capital structure to senior debt, by definition, mezzanine debt is riskier than senior debt and begins to straddle in definition between equity and debt. Private credit, like public credit, ranges in its risk and return characteristics from less risky senior debt to distressed scenarios to subordinate credit. (Chan, 2023)

Private credit is the result of a shrinking traditional banking sector. Since 2000, the number of US banks has declined from 8,315 to 4,036 between 2000 and 2023. (FDIC, 2024) With the decline in the number on banks and consolidation of banks, they have focused on larger borrowers. Small- to mid-market lending was once dominated by traditional banks from 72% of capital raised in 1994 to only 13% in 2021. (Elsabee, 2023) Private credit also has its own tradeoffs for both the lender and borrower versus the traditional banking channels. From the lenders' perspective, they lack liquidity and require greater due diligence, but achieve potentially higher return, lead the due diligence process themselves, negotiate more advantageous terms, have greater management team access, and more control in downside scenarios. Conversely, from a borrowers' perspective, they are paying higher coupons and have more restrictive terms but are trading that off for a customized loan solution, improved certainty of execution, privacy from disclosure, and a partner-like lender. The

structural banking changes along with the certainty of execution have led to the development and continued growth of the Private Credit market.

Although Private Credit is considered an alternative, its risk-return characteristics are like public fixed income securities. They tend to have higher returns than other fixed income securities with risk comparable to other fixed income securities like Treasures and Investment Grade bonds with returns higher than High Yield.

Commodities

Commodities are most easily understood by physical commodities such as tons of wheat or corn. However, owning commodities does not necessarily have to be physicals since owning physical commodities require storage and transportation. One could also invest in natural resource equities like mining firms, but they have increased correlation with public equities unlike actual commodities. Instead, funds often own either futures contracts to avoid physical possession or other alternatives that are then used to track commodity indices. Commodities provide diversification and an inflation hedge since they are poorly correlated with other asset classes and provide protection against inflation. (Nelson, 2023)

Commodities are highly correlated with global nominal GDP growth. They also have low correlation to both public equities and bonds, while having outsized performance to inflation. This makes commodities an attractive inflation hedge that is not correlated with traditional markets even outpacing real estate in protecting against inflation. (Nelson, 2023)

Private Real Estate

Private real estate includes residential, commercial, and other properties like data centers and storage units. Ownership interests can be structured through funds in several ways from outright ownership to leveraged purchases to privately traded securities backed by pools of properties. Commercial real estate is valued at $22.5 trillion making it the third largest investable asset class after debt and equities. Of the $22.5 trillion, 6% is owned through public real estate investment trusts, which are like traditional equities with additional requirements to return most of the rental income to owners. The remaining 94% is owned privately. (Financial Stability Report, 2024)

Real estate risk and return straddle equity and debt markets. They are not as conservative as debt markets nor are they as risky as equity markets. Real estate funds are segmented into 4 sub-asset classes: core, value-added, opportunistic. Each portion of the market invests differently from each other. Core represents stabilized properties that have tenants. They tend to have lower returns, but also lower volatility. Value-added properties require additional work, such as modifications to make them rentable and so they have higher risk, but potentially higher return. Opportunistic is the most speculative portion of the real estate market. They seek to develop land and build new construction to eventually rent to tenants. (Hartung, 2023)

Infrastructure

Infrastructure is another major real asset class along with commodities and real estate. It can range from physical infrastructure like ports, airports, and highways to sector specific infrastructure like power lines and aqueducts.

Hedge Funds

Although hedge funds by name may sound like they hedge risk. This is not necessarily true. Instead, hedge funds may both purchase and short sell securities, use leverage to magnify returns and losses, or use derivative instruments such as options, swaps, and futures. Some hedge funds will hedge risk by being low beta and develop a stream of returns that are purely uncorrelated with traditional investments. While other hedge funds may have significant biases in a long or short position on markets. Hedge funds are characterized by their absolute return mandates, so that their returns are not measured against major markets like traditional equity and fixed income. Due to the structure of their transactions, they often have higher liquidity than other alternative investments with quarterly redemptions versus multi-year lockup periods.

Hedge funds can be categorized into 4 sub-asset classes: equity hedge, event-driven, relative value, macro, and multi-strategy. Within each sub-asset class, there is further segmentation, but is beyond the scope of this dissertation.

Equity hedge strategies use a long/short strategy to develop returns. Exposures can range for example a 100/40 strategy would be 100% long and 40% short to have a 60% net exposure and 140% gross exposure to equity markets, while some products can be 120/20 which would be 120% long and 20% short to have a 100% net exposure and 140% gross exposure. The combinations are up to the fund manager and client to design the product that best fits the need of the broader investment portfolio.

Event-driven hedge funds are exactly as they sound in focusing on events and finding returns in those idiosyncratic moments. They focus on merger arbitrage, activist events, distressed/ restructuring opportunities, or other special situations. Merger arbitrage will purchase the target firm and short the acquiring firm to deliver returns. Activist strategies will buy shares to obtain board seats then advocate significant strategic changes such as asset sales, divestitures, or other changes in management. Distressed/ restructuring strategies will purchase debt trading at deep discount from a bankruptcy situation and seek to recapitalize or restructure the debt into favorable terms. Lastly, other special situations include creating merger opportunities, liquidating assets, refinancing debt, and tax strategies.

Relative value hedge fund strategies generate returns through a series of small market discrepancies. To generate greater returns, these strategies often deploy leverage to magnify their returns. Long-Term Capital Management was famous for using relative value across markets on a global scale until interest rates rose and the cost of borrowing to magnify returns bankrupted the firm.

Macro hedge fund strategies seek profits from market swings due to political or economic events around the world. They are focused on price, economic, and political variables rather than individual companies. They will trade in liquid markets such as currencies, commodities, interest rates, or equities often using derivative instruments such as futures, forwards, options, and swap contracts. Perhaps the most famous example of this strategy is George Soros' 1992 short of the British Pound, which was overvalued relative to the German Mark. The UK tried to maintain its exchange rate limit as prescribed by the European Exchange Rate Mechanism (ERM I). Eventually the British government exited the ERM I and let the pound float against European currencies. Soros is estimated to have made over $1 billion on this single trade. (Litterick, 2002) Macro funds use two

different approaches: discretionary and systematic. Soros' British Pound trade is a discretionary approach, taking a bottom-up approach in finding market dislocations. Systematic strategies find patterns in markets and trade pricing differences.

Multi-strategy hedge funds deploy all four of the previously mentioned strategies. Rather than having one manager responsible for a single fund, they have multiple specialized portfolio managers deploying each of the strategies. By blending the four strategies, multi-strategy solutions generate a blended return stream with lower risk, while allowing the multi-strategy manager allocate capital between strategies for clients. The tradeoff with these strategies is that they tend to have higher fees since clients are paying for multiple layers of portfolio managers, so scale is critical to managing costs to remain competitive.

The hedge fund industry's growth has slowed over the years in both assets and firms. The compound annualized growth rate of assets was 15.4% from 1990 to 2022, while from 2012 to 2022, it grew at 5.4%. The number of funds has leveled off around 8,000 funds since the mid-2000s. This has led to larger and larger hedge funds, where less than 10% of hedge funds control nearly 70% of assets. These larger firms typically have greater governance structures and risk management systems. (iCapital, 2023)

Hedge fund performance has declined on a relative and absolute basis since the Global Financial Crisis of 2008. Returns between 1990 and 2008 were 11.8% versus the S&P 500 returning 7.3% with only 7.1% standard deviation versus 14.6% for the S&P 500. However, from 2009 to 2022, returns have declined to 5.5% versus 13.1% with the S&P 500, while volatility has been 6.1% versus 15.4%. The downshift in performance is attributed to a range of factors such as the historically low volatility in markets and interest rates coming out of the Global Financial Crisis. Their continued growth in assets is an indicator of how large asset managers still see value in hedge funds managing return streams in a portfolio.

Private Equity

Private equity firms invest in equity of firms that are private. They can be early-stage investors like angel investors when companies are no more than an idea. Venture capital firms could also be early to mid-stage investors looking to provide capital to grow firms. In this phase, a firm's market is still unclear as they are developing products. Traditionally, these were firms in technology or healthcare, but now include new categories like financial technology, biotechnology, consumer products, marketplaces, software-as-a-service, frontier technology, and artificial intelligence firms. Private equity could also include leveraged buyout (LBO) funds that use leverage to purchase existing firms then use a combination of cutting costs, increasing revenue, or re-capitalize the firm to sell the company at a higher multiple than the original purchase price. LBO funds accumulate most of the assets in private equity representing more than 50% of the overall private equity market.

Like hedge funds, the LBO market is also consolidating. In 2022, megafunds, with assets greater than $5B, represented 57% of the total capital raised rising from only 19% in 2015. They were also more successful in raising capital compared to small fund peers. 93% of megafunds met their 2022 targets while only 53% of funds with less than $5B in assets met their targets. As funds grow, they are also generating higher returns. Funds with over $1B in assets were able sell their acquisitions at

12.9x multiples versus funds with less than $50M could only divest at 8.1x, generating a 59% improvement at exit. (Burger and Calcagno, 2023)

Others

Other alternatives include real assets not included in the list. These include, but are not limited to artwork, fine wines, stamps, or antiques. There is also growing interest in environmental, social, and governance (ESG) investing in alternatives. This is not a unique asset class but intersects multiple asset classes. For example, there is ESG real estate where investors purchase organic farms or ESG infrastructure funds providing debt or equity investments in solar and battery power plants.

The Framework

Optimization problem

The dissertation seeks to examine the risk-return tradeoff between a portfolio of public only assets versus a portfolio that has access to both private and public assets. In doing so, it will employ a mean-variance optimization. (Markowitz, 1952) Mean-variance optimization is a quantitative method that adjusts the weights in a portfolio of investments to find the minimum level of risk subject to a level of return, a fully invested portfolio, and to not short any investments. This research will use six different sets of capital market assumptions, which include long-term expected risk and returns of different asset classes along with their correlation to each other, to determine a range of portfolio solutions that minimize risk, while maximizing return over the range of possible returns within the data set. For example, one set of assumptions minimum return is from 2.0% and its maximum return is 10.0%, then it will solve for the pareto optimal portfolios over that entire range.

Optimization Math

The most general form of the optimization specification is to find the optimal portfolio by minimizing risk subject to a given level of return, being fully invested, and not short selling any investment. Solving this problem over the range of asset class returns translates to a pareto optimal portfolio. To do this, the optimization problem is solved over small increments of returns to develop the portfolio curve. Specifically, the dissertation uses Excel Solver's Generalized Reduced Gradient Nonlinear method to solve the problems. (Lasdon et al, 1978) The analysis will return two pareto optimal portfolio sets. One with public only assets and another with a combination of public and private assets. The resulting combination plots show the tradeoff of mean-variance optimized portfolios. Furthermore, the curve of the graph will span a range of returns and portfolio standard deviations, which can further explore the differences at low return, high return, and transitional spaces for a range of investment return needs for individuals.

Equations and Definitions

The objective function of the optimization problem is to select weights on each asset class to minimize risk as shown in Equation 1. This is a function of the covariance between asset classes and their portfolio weights. By changing the weights, w, in Equation 1, this will find the minimum level of risk. The i^{th} and j^{th} terms are not exclusive in that the $\sigma_{i,i}$ is the asset class's variance and correspondingly $w_i w_i$ is its weight and the direct contribution to the overall portfolio risk. Conversely, when $i \neq j$, then the portfolio risk is the contribution from the correlation between asset classes.

Minimize:

$$\sigma^2(w_i) = \sum_{j=1} \sum_{i=1} \sigma_{i,j} w_i w_j$$

Equation 1: Portfolio Risk as Measured by Portfolio Variance

There are several key components to Equation 1:

σ^2: variance of portfolio of securities, a function of covariation and asset class weights

$\sigma_{i,j}$: covariation of asset class with respect to the ith and jth asset classes

w: weight of asset classes

The variance, σ^2, will be minimized and its constraints will be described below. The covariation, $\sigma_{i,j}$, is provided by the capital market assumptions from each of the financial institutions. The weight, w_i , is endogenous to the model and is the weight or level of investment in each asset class within the portfolio. As such, it has a subscript i to represent each asset class. The value of w_i will change to satisfy the requirements of the optimization.

The objective function is bounded by a set of constraints. The first is the return constraint in Equation 2, the product of the asset class weights, and their expected return must meet a level of return r. The portfolio must also be fully invested in that the summation of the weights equal one as shown in Equation 3. This is a binding constraint as even cash or cash equivalents are an investable asset class in the capital market assumptions. Lastly, the asset class weights are greater than or equal to zero and less than or equal to one in that there is no shorting in a portfolio nor can an asset class exceed the total investment as shown in Equation 4.

Subject to:

Return constraint of a portfolio:

$$r - \sum_{i=1} w_i x_i \leq 0$$

Equation 2: Expected Return of a Portfolio

r: given level of return in a portfolio

x: given level of return for an asset class

Fully invested portfolio:

$$\sum_{i=1} w_i = 1, i = 1,2, \dots, m$$

Equation 3: Summation of Weights of Asset Classes

All long positions:

$$0 \leq w_i \leq 1$$

Equation 4: Short Selling Exclusion and Maximum Investment Boundary

Pivoting to the exogeneous variables, each financial institution provides risk, return, and a covariance matrix. x_i is the expected return of asset class i. σ and σ^2 will be used to represent standard deviation and variance of the overall portfolio. These will have a subscript for a given security and not when discussing a portfolio for simplicity. For example, σ_i is the standard deviation of asset i , $\sigma_{i,j}$ is the covariance of asset i and j, and σ is the standard deviation of a portfolio consisting of the different asset classes.

Data and Descriptive Statistics

The data

The analysis uses forward-looking 10-year capital market assumptions from six different firms including BlackRock, Callan, Goldman Sachs, JP Morgan, Russell, Willis Towers Watson. These are a range of institutions including investment companies, insurance firms, and investment consultancies. BlackRock is a multinational investment company and the world's largest asset manager. Callan is an investment consultancy responsible for advising institutional investors such as pensions and endowments. Goldman Sachs in a multinational investment bank and financial services company. JP Morgan is a multinational finance company and is not only the largest bank in the United States, but also the largest bank in the world by market capitalization. Russell is an investment firm responsible for outsourced investment management and investment consultancy. Willis Towers Watson is a multinational insurance firm. Each of these firms represent different stakeholders that either buy investments, market products, or provide services to manage investments on behalf of clients. As such, they provide a representative sample of broad market expectations across asset classes. Each firm publishes annual forecasts for public use.

The analysis uses 10-year assumptions as these are long-term expectations from these firms. It does not use short-term expectations such as 1-year to 5-year views since these are driven by current market trends. Retirement horizons are beyond 10-years, but most firms consider their 10-year forecast their long-term outlook. Some firms have 20-year outlooks, but coverage is limited for those horizons and do not vary from their 10-year forecasts. The analysis is using long-term expectations as it represents an average of returns consistent with what individuals would use in their retirement savings portfolios. Although these are forward-looking guidance on expected returns, they are based on a combination of long-term historical returns and the firms' expected economic growth in the economy, this translates to an internally consistent set of assumptions based on history and an expected future.

The data used is from a range of institutions. Each firm has different views on the investable universe of asset classes in how they delineate asset classes. These institutions develop forecasts for 16 to 53 different investable asset classes. There are different explanations as to why the number of asset classes varies. There are some asset classes that one firm may have a view on that other firms

do not include. For example, gold is covered by only one firm. Similarly, one firm may have a view on one larger class of assets, while another provides a deep dive into the subcategories within that asset class. Hedge funds are an example, with one institution including asset classes for five different strategies of hedge funds, while others only one category for all hedge funds.

There are fundamental differences between institutions. Particularly with alternatives, each institution uses their own benchmarks to evaluate past performance since there is not a public market. Some institutions develop their own internal benchmark based on information they have access to through their clients, which can lead to selection bias. Other institutions use public benchmarks of alternatives, but those too are problematic since the data is not updated frequently, while others are surveys of fund managers. These survey methods have their own issues since weighting between managers in these benchmarks are not consistent. Public benchmarks that are well-designed and robust for alternative asset classes continue to be a major opportunity area.

Furthermore, each of these institutions take different approaches to developing their forecasts. Institutions can take a bottom-up approach, top-down view, or a hybrid of the two to develop their long-term forecasts. Some institutions will use a bottom-up approach where they aggregate long-term country and company forecasts to build up earnings growth and aggregate them up to asset classes such as Willis Towers Watson. On the other hand, some institutions take a macro view on productivity, GDP growth, and inflation to inform their projections such as Callan. Other institutions will take the combination of these bottom-up and top-down approaches to develop their forecasts such as Goldman Sachs and JP Morgan. The combination of these factors leads to differences in forecasts for any given asset class.

A look at the data

Large U.S. equity index, i.e.: S&P 500, is covered by all six institutions. As shown in Figure 1, the projected annualized return for an annualized ten-year period ranges from 6.3% to 8.1% with a projected standard deviation in a year of 15.3% to 17.7%. Despite being a well-covered space in the investable universe, there is a significant difference of opinions as to what the S&P 500 will return in the long-term. These differences highlight the fundamental tension of using one set of forecasts from one institution. Conclusions using only one institution's forecasts could lead to a strategic asset allocation that would not consider the range of potential futures. Each firm has a different approach to informing their estimates.

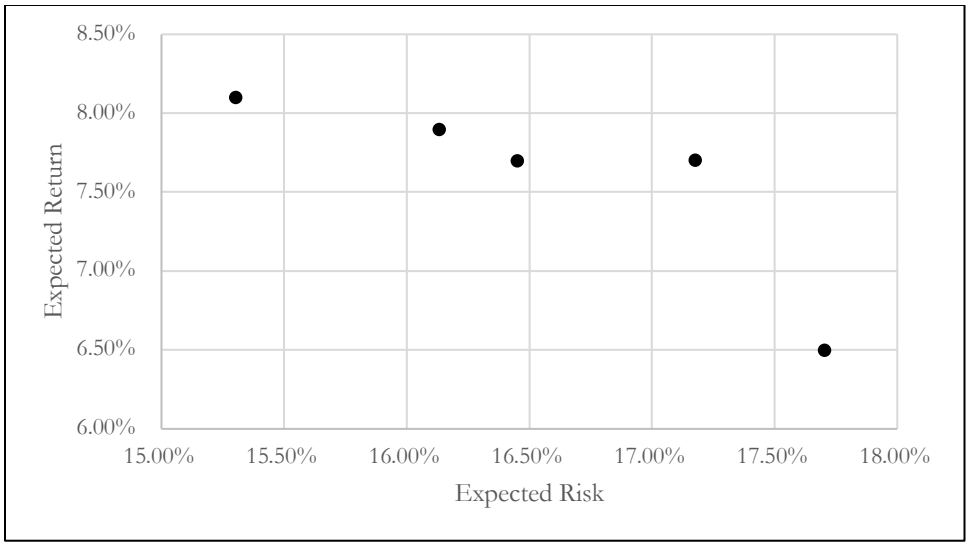

Figure 1: Expected Returns and Risk for the S&P 500

The data yields similar differences in correlations between asset classes. Examining the subset of asset classes between US Large Cap Equity (S&P 500), US Investment Grade Corporate Bonds (the Agg), and Hedge Funds, we see spread between Goldman Sachs, JP Morgan, and Willis Towers Watson. Russell was excluded in this comparison since they only provide a forecast on US Equities broadly. The resulting sub-matrix of correlations is the average correlation between asset classes in Table 2. As shown in Table 2, equities and bonds have a low correlation with minimal spread. Adding hedge funds in the third column increases spread in the correlation, but also provides a different layer of diversification since hedge funds are not highly correlated with either equities or bonds. These results begin to illustrate the potential benefits of adding alternative asset classes to a portfolio that previously only contained public assets.

	S&P 500	Agg	Hedge Funds
S&P 500	1.00	0.22 ± .03	0.57 ± 0.12
Agg		1.00	0.12 ± 0.07
Hedge Funds			1.00

Table 2: Average correlations and standard deviations of subset of asset classes

Given the differences in expectations across firms and asset classes, the relative weights within a portfolio are more relevant in this analysis than absolute numbers. These are all forecasts on risk, return, and the correlation between asset classes. As such, there is inherent uncertainty in making projections about the future and most likely none will perfectly project what will happen in the future.

Results and Discussion

The following section provides the results of the mean-variance optimization for all-market versus public only portfolios from the assumptions provided by each of the six institutions.

Russell

The mean-variance optimization used Russell's assumptions on 10-year forward looking returns across asset classes. We first consider Russell's 10-year forecast. Russell has 20 different asset classes. Figure 2 compares the minimum variance solution over the range of potential returns of the Public Only portfolio compared to the All-Market portfolio. The annualized standard deviation is on the x-axis and the expected annualized return is on the y-axis. As shown in Figure 2, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness in that for the same level of risk the All-Market portfolio had a higher level of expected annualized return. For example, the Public Only portfolio has a 2.8% annualized standard deviation with a 4.2% expected annualized return compared to the All-Market portfolio having a 6.3% expected annualized return at the same level of risk. This difference decreases as risk increases and both portfolios converge at 6.4% annualized standard deviation with 7.5% expected annualized return. The All-Market portfolio also offered lower risk options compared to the Public Only portfolio. While the Public Only portfolio has a lower bound of 2.8% annualized standard deviation, the All-Market portfolio has a lower bound of 2.2%. Furthermore, the lowest risk portfolio has higher returns with the All-Market portfolio at 5.4% expected annualized return versus the Public Only portfolio of 4.2%. The All-Market portfolio could also achieve higher returns greater than 6.4% with increased overall risk that the Public Only portfolio could not achieve with its set of asset classes. The All-Market portfolio has an expected annualized return maximum of 9.0% albeit with a 23.4% expected annualized standard deviation versus the Public Only portfolio maximum return of 6.4% with 7.5% annualized standard deviation.

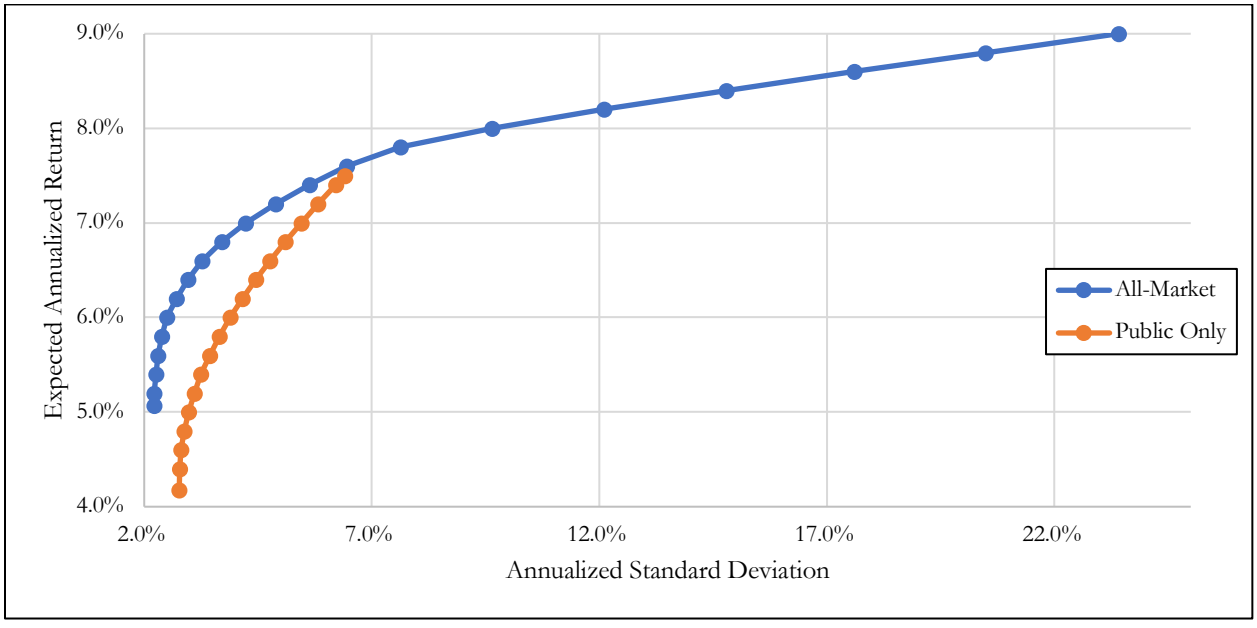

Figure 2: Russell's All-Market vs. Public Only Portfolios

To achieve these results, the All-Market portfolio used a combination of Alternatives and Fixed Income asset classes as shown in Figure 3. This figure uses the data from the All-Market portfolio to describe its composition between Alternatives, Fixed Income, and Equities. The x-axis is also the annualized standard deviation of the portfolio, while the y-axis is the percent of the portfolio to the

respective category of asset classes. The optimal portfolio did not include publicly traded Equities since Alternatives offered improved risk-adjusted returns versus Equities. Risk-return characteristics converge in Figure 2, where traditional assets peak in Figure 3. The changing distribution in Alternatives imply different asset class allocations within the Alternatives space. As the portfolio increases in riskiness, it is moving from one Alternative asset class to another.

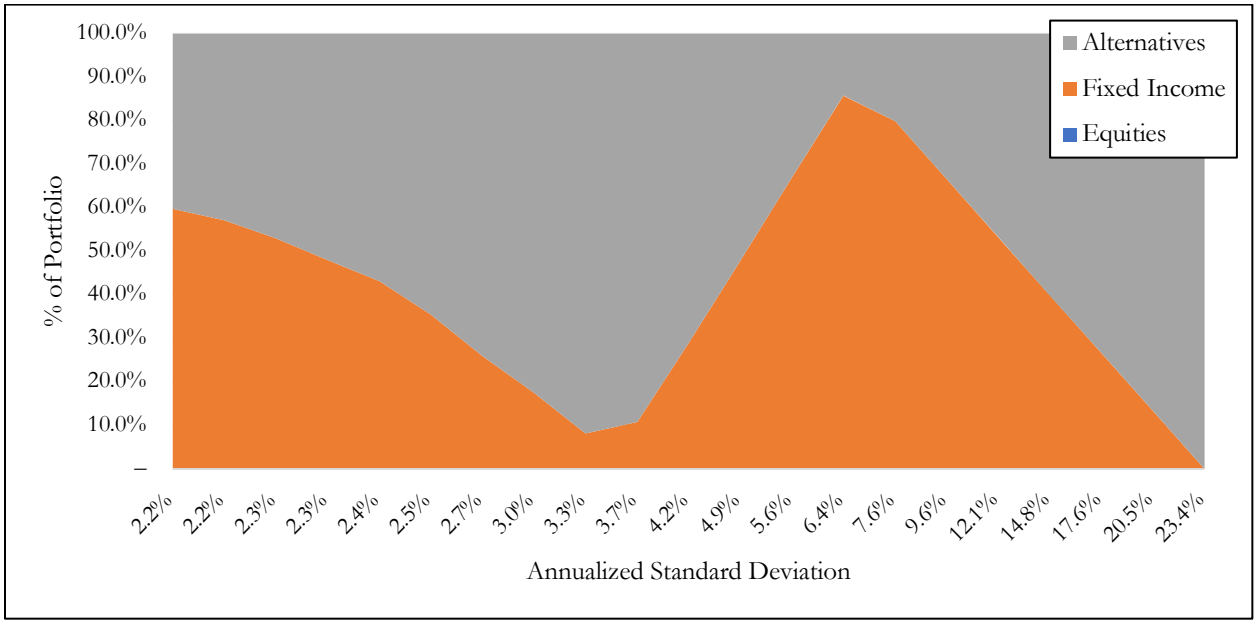

Figure 3: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Private Credit and Private Equity as shown in Figure 4. Figure 4 further describes the findings of Figure 3 by examining the composition of the Alternatives used in the All-Market portfolio. The x-axis is once again the annualized standard deviation, but the y-axis now represents the % of Alternatives within the portfolio to normalize the distribution of Alternative asset classes. Despite the data set having multiple Alternative asset classes, only two were dominant in the mean-variance optimized portfolio. The low-risk portion of the portfolio uses mostly Private Credit and then shifts to Private Equity in the high-risk portion of the portfolio. Other asset classes like hedge funds and other real properties, such as commodities, real estate, and infrastructure, were not in the All-Market portfolio composition since Private Credit and Private Equity provided sufficient return and diversification benefits that offset the need for any other Alternative asset class. The transition of the two also coincides with where the All-Market and Public Only portfolio converges in risk-return characteristics at 6.4% annualized standard deviation.

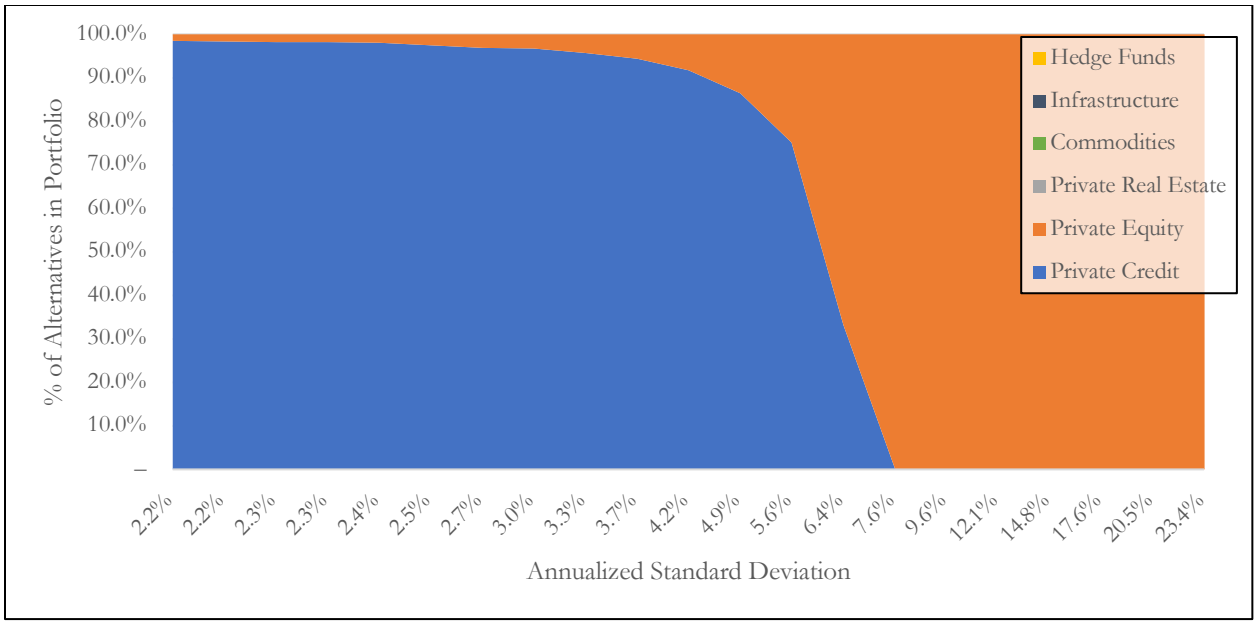

Figure 4: Mix of Alternatives in All-Market Portfolio

JP Morgan

Next, we consider the mean-variance optimization using JP Morgan's assumptions on 10-year forward looking returns across asset classes. As shown in Figure 5, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness. Both portfolios have a minimum annualized standard deviation of 0.5%, but the All-Market portfolio has an expected annualized return of 2.5%, while the Public Only portfolio has an expected annualized return of 2.4%. This difference increases to nearly 1% of out-performance with the All-Market portfolio between 7.0% and 10.0% annualized standard deviation. The All-Market portfolio could not achieve higher returns with increased overall risk than the Public Only portfolio since both had Emerging Market Equity as the highest potential returning asset class across all traditional and alternative asset classes. The All-Market portfolio offered lower risk options compared to the Public Only portfolio by 0.3 basis points.

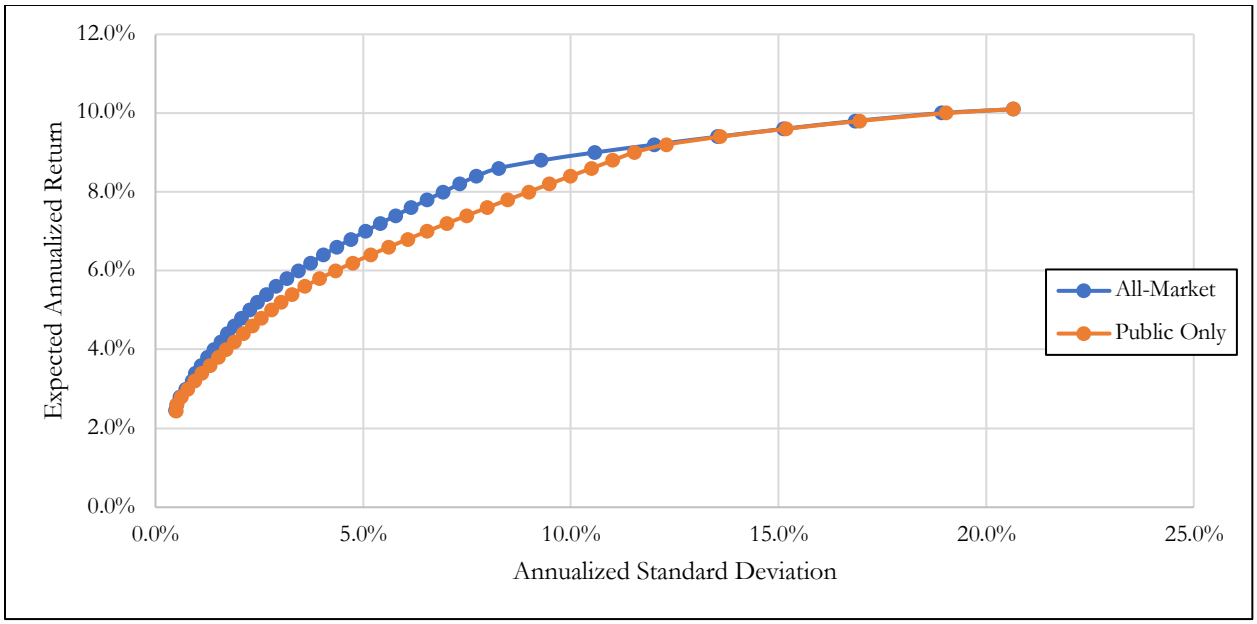

Figure 5: JP Morgan's All-Market vs. Public Only Portfolios

To achieve these results, the All-Market portfolio used a combination of Alternatives, Equities, and Fixed Income asset classes as shown in Figure 6. Risk-return characteristics converge in Figure 5, where traditional assets peak in Figure 6. The changing distribution in Alternatives imply different asset class allocations within the Alternatives space.

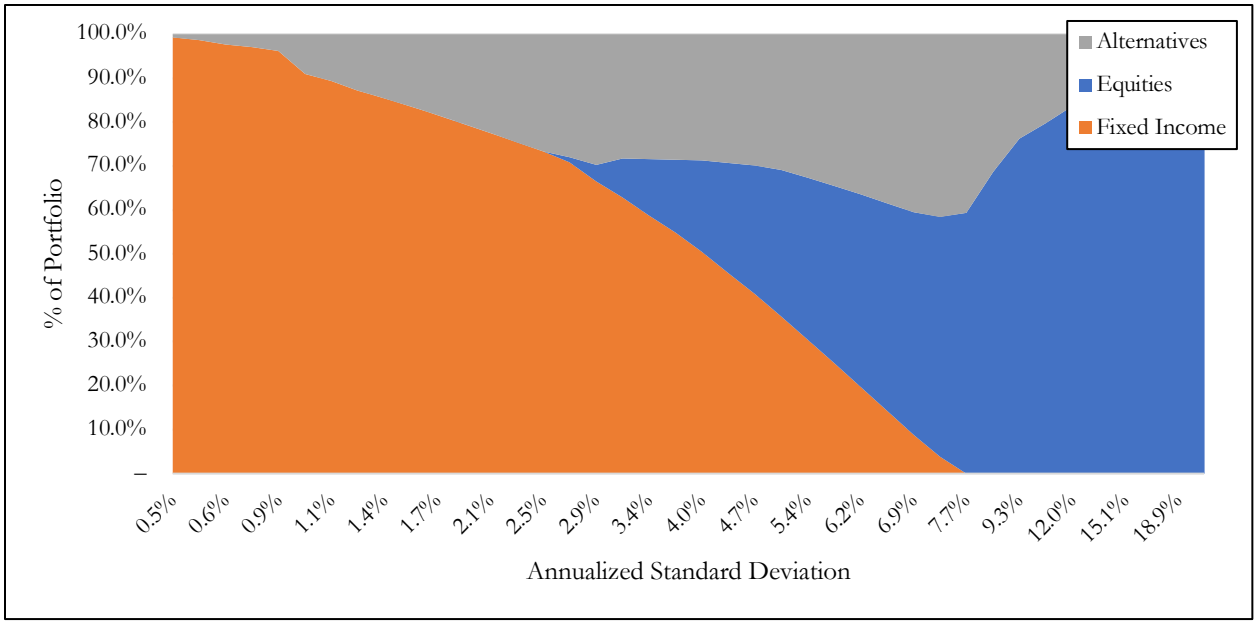

Figure 6: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Alternatives as shown in Figure 7. This included Private Equity, Real Estate, Infrastructure, Private Credit, and Hedge Funds. Although the data set included commodities, the analysis did not show an allocation to commodities. The low-risk portion of the portfolio uses mostly Real Estate and Private Credit and then shifts to Private Equity and

Infrastructure in the high-risk portion of the portfolio. Hedge Funds are found between the two phases of the portfolios.

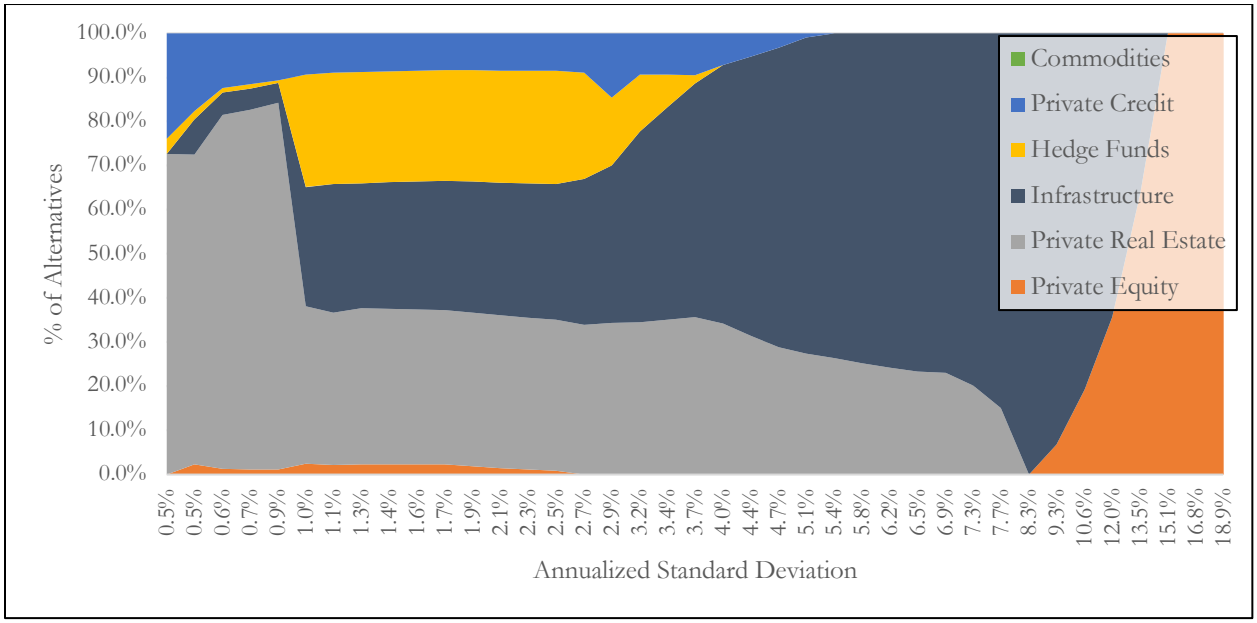

Figure 7: Mix of Alternatives in All-Market Portfolio

Willis Towers Watson

Next, we consider the mean-variance optimization Willis Towers Watson's (WTW) assumptions on 10-year forward looking returns across asset classes. As shown in Figure 8, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness. The outperformance is approximately 0.5% of expected annualized return from 5.0% to 10.0% in annualized standard deviation. Unlike other results, the Willis Towers Watson results did not result in a lower overall risk All-Market portfolio since the lowest risk option consisted of publicly available fixed income asset classes. The All-Market portfolio could achieve higher returns with increased overall risk than the Public Only portfolio. The maximum expected annualized return for the All-Market portfolio was 10.5% with 35.1% annualized standard deviation compared to the Public Only portfolio with a maximum expected annualized return of 7.9% and 19.1% annualized standard deviation.

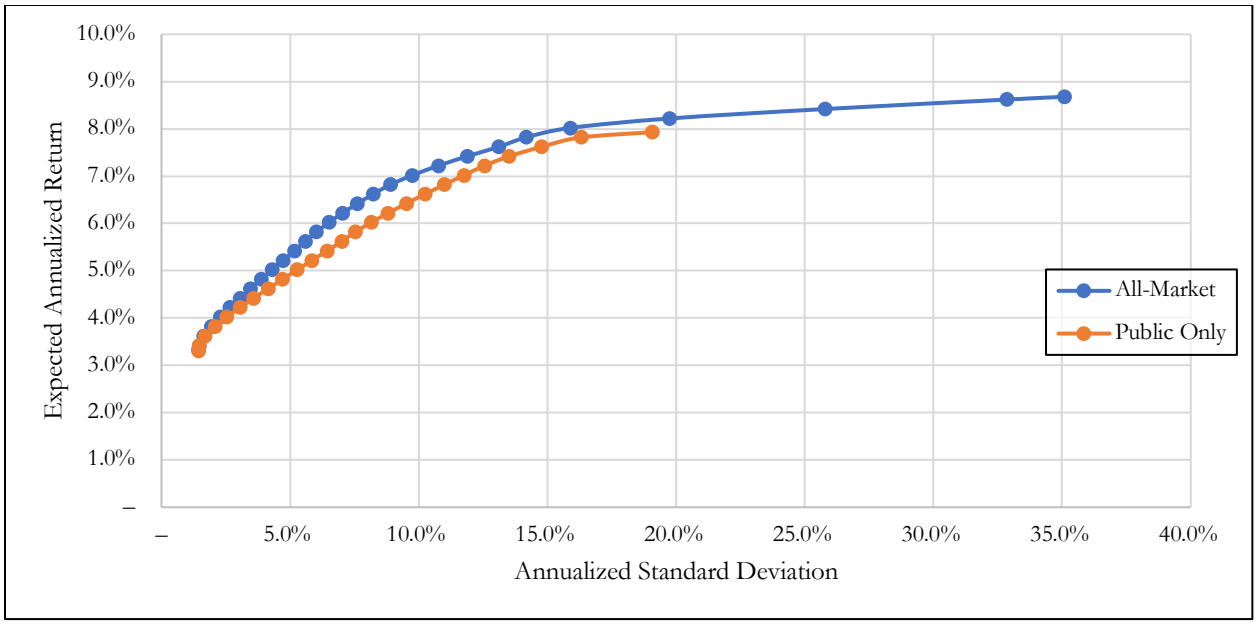

Figure 8: WTW's All-Market vs. Public Only Portfolios

To achieve these results, the All-Market portfolio used a combination of Alternatives, Equities, and Fixed Income asset classes as shown in Figure 9. Risk-return characteristics converge in Figure 8, where traditional assets peak in Figure 9. The changing distribution in Alternatives imply different asset class allocations within the Alternatives space.

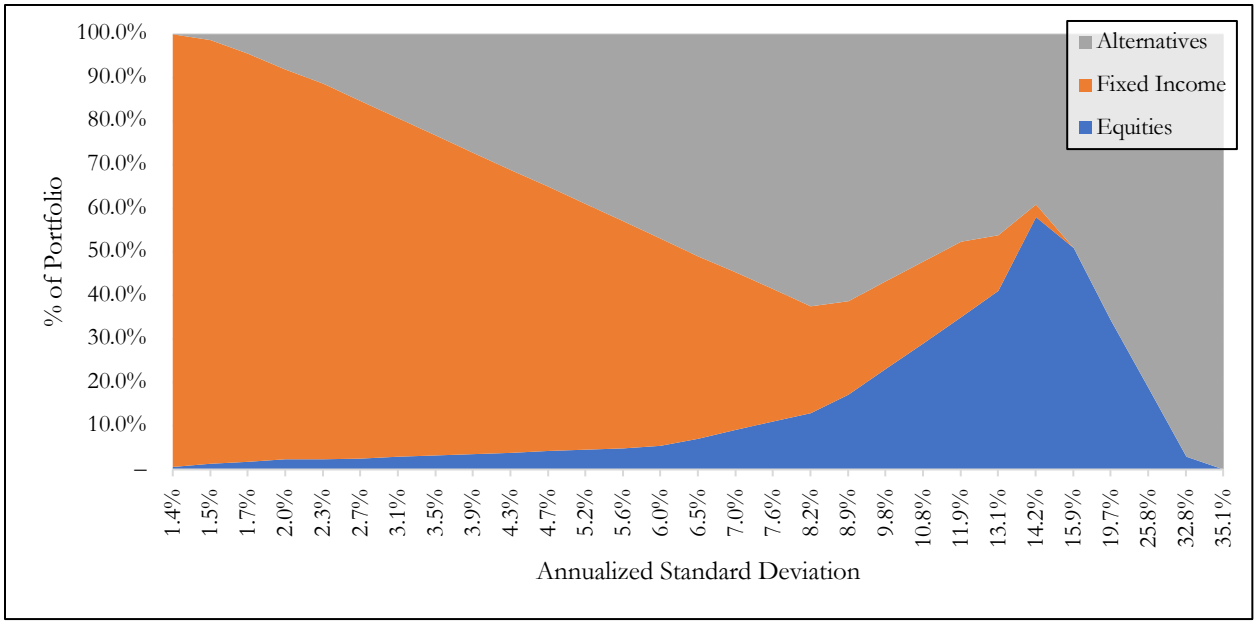

Figure 9: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Alternatives as shown in Figure 10. This included Private Equity, Real Estate, Commodities, and Hedge Funds. The low-risk portion of the portfolio uses mostly Hedge Funds and then shifts to Private Equity in the high-risk portion of the portfolio. Commodities and Real Estate are found between the two phases of the portfolios.

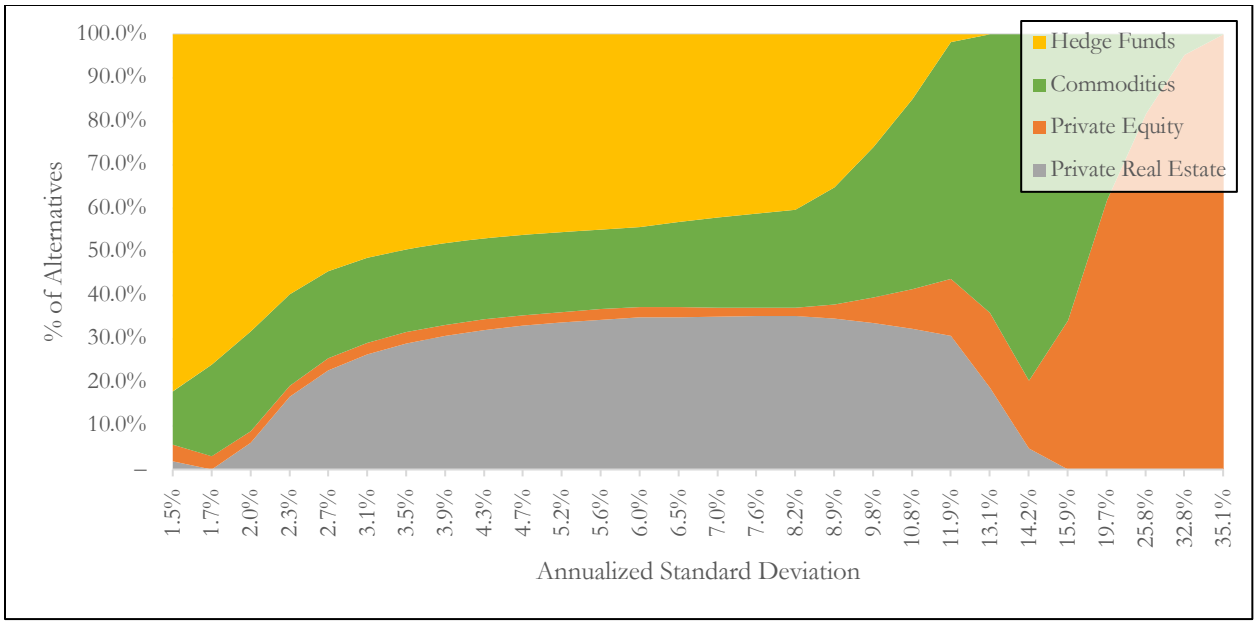

Figure 10: Mix of Alternatives in All-Market Portfolio

Goldman Sachs

Next, we consider the mean-variance optimization using Goldman Sachs' assumptions on 10-year forward looking returns across asset classes. As shown in Figure 11, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness. The outperformance of the All-Market portfolio grows from 1.0% at the Public Only portfolio minimum risk of 3.3% annualized standard deviation to a maximum of 2.6% at the maximum risk of the Public Only portfolio at 18.9% annualized standard deviation. The All-Market portfolio offered lower risk options compared to the Public Only portfolio as well. The All-Market portfolio minimum risk is at 3.0% annualized standard deviation with 4.5% annualized standard deviation. Meanwhile, the Public Only portfolio has a minimum risk portfolio of 3.3% annualized standard deviation and 4.2% expected annualized return. The All-Market portfolio achieved higher returns with increased overall risk than the Public Only portfolio. The portfolio reaches a maximum expected annualized return of 12.9% with 20.6% expected annualized return.

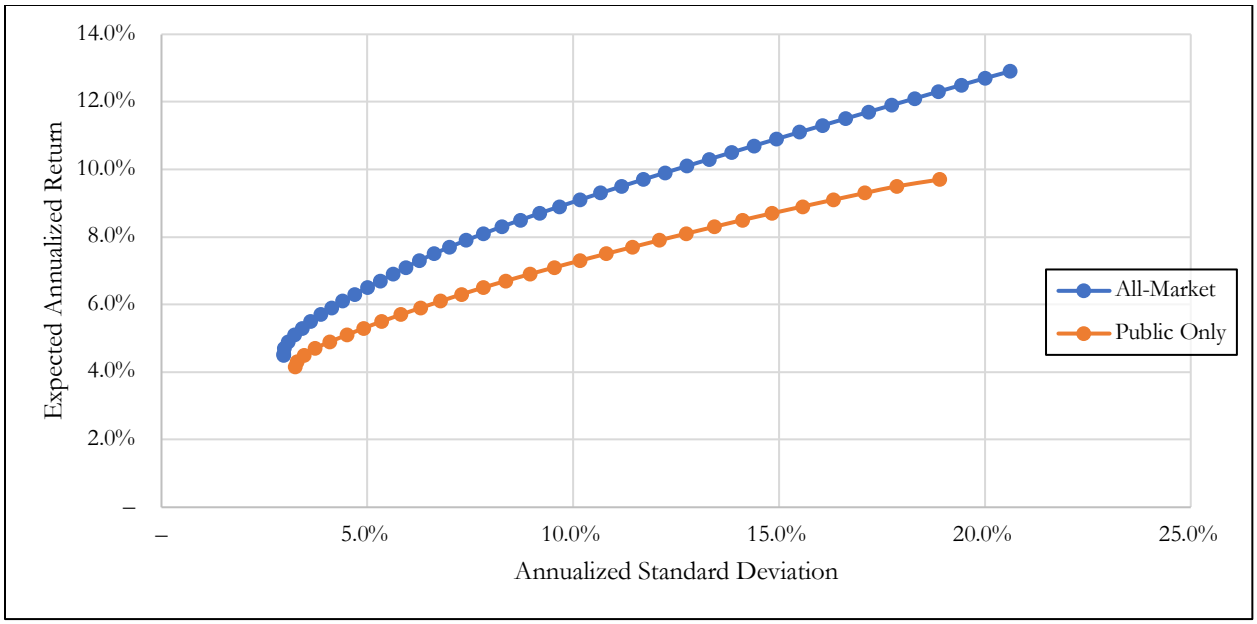

Figure 11: Goldman Sachs' All-Market vs. Public Only Portfolio

To achieve these results, the All-Market portfolio used a combination of Alternatives and Fixed Income asset classes as shown in Figure 11. Risk-return characteristics converge in Figure 11, where traditional assets peak in Figure 12.

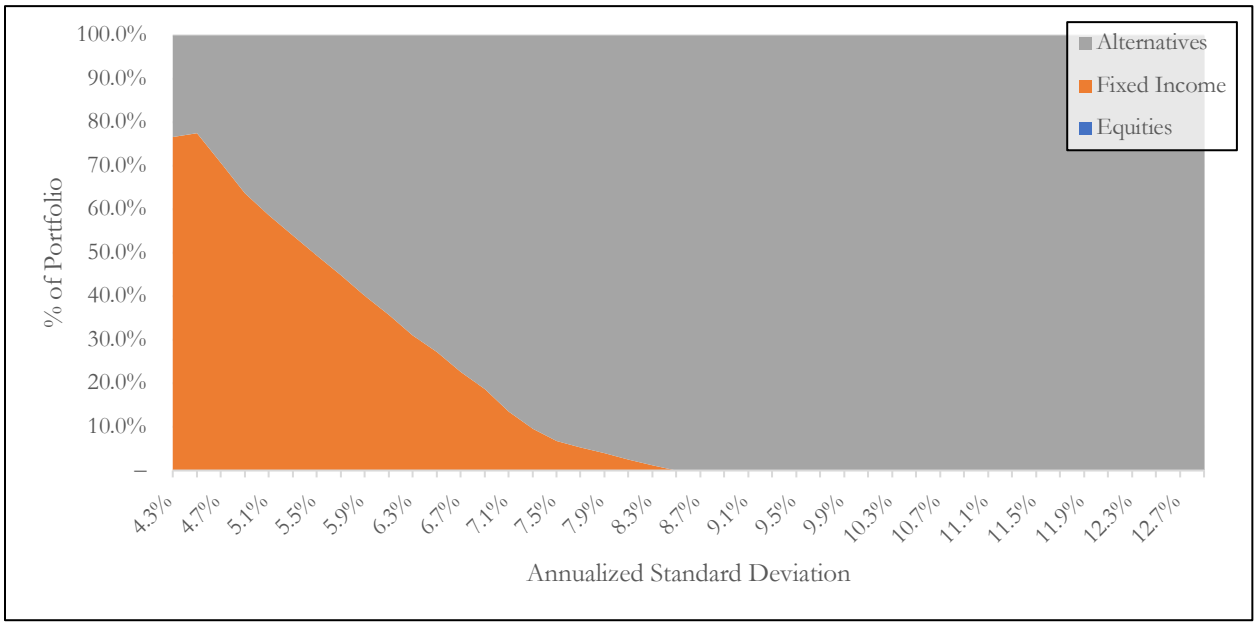

Figure 12: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Alternatives as shown in Figure 13. This included mostly Private Equity and Hedge Funds with Commodities and Real Estate playing a smaller role. The low-risk portion of the portfolio uses mostly Hedge Funds and to a lesser degree Commodities then shifts to Private Equity and Real Estate in the high-risk portion of the portfolio. The consistent expected outperformance of the All-Market portfolio can be attributed to the use of Hedge Funds at

the low-risk portion of the portfolio, while Private Equity is what drives the higher returns compared to the Public Only portfolio.

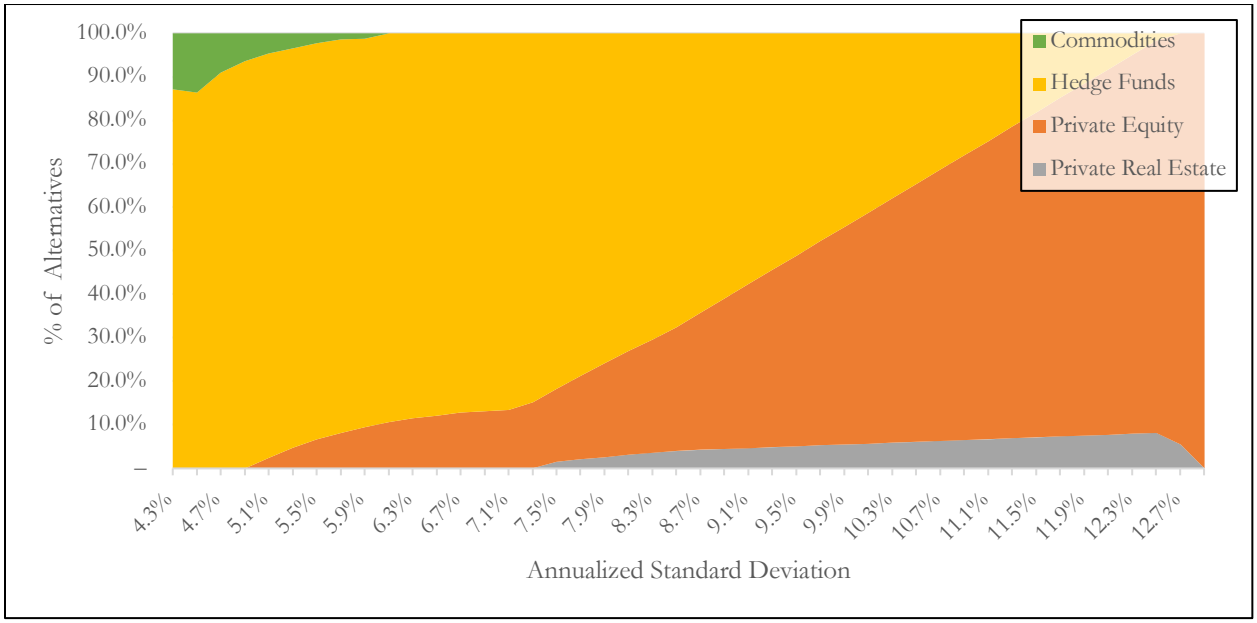

Figure 13: Mix of Alternatives in All-Market Portfolio

BlackRock

Next, we consider the mean-variance optimization using BlackRock's assumptions on 10-year forward looking returns across asset classes. As shown in Figure 14, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness. The minimum risk portfolio for both All-Market and Public Only portfolios consist of public assets with a 2.6% annualized standard deviation and 3.6% expected annualized return. From there, the outperformance of the All-Market portfolio grows to over 2.0% at 8.0% annualized standard deviation. The All-Market portfolio achieved higher returns with increased overall risk than the Public Only portfolio. The portfolio reaches a maximum expected annualized return of 12.8% with 31.6% expected annualized return. Comparatively, the Public Only portfolio maximum expected annualized return reaches 10.5% with an annualized standard deviation of 18.3%.

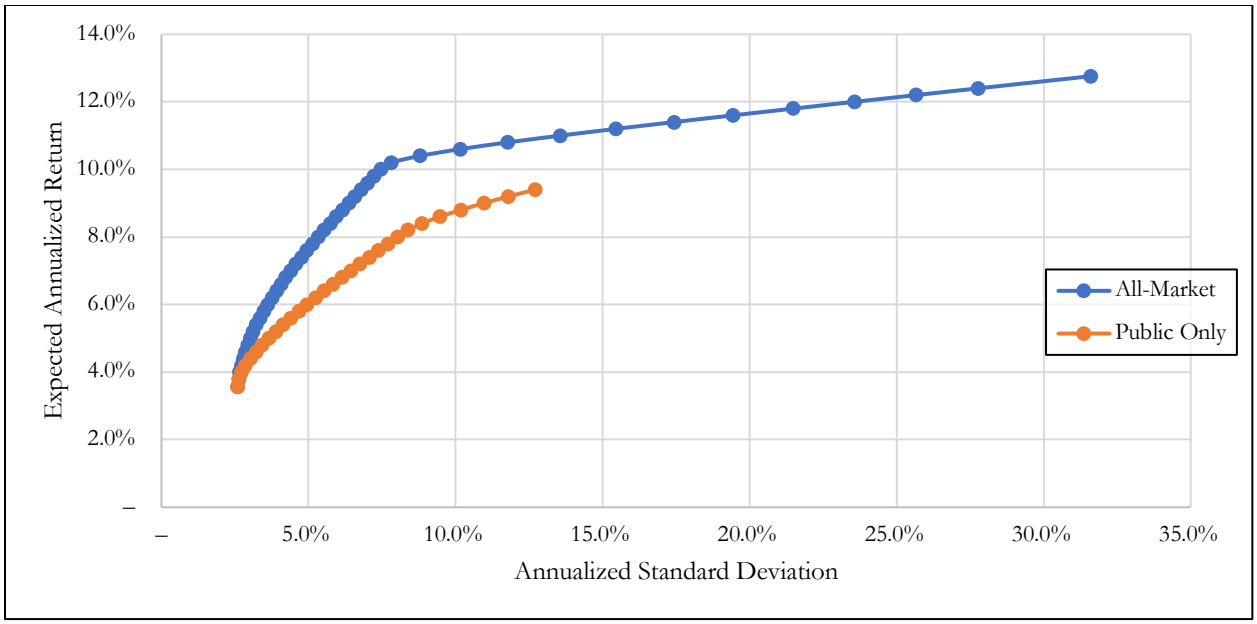

Figure 14: BlackRock's All-Market vs. Public Only Portfolio

To achieve these results, the All-Market portfolio used a combination of Alternatives and Fixed Income asset classes as shown in Figure 15. Risk-return characteristics converge in Figure 14, where traditional assets peak in Figure 15.

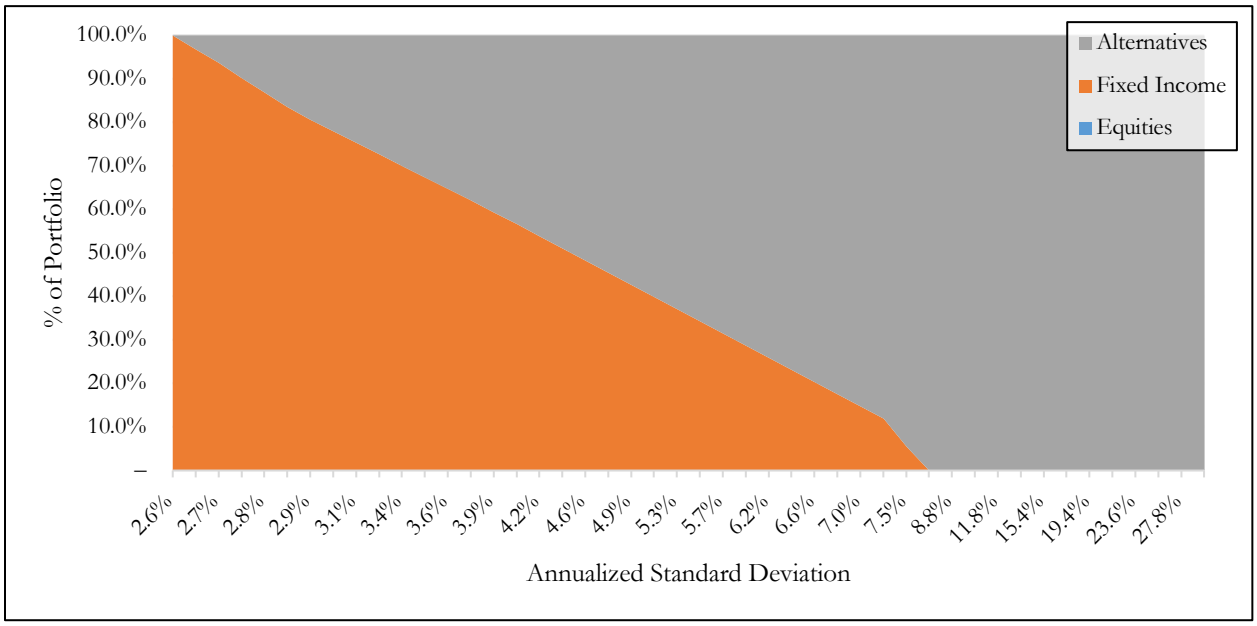

Figure 15: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Alternatives as shown in Figure 16. This included Hedge Funds for most of the risk range and Private Equity at the high-return portion of the portfolio starting at 7.8% annualized standard deviation. The consistent expected outperformance of the All-Market portfolio can be attributed to the use of Hedge Funds at the low-risk portion of the

portfolio, while Private Equity is what drives the higher returns compared to the Public Only portfolio.

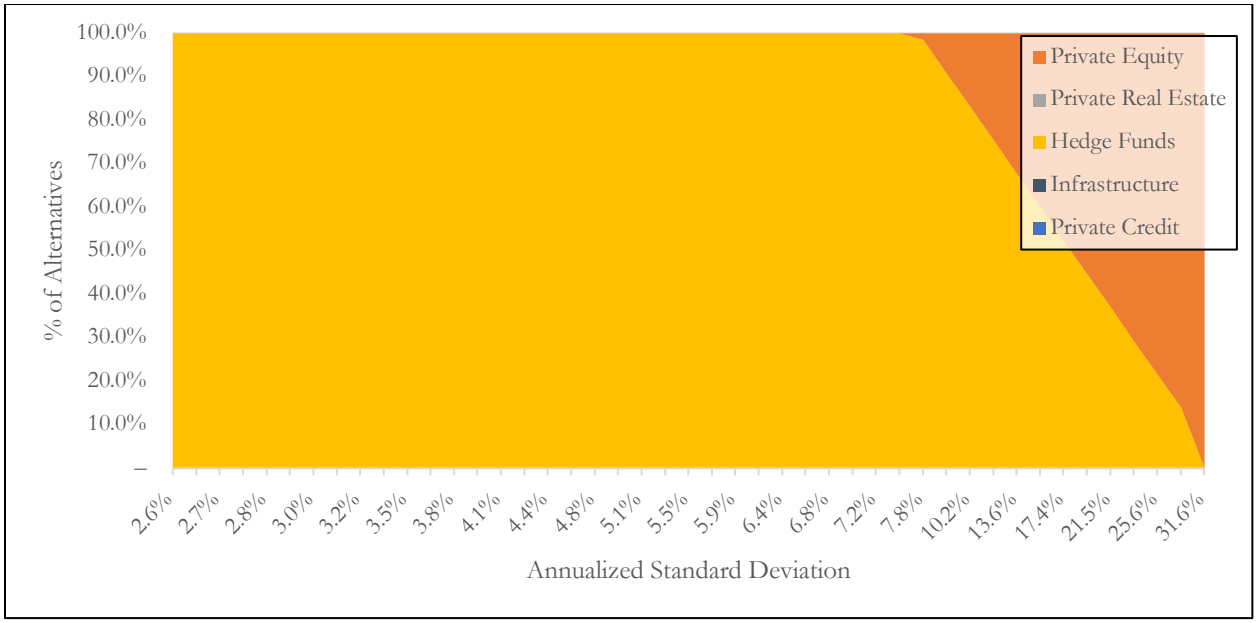

Figure 16: Mix of Alternatives in All-Market Portfolio

Callan

Finally, we consider the mean-variance optimization using Callan's assumptions on 10-year forward looking returns across asset classes. As shown in Figure 17, there were several key findings. The All-Market portfolio outperformed the Public Only portfolio, where the two portfolios overlapped in terms of riskiness. The All-Market portfolio grows from 0.2% outperformance at 2.0% annualized standard deviation to nearly 1.0% outperformance before reducing to 0.3% outperformance at 17.9% annualized standard deviation. The All-Market portfolio offered lower risk options compared to the Public Only portfolio as well. The All-Market portfolio minimum risk is at 0.9% annualized standard deviation with 1.2% annualized standard deviation. Meanwhile, the Public Only portfolio has a minimum risk portfolio 0.05 basis points higher than the All-Market portfolio with performance that is 0.6 basis points lower. The All-Market portfolio achieved higher returns with increased overall risk than the Public Only portfolio. The portfolio reaches a maximum expected annualized return of 8.0% with 27.6% expected annualized return.

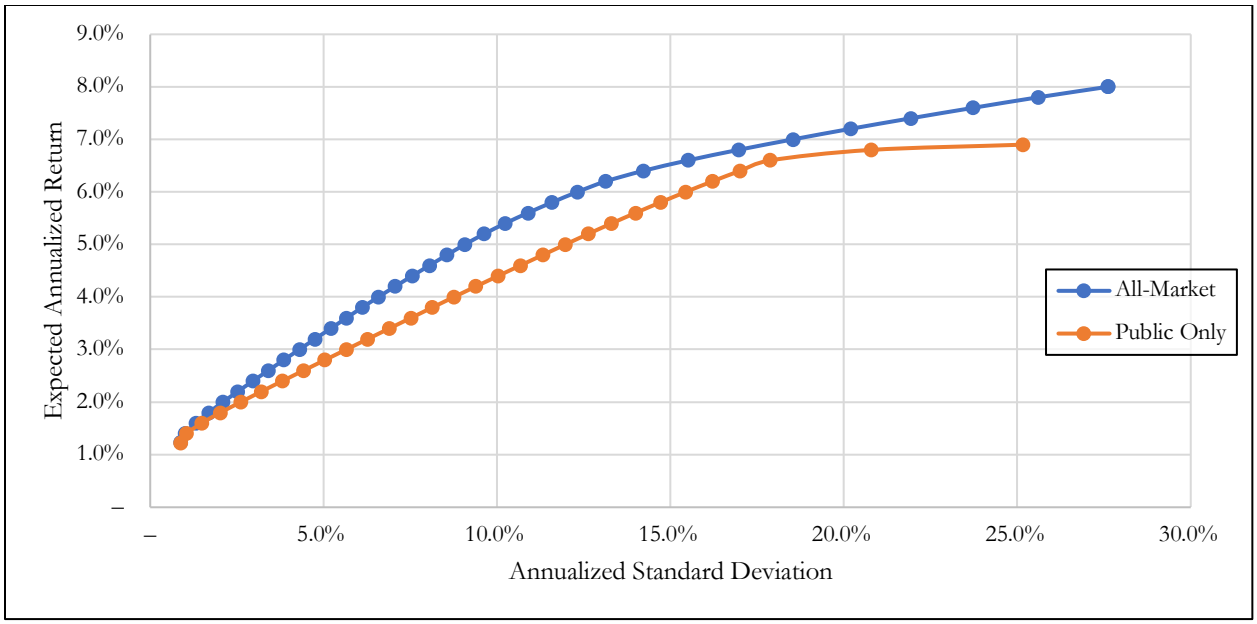

Figure 17: Callan's All-Market vs. Public Only Portfolio

To achieve these results, the All-Market portfolio used a combination of Alternatives, Fixed Income, and Equities as shown in Figure 18. Risk-return characteristics converge in Figure 17, where traditional assets peak in Figure 18.

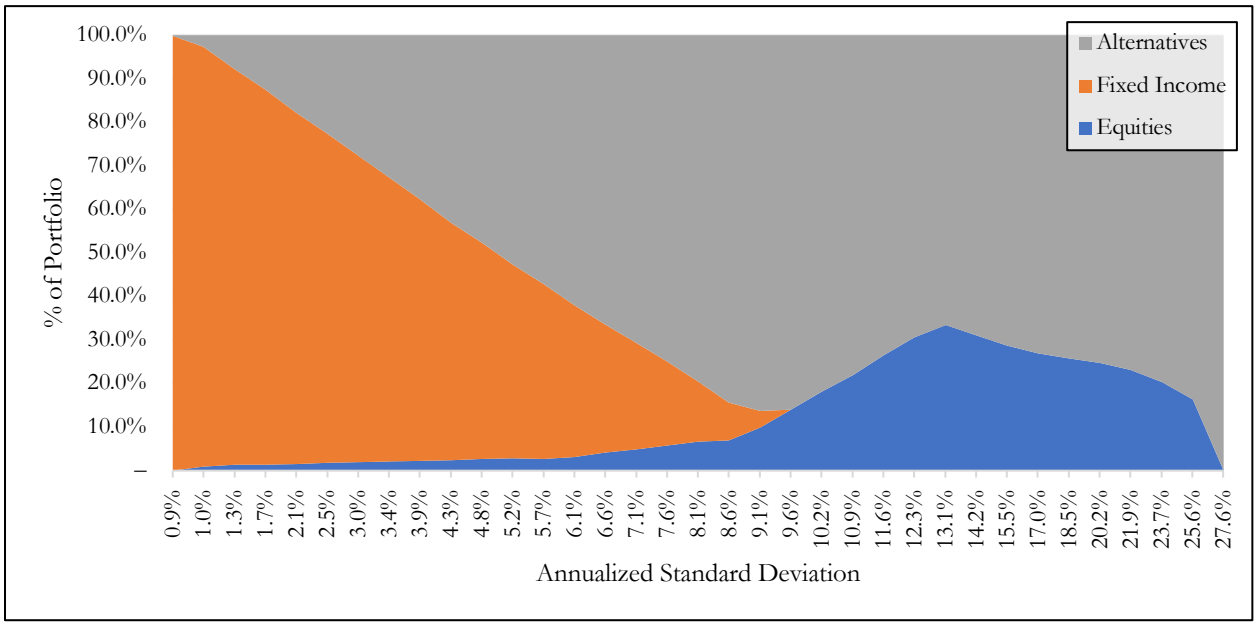

Figure 18: Mix of Asset Classes in the All-Market Portfolio

The All-Market portfolio uses a combination of Alternatives as shown in Figure 19. This included mostly Real Estate, Hedge Funds, and Infrastructure with Private Equity playing a more significant role at the right-tail of the risk-return curve. The consistent expected outperformance of the All-Market portfolio can be attributed to the use of Hedge Funds, Infrastructure, and Real Estate throughout much of the range of portfolio risk. Private Equity drives the higher returns compared

to the Public Only portfolio at the higher-risk portion of the portfolio and drives the absolute performance gap that the Public Only portfolio cannot achieve.

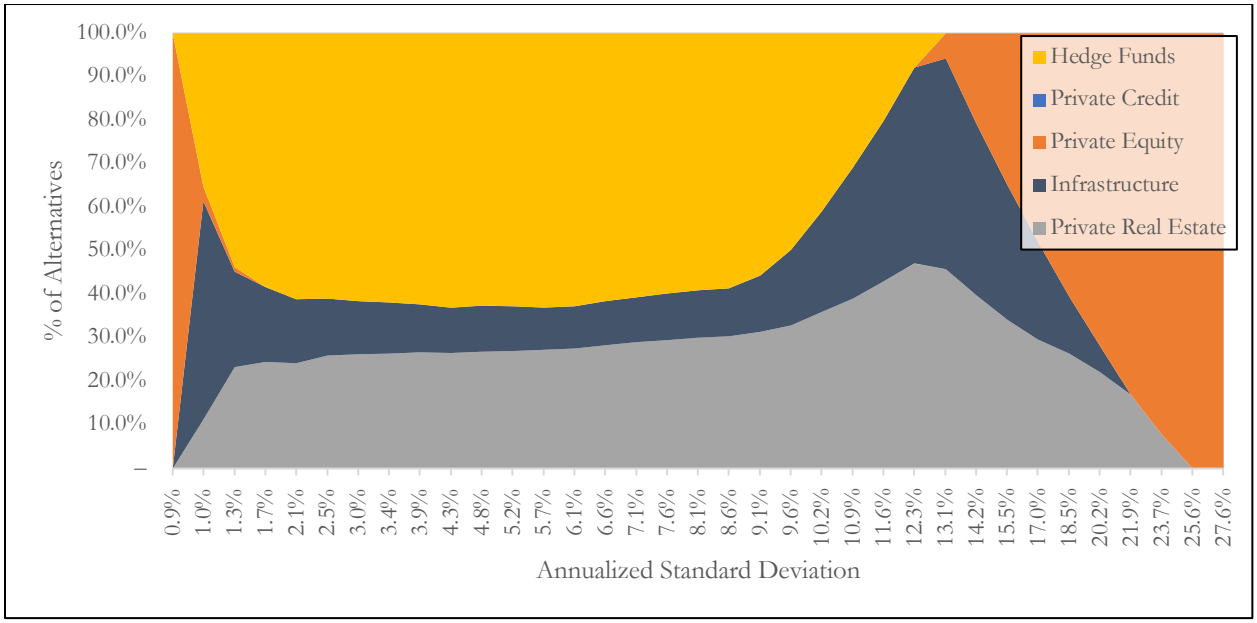

Figure 19: Mix of Alternatives in All-Market Portfolio

Overall Conclusions of Mean-Variance Optimization

The results of the analysis consistently show that the All-Market portfolio does at least as good if not better than the Public Only portfolio. This is true for all six different set of assumptions. Four of the six assumption sets yielded All-Market minimum risk portfolios that outperformed the Public Only portfolio. Lastly, five of the six assumptions led to outperformance when comparing the highest returning assets. These results indicate that un-constraining investment options to include both traditional and alternative investments can lead to a pareto improvement in portfolio performance.

Robustness of the Results

This research uses capital market assumptions by each institution to evaluate optimal portfolios. To evaluate the robustness of the results, it also examines mixing capital market assumptions between firms. In this section, there are two different approaches to evaluating the robustness of results. The first is to hold return constant, then evaluate the minimal risk after switching assumptions. Conversely, another approach is to hold risk at a certain level to solve for the return after switching assumptions. Despite mixing results, the analysis consistently shows that adding alternative assets to a portfolio improves risk-adjusted returns.

Using Russell's assumptions as a basis for analysis, alternative asset assumptions are switched. The resulting optimization with those new assumptions are then compared with the existing Russell solutions of the Public Only and All-Market portfolios as shown in Figure 20 below. If the risk of the switched portfolio assumptions are less than the Public Only portfolio, then even when switching assumptions, the conclusion that alternatives improve risk-adjusted returns still holds. The far left bar displays the standard deviation for the All-Market portfolio with a return of 7%. The far

right bar displays the standard deviation for the Public Only portfolio. The far left and far right bars provide upper and lower bounds to which the optimal portfolios derived from other firms' assumptions can be compared. The assumptions from all other firms predict risk below the Russell Public Only portfolio. In fact, one set of assumptions led to a lower level of risk at the 7% return level than the Russell All-Market Portfolio. Under BlackRock's assumptions, the minimum risk associated with a 7% return was only 3.6%. This was driven by the lower expected volatility in the underlying alternative investments under Blackrock's assumptions. These results show that the consistent outperformance of the All-Market portfolio versus the Public Only is not due to the internal consistency within assumption sets, but the findings would hold under any of the assumptions.

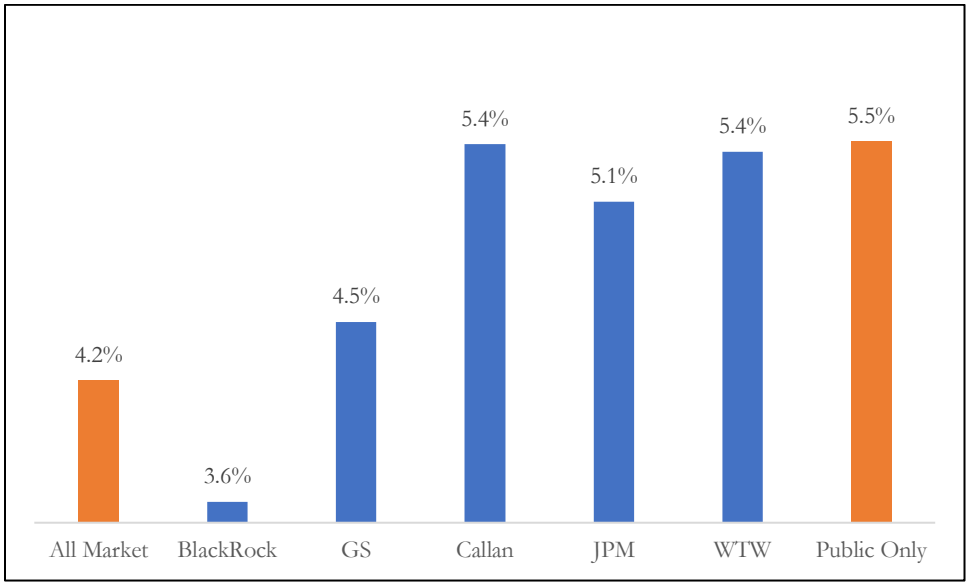

Figure 20: Standard Deviations of a Portfolio with 7% Expected Returns

As shown in Figure 21 below, the analysis uses the Russell assumptions to compare against other capital market assumptions at a 4% annualized standard deviation. The far left and far right bars are bounding comparisons of the portfolio risk when moving from Russell's assumptions for alternative assets to another set of assumptions. All the new assumptions showed return above the Russell Public Only portfolio. In fact, BlackRock's set of assumptions outperformed the Russell All-Market Portfolio driven by higher returns and lower volatility in the underlying alternative investments. These results show that the consistent outperformance of the All-Market portfolio versus the Public Only is not due to the internal consistency within assumption sets, but the findings hold when mixing assumptions.

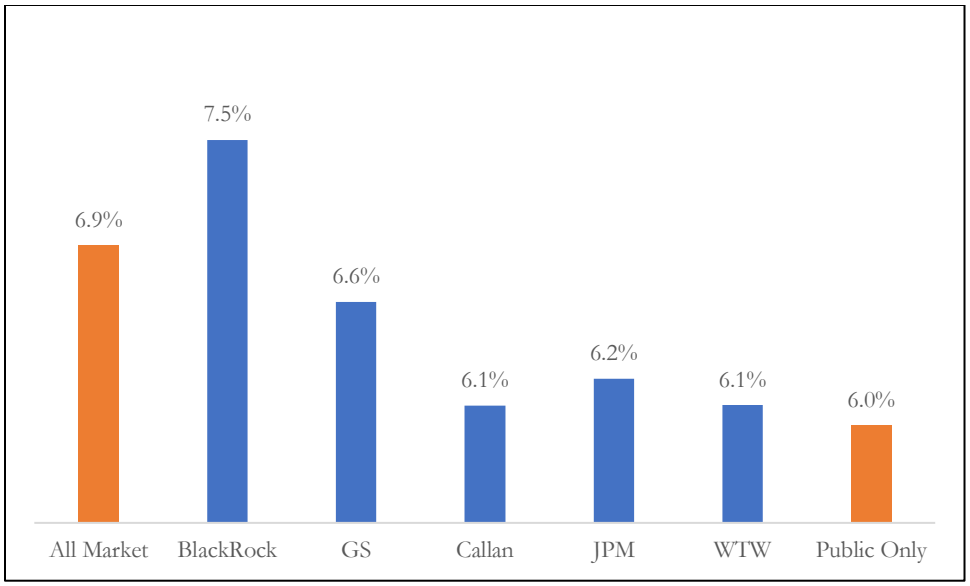

Figure 21: Expected Return of a Portfolio with 4% Annualized Standard Deviation

Returns Matter

Each firm has different assumptions leading to different results, so results are best interpreted on a relative basis. However, a 1% outperformance may not seem significant. To illustrate the impact, the following table illustrates the incremental impact of excess performance over the average S&P 500 expected return from Table 3 using a $10,000 principal with a 40-year time horizon.

Assumed Return	Expected Assets after 40 Years	% Increase in Assets
7.6%	185,892	–
8.1%	223,776	20.4%
8.6%	269,149	44.8%
9.1%	323,449	74.0%
9.6%	388,376	108.9%

Table 3: Impact of Increasing Returns

Risk Also Matters

The analysis also shows that at any given level of risk the portfolio return improves. The other perspective is that at any given level of return, the All-Market portfolio is at a lower level of risk than the Public Only portfolio. Since most individuals have a relatively constant risk aversion, then a reduction in portfolio variability can improve individual utility. (Sahm, 2007)

Alternatives Do Not Necessarily Dominate Traditional Equity

Across the six set of assumptions, alternative asset classes displace traditional equity in portfolios. This conclusion is a bit surprising since equities are fundamental to many portfolios. However, this is rarely observed in portfolios even amongst those that invest in alternative asset classes like endowments or pensions. On rare occasion, this is seen with some pensions that have payouts far out in the future with limited current and near-term capital needs. This highlights the challenges with alternatives. Their low liquidity, high fee structures, and high minimum investments make them difficult to deploy even for professional money managers as they must balance their own

requirements around return targets and liquidity requirements to meet current and future obligations.

Potential Leading Solutions

The dissertation does not seek to recommend investment managers, rather it is showing if adding alternative asset classes may improve portfolio performance. The resulting strategies that appear to be superior by each set of assumptions is a result of what alternative asset classes are covered by each set of assumptions. For example, if one institution does not include an asset class like private debt, then naturally it does not appear in the optimization work. However, it does not mean that private debt may not be a worthwhile asset class to consider. As a result, this section will highlight what are common characteristics given these constraints in the data.

Table 4 compares what each institution covered amongst alternatives and what appeared in their respective All-Market portfolio. Private Equity, Hedge Funds, and Private Real Estate were covered by all six. Private Equity appeared in all six portfolios; while Hedge Funds and Private Real Estate appeared in five and four portfolios, respectively. Private Debt, Infrastructure, and Commodities were covered by four institutions, and they all appeared twice.

Covered | Included	**Russell**		**JPM**		**WTW**		**GS**		**BlackRock**		**Callan**		**Total**
Private Equity	X	X	X	X	X	X	X	X	X	X	X	X	**6/6**
Private Debt	X	X	X	X					X		X		**2/4**
Private Real Estate	X		X	X	X	X	X	X	X		X	X	**4/6**
Hedge Funds	X		X	X	X	X	X	X	X	X	X	X	**5/6**
Infrastructure	X		X	X					X		X	X	**2/4**
Commodities	X		X		X	X	X	X					**2/4**

Table 4: Alternatives included in All-Market Portfolios

Private Equity and Private Real Estate are covered by all the institutions. It consistently appears particularly in the high-risk, high-return regime of the All-Market portfolio. Comparatively, Private Real Estate consistently appear in the low-risk, low-return to the mid-risk, mid-return portion of the portfolio. These two areas within alternative asset classes are some of the most well covered portions of the private market and their lack of correlation with traditional markets make them attractive additions to portfolios.

Private Credit, Commodities, and Hedge Funds have differential coverage by each institution. Among the firms that do cover these asset classes, they play different roles in the All-Market portfolio. Private Credit and Commodities are found in the low-risk, low-return regime of the portfolio to diversify returns with traditional fixed income products. Hedge Funds are found throughout the portfolio's asset allocation from the low-risk, low-return to the high-risk, high-return portion of the portfolio. Given their lack of correlation with traditional asset classes and absolute return mandates, they provide an uncorrelated return stream that improves portfolio risk-return characteristics.

Barriers to Adoption

Despite the potential risk-return improvements, alternative asset classes also have their challenges to adoption. They are complex investments that lack transparency, which can be challenging for individual investor adoption. Alternatives also lack liquidity with lock-up periods from a quarterly

basis to a multi-year basis unlike traditional investments that provide daily liquidity. Since they lock up capital for multiple years, alternative assets often have high minimum investment thresholds as a testament to investor confidence in a strategy. Alternative asset classes also have notoriously high fee structures compared to traditional asset classes. These all become natural barriers to adopting alternative asset classes.

Investor Literacy

This section examines how individuals invest and the potential impacts of providing greater access to alternative asset classes. Literature shows that individuals are poor asset allocators and default to simple diversification amongst the possible choices they are provided. Education could play a role in improving how individuals choose to invest, but the results are mixed. The other potential solution is limiting choices for individuals. By designing diversified portfolios for individuals and defaulting them into a solution, this "libertarian paternalism" approach can allow for the use of alternative assets.

Most people do not understand investments and in turn make significant mistakes in their investments. People believe bonds are riskier than money markets. Despite controlling for income and wealth, higher educational attainment is strongly correlated with exposure to public equities. Even with increased equity exposure, there are still concerning issues with equity exposure including a local and regional bias and high concentrations of employer stock in portfolios. These issues lead to greater idiosyncratic risk for households. (Campbell, 2006)

Even if they do invest, most individuals are poor investors. Their default diversification strategy is a function of the number of choices available to them, resulting in a 1/n rule. (Benartzi and Thaler, 2001) For example, if a defined contribution plan has 10 different funds, most individuals will invest 10% in each fund. This may lead to sufficient diversification, but if the choice set is overrepresented in one asset class like fixed income in a defined contribution plan, then this would lead to insufficient returns for a young saver. Not only is the initial choice architecture of funds problematic for individuals, but people often do not adjust their investments. (Ameriks and Zeldes, 2004) In a 10-year longitudinal study, 44% of individuals did not trade and only 17% made on change. One of the key principles of diversification is not only the initial allocation of capital over a diverse set of investments, but to follow-through with those choices and to adjust investments over time. This allows for investments that have exceeded expectations to be sold and shifted to underperforming investments. The process allows investors to lock in profits and rebalance to an optimal asset allocation.

Given these issues, financial education could help individuals not only become better investors but improve their personal finances more broadly. However, the literature is mixed in the space and there is an inherent endogeneity problem since more assets are correlated with increased educational attainment and financial sophistication (Hilgert, Hogarth, and Beverly, 2003) Cognitive abilities could alter investment choices and savings rates, which if we cannot control for this would imply greater benefit for financial education. (Delavande, Rohwedder, and Willis, 2008) The 2008 Global Financial Crisis provided a natural experiment for researchers to help identify the value of financial education. During that period, the least financially literate were more likely to sell assets that had lost value, thus locking in losses. (Bucher-Koenen and Ziegelmeyer, 2011)

Another approach in lieu of financial education is to design choices and implement defaults that can reduce these risks. By auto enrolling individuals into defined contribution plans, so that they would need to un-enroll themselves, enrollment increased from 40% to 90%. (Madrian and Shea, 2001) Similarly, the introduction of target-date funds has improved equity allocation by age and simplified investment decisions for individuals. (Mitchell and Utkus, 2012; Fisch and Turner, 2018) This behavioral approach to improving investment choices may also have the opposite effect. Individuals also tend to not change their savings rate and tend to have a lower savings rate than they should. (Beshears et al, 2012) Employers have also employed financial education to help re-evaluate their choices.

When considering default investments, implementing alternatives in target date funds would be consistent with the literature in life cycle funds. These models show that younger households ought to invest in equities and then shift to fixed income as they near retirement. (Gomes et al, 2008; Viceira, 2001; Bodie et al, 1992) Alternative investments do not neatly into these two categories instead they span the investable universe and provide diversification benefits to these models. As such drawing parallels from the literature to implications for alternative asset classes would imply that younger households would benefit from investing in private equity. Conversely, as households near retirement a shift towards private debt and commodities become a natural fit in this framework. Furthermore, investments like hedge funds and real estate provide positive returns and are utilized across the risk spectrum providing important diversification benefits to portfolios that would see these investments in portfolios from younger households to those nearing retirement.

Interventions such as financial education can yield "better" financial outcomes since individuals often cite the lack of knowledge for choices they have made. (Courchane and Zorn, 2005) Employers often sponsor financial education seminars as part of their benefits packages to educate employees on 401(k) and other benefit programs. Remedial financial education seminars focused on individuals that were not sufficiently saving increased participation rates by 36%. (Clark and Schieber, 1998) Similarly, frequent seminars increased participation rates and contribution rates for non-highly compensated individuals. (Bayer, Bernheim, and Scholz, 1996) In addition to improving savings rate, seminars improved asset allocation for low-income households by increasing equity holdings. This was an estimated increase of 7-14% from 29%, resulting in a 31% to 33% increase. In comparison, there was little to no effect on higher wealth and higher income households since they already had higher existing rates of equity in their portfolios. (Lusardi, 2003)

Alternatives have their own set of issues that literacy alone will not be the barrier to adoption. However, having a fiduciary in the investment selection process will help solve the knowledge barriers to effectively allocate capital for individuals. By adding an agent acting on behalf of the individual's best interest then a fiduciary can help balance the needs of the individual, while providing exposure to alternatives, which have been shown to improve risk-adjusted returns.

Liquidity

Liquidity is the ability to sell assets at their market price to monetize the investment. This requires execution at the fair market value of the underlying asset. For example, cash is the most liquid of investments. Investors can move cash between accounts easily and at its stated value without a loss in value. Liquidity is an important factor because investors need to move assets and in the context of alternatives, their lack of liquidity is a critical factor to consider.

Investments in retirement accounts have low liquidity requirements for those accumulating assets. An estimated 1.2% of assets are withdrawn annually from retirement accounts. (Munnell and Webb, 2015) Of those, 0.5% were cashouts, assets taken out of defined contribution plans without rolling them into individual retirement accounts. Another 0.3% were due to hardship and 0.2% from defaulting on loans with retirement assets as collateral. The inherent lack of liquidity needs in defined contribution accounts make them an attractive option when comparing to illiquid nature of alternative assets. Comparatively, those nearing retirement or in the decumulation phase require liquidity that may be difficult to achieve with certain alternative assets.

Alternative investments do not have daily liquidity unlike traditional investments. If an investor wants to sell shares, they are not only able to get pricing but can execute on that day. Alternative investments, in contrast, require multi-year investment horizons although some may be quarterly as shown in Table 5, which summarizes the liquidity of each alternative asset class.

Alternative Asset Classes	
Private Equity	3-to-7-year lock-up periods; closed-end1 or 12-16 years (Cote, 2021)
Hedge Funds	no lock-up periods; open-end (Tretina, 2023)
Private Real Estate	Usually open-ended with windows quarterly windows, but can be locked up for 5-10 years (Blackstone Real Estate Income Trust, 2024)
Private Debt	6-8 years (Blackstone Credit, 2024)
Infrastructure	3-4 years and increasing with renewables only funds at over 10 years (KKR Infrastructure, 2024)

Table 5: Typical Investment Horizons for Alternative Asset Classes

Individual investors would tie up their funds for multiple years with an investment in alternative asset classes. This longer time horizon is aligned with investment objectives like in a retirement context where investment horizons are typically multiple years out.

Furthermore, managing exposure to alternatives in the context of a portfolio with alternatives and traditional assets also provide greater liquidity in a portfolio. The liquid traditional investments can provide capital when needed, while alternatives are these least liquid portion of a portfolio.

High Minimum Investments

Alternative investments often have high minimum investments compared to traditional investments. Retail brokerage accounts and mutual funds usually have no minimums but may be up to several thousand dollars. In contrast, alternative investments have significantly higher minimum investments as shown in Table 6, which summarizes common investment minimums for each alternative asset class.

Alternative Asset Classes	Dollar Range
Private Equity	$25 million, but as low as $25,000 (Cote, 2021)
Hedge Funds	$100,000 to $2 million (Tretina, 2023)
Private Real Estate	$1 million (Blackstone, 2024)
Private Debt	$1 million (Blackstone, 2024)
Infrastructure	$1 million (KKR, 2024)

Table 6: Investment Minimums for Asset Classes

Given the above minimum investments, a 10% asset allocation to an alternative with a $1 million minimum implies a portfolio of $10 million. This dissertation does not address diversification within an alternative asset class, but this simple analysis is only for a single alternative investment. Increasing diversification within the asset class would require increased investments. For example, if an investor wanted a 10% allocation with 5 investments and $1 million minimum translates to a $50 million portfolio. To effectively deploy alternatives, require substantial pools of capital to reap their potential benefits without introducing significant idiosyncratic risk.

High Fees

Investment fees are paid to those that are responsible for investing on behalf of individuals. These are often charged in the form of a management fee and can reduce the gross returns of an investment. Individual investors are often unable to differentiate investments by fee structures even though fees may be the greatest differentiating factor. (Choi et al, 2010) In fact, when comparing similar products like S&P 500 index funds, individuals were more likely to choose more expensive funds, despite being ostensibly the same. (Dominitz et al, 2009) If consumers do not understand the expenses associated with simple investments, the implementation of alternative investments with more complex pricing structures more difficult.

Alternative investments are often characterized by their high fees compared to traditional investments. Private equity and hedge funds often have a "2 and 20" fee structure in there is a 2% management fee for the assets under management and an additional 20% performance fee above a predetermined level of performance. For example, a hedge fund might have an absolute return requirement of 5%. If it returns 6%, then the performance fee would be 0.2%. Beyond these fee structures, many alternative products have bespoke fee structures per client making them even more difficult to compare with traditional investments. These higher fees may make alternative investments unattractive, but it does not account for the potential of higher returns or how these assets may reduce risk in a portfolio since they are not highly correlated with traditional assets.

Private equity often uses an equity benchmark like the S&P 500. Using the capital market assumptions, potential fees and net of fees performance are estimated as shown in Table 7. The estimates use a 2% management fee, then a 20% performance fee for returns above the S&P 500 benchmark. The estimated fee and net performance are then calculated. Potential private equity fees could range between 2.0% to 3.0% with these assumptions. Using this approach, Callan and Willis Towers Watson had private equity net of their management fee underperform their benchmark, so no performance fee was incurred. Three of the five firms, namely BlackRock, Goldman Sachs, and JP Morgan, have private equity generating performance fees since they exceeded their benchmark after accounting for the management fee. This analysis only accounts for the impact of fees on

performance but does not account for the correlation impacts between private equity and other asset classes.

Firm	S&P 500 Gross Returns	Private Equity Gross Returns	Estimated Fee	Private Equity Net Performance
BlackRock	7.7%	12.8%	3.0%	9.8%
Callan	6.5%	8.0%	2.0%	6.0%
Goldman Sachs	8.1%	12.9%	3.0%	9.9%
JP Morgan	7.9%	9.9%	2.4%	7.5%
Willis Towers Watson	7.7%	8.7%	2.0%	6.7%

Table 7: Potential Net Private Equity Returns and Fees

Since alternative investments have varying fee structures and benchmarks may vary, there is insufficient information to determine their net returns on a broad basis. In turn, this dissertation uses the results of the mean-variance optimization to find a break-even return at a given level of risk between the All-Market portfolio, which includes traditional and alternative assets, versus a Public Only portfolio, which only holds traditional assets as shown below in Equation 5. This approach solves for the marginal return benefit of the alternative assets in the All-Market portfolio and in turn what fee structure would make an investor indifferent between the All-Market portfolio and the Public Only portfolio.

f_i: net fee on alternatives

$$\sum_{\forall\, Alternatives} w_i x_i (1 - f_i) + \sum_{\forall\, Traditional} w_i x_i \Big|_{All-Market} = \sum w_i x_i \Big|_{Public\ Only}$$

Equation 5: Break-even net fee for All-Market versus Public Only

By solving for Equation 5, this finds how high fees can be for investors to be indifferent between the two optimized portfolios at a given level of risk. For example, using Russell's analysis, at 3% standard deviation, the performance difference attributed to alternatives generates 24.2% more return, so the fees would need to be 24.2% to break even with the Public Only portfolio. This difference decreases as risk increases since the performance gap narrows with Russell. At 4.5% standard deviation, the outperformance gap is 15.2%, so the break-even cost to alternatives would be 15.2%. At 6.0% standard deviation, the outperformance further narrows so that the net fee to breakeven on alternatives in the All-Market portfolio is 7.3%. Across the multiple mean-variance analyses, ranges of break-even fee structures were calculated as shown below in Table 8.

	Sample 1 (SD, Expected Public Only Portfolio Return)	Sample 2 (SD, Expected Public Only Portfolio Return)	Sample 3 (SD, Expected Public Only Portfolio Return)
Russell	3.0%, 5.0%	4.5%, 6.4%	6.0%, 7.3%
Break-even Fee Structure	24.2%	15.2%	7.3%
WTW	5.0%, 4.9%	10.0%, 6.6%	15.0%, 7.7%
Break-even Fee Structure	17.1%	15.2%	10.5%
Goldman Sachs	5.0%, 5.3%	10.0%, 5.6%	15.0%, 8.8%
Break-even Fee Structure	22.4%	37.8%	19.8%

Table 8: Break-even fees from a sample of portfolios

The results were higher than expected and I further explored the mathematics behind such potentially large fee structures. Consider a two-asset portfolio, where the All-Market portfolio consists of a weight w_{Aa} in a traditional asset A and a weight w_{Ab} in an alternative asset B; while the Public-Only portfolio is 100% in the traditional asset A. Assuming, these two portfolios are at the same-level of risk, then the gross returns are as follows in Equation 6.

$$w_{Aa}r_a + w_{Ab}r_b > r_a$$

Equation 6: Hypothetical Two Asset All-Market Portfolio versus One Asset Public Only Portfolio

Once again, I solve for break-even in Equation 7 by applying a net fee structure on the alternative asset portion of this two-asset portfolio.

$$w_{Aa}r_a + w_{Ab}r_b(1 - f_C) = r_A$$

Equation 7: Break-even fee equation for hypothetical situation

Instead of solving the equation numerically as previously shown, this approach analytically solves for the term f_c in Equation 8, which results in the ratio of performance between the traditional asset versus the alternative asset between the two portfolios.

$$f_C = 1 - \frac{r_a(1 - w_{Aa})}{w_{Ab}r_b} = 1 - \frac{r_a}{r_b}$$

Equation 8: Solution to two-asset scenario

This shows that for any given portfolio comparison, the ratio of the traditional asset returns versus its replacement alternative asset return in the All-Market portfolio is what drives the fee structure. Even at low weights to alternatives or small differences in return between All-Market versus Public Only, the fee structure can still yield high potential fees so long as the difference in gross returns is substantial.

The break-even fee structure for alternatives is higher than the average fee of traditional investments. Average expense ratios for mutual funds are 0.44% for equities and 0.37% for fixed income mutual funds. (Investment Company Institute 2023) If investors can achieve fees lower than these when allocating capital to alternatives, then they would achieve an improvement versus the Public Only portfolio. Since alternatives often have bespoke fee structures, investors could achieve lower fees than calculated breakeven when pooling assets due to increased bargaining power resulting in superior returns versus the Public-Only portfolio.

The optimization results from the six different institutions uses gross returns for all asset classes and does not account for potential fees given the heterogeneity in fee structures across different asset classes.

Structures to Address the Barriers

Given the barriers to adopting alternatives, individual investors may not have the financial resources and knowledge to effectively allocate funds to this asset class. In contrast, high net worth individuals can access this asset class. With the difference in access to potentially higher investment returns, this leads to greater wealth inequality. (Benhabib, 2018)

To facilitate the use of alternatives, this section will explore how alternatives have been used to provide broader access. There are two examples that I came across in exploring this space. PGIM, formerly Prudential Investment Management, offers employers solutions that give employees access to alternatives in their defined-contribution plans. The Illinois 529 plan, branded as Bright Start 529, offers products for those saving to pay for qualified education expenses.

Both plans pool assets from a group of savers to meet the high minimum investment thresholds, deploy alternatives consistent with their savers' investment horizons allowing the plan sponsors to manage the liquidity risk, and use alternatives with other traditional investments to manage the overall fee to investors.

PGIM Structure

PGIM offers a turnkey 401(k) plan to employers. They provide collective investment trust (CIT) and mutual fund solutions. CITs are unregistered lower-cost financial vehicles with fewer regulatory requirements available to ERISA-qualified plans compared to mutual funds, which are broadly available, regulated by the SEC, and have greater regulatory requirements. (Putnam, 2024) Both solutions offer employers a suite of investments in their 401(k) including target-date funds. The mutual fund and CIT solution offers exposure to commodities. In addition to commodities, the CIT also offers an allocation to private real estate in their target date funds.

As shown in Figure 22 below, the PGIM solution has a 9%-12% allocation to alternatives such as commodities and real estate in their target-date product through an employee's career and retirement. The allocation to alternatives increases as an employee nears retirement. Real estate as a percentage of the portfolio starts from 5% and reaches 6% by the 2030 portfolio and remains at 6% through retirement. The allocation to commodities similarly starts at 3.8% and increases to 5.8% by the 2025 portfolio and remains at 5.8% through retirement. This allocation implies diversification benefits to traditional assets, but also uncorrelated income streams for those in retirement.

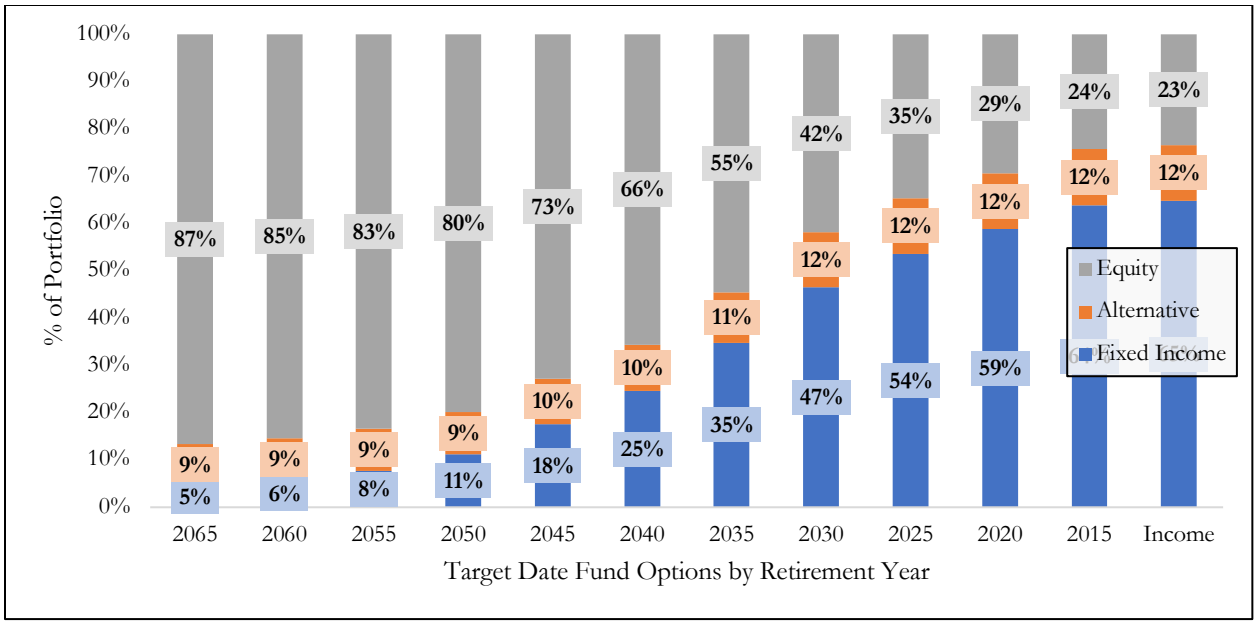

Figure 22: Asset Allocation in PGIM TDF Solutions

The CIT manages the risks of alternatives through multiple levers. The maximum allocation for an employee to the private real estate fund is 25% of their total portfolio. (PGIM, 2024) The real estate fund allocated 25% of its assets to REITs to provide liquidity. (Pensions & Investments, 2023) These layers of protections enable employees to have exposure to the alternative asset class, while mitigating its risks by allowing for daily liquidity and not be overly concentrated.

Illinois 529 Structure

Another structure is the Illinois 529 plan. A 529 plan is a tax-advantaged education savings plan that is sponsored by individual states. Illinois' plan is unique in that it offers alternative-like products in their funds. To understand how they can manage fees and liquidity requires an understanding of the structure of its plan. Figure 23 highlights the plan structure, which includes Individual investments, Risk-Based investments, and Age-Based investments.

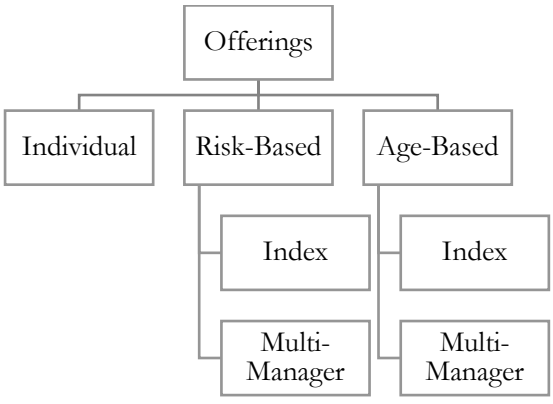

Figure 23: Offering Structure in Illinois 529

The Illinois 529 plan offers three different categories of investments. There are 17 individual investments, 6 risk-based products, and 54 total age-based funds. These different investments have a

passive approach using indices and an active approach with multiple investment managers, referred to as a multi-manager team. The individual investments range from low-risk products like money market and bank savings to high-risk products like traditional equities. The risk-based products have 3 strategies with index management and 3 strategies with a multi-manager team. These include a low-risk fixed income fund, a mid-risk tolerance blend of equities and bonds, and a high-risk tolerance of a combination of equity products. Similarly, the age-based products are split between 27 with index management and 27 with a multi-manager approach. These offerings are then further sub-divided by 3 investment styles (low-risk, mid-risk, and high-risk) and 9 age tiers, respectively. For example, index-managed low-risk has 9 two-year windows for each age group until a beneficiary reaches 18 years of age.

The risk-based products have different style orientations: equity (high-risk), balanced (mid-risk), and fixed income (low-risk). There are 3 index options, which are managed by Vanguard. This is in contrast with the 3 multi-manager options, which are managed by Vanguard and a set of active managers. The index equity strategy has 3 underlying funds, while the multi-manager solution has 12 underlying funds as shown in Figure 24. This combination of active and passive managers in the multi-manager solution help maintain competitive fees, while giving participants exposure to the potential value-add of active managers.

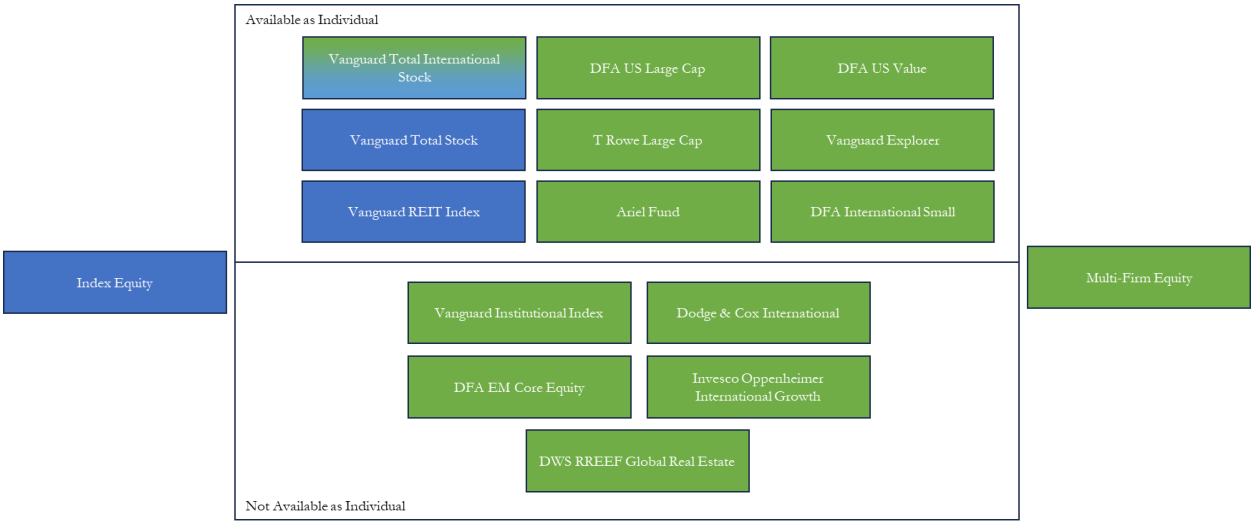

Figure 24: Comparison of Index vs. Multi-Manager Equity Products

Moreover, the composition of these funds is not entirely based on the 17 individual funds, but a combination of those plus funds not offered directly in the 529 plan. These include those below the line namely the Vanguard Institutional Index, Dodge and Cox International, DFA Emerging Market Core Equity, Invesco Opportunity Institutional Growth Fund, and the DWS RREEF Global Real Estate Fund. The DWS and DFA funds investing in more thinly traded global real estate and emerging markets, respectively.

The strategy of below the line funds is not exclusive to the multi-firm strategies. This is also true for both index and multi-manager products with the fixed income products as shown in Figure 25. Both the index and multi-manager products use funds not available as individual products. This structure

implies that funds in a pooled strategy like the risk-based or age-based solutions do not necessarily need to be composed of funds that are available on an individual basis.

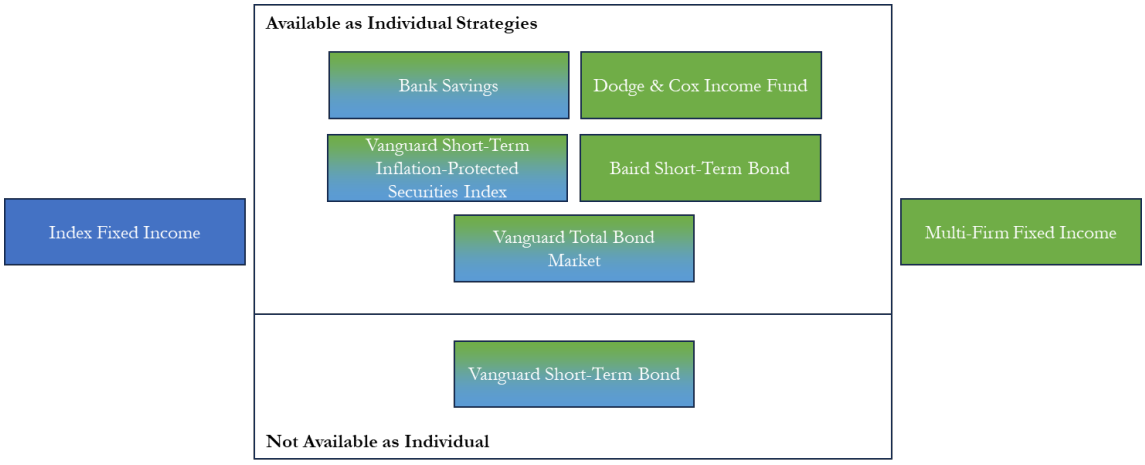

Figure 25: Comparison of Index vs. Multi-Manager Fixed Income Products

This structure of having investment products as a composition of funds without those funds being offered individually has unique advantages for other savings plans. For example, the PGIM offering could be offered with target-date funds that have a private real estate investment without directly offering the private real estate to employees to further safeguard against over allocation to private real estate and reduce the need of public REITs for daily liquidity.

Since Illinois switched plan administrators in September 2024, benchmarking performance and fees are inherently incongruent since both fund investments and fees have changed. Even when matching on fund investments, the move in plan administrators changed fee structures differently between investments. Furthermore, performance is only stated in terms of returns and metrics on variability are not provided, so a risk-adjusted comparison is not possible. Table 9 below compares passive and active risk-based portfolios, where passive is only index products, while the active portfolios include indices, active managers, and alternative investments. This table shows prior 5-year net-of-fee performance before the September 2024 transition and the change in fees from the September 2024 transition. Fees have decreased for most products after the transition. Passive products decreased in cost by 0.01% to 0.02%. Active equity decreased by 0.135%, but active balanced and active fixed income increased in cost by 0.005% and 0.115%. Historical returns are reported net of fees and reflect the pre-September 2024 results. The active version of portfolios, which include the more complex investments, consistently outperformed their index counterparts. Equity outperformed by 0.02%, the balanced portfolio outperformed by 0.2%, and the fixed income portfolio outperformed by 0.18% over a 5-year period. In this sample of funds in the Illinois 529, the active solution outperformed the index-based solution.

Risk-Based Portfolio	Pre-Sep 2024		Post-Sep 2024		Historical 5-Yr Net Performance		Difference in Performance
	Active	Passive	Active	Passive	Active	Passive	
Equity	0.40%	0.11%	0.265%	0.10%	11.77%	11.75%	+0.02%
Balanced	0.38%	0.12%	0.385%	0.10%	8.25%	8.05%	+0.20%
Fixed Income	0.17%	0.09%	0.285%	0.08%	2.24%	2.06%	+0.18%

Table 9: Risk-Based Portfolio Performance and Fee Benchmark

Exploring Public Proxies for Alternatives

Traditional assets as a proxy for alternatives could potentially provide the benefits of alternatives without the constraints of alternatives like liquidity and high minimums. These proxies include the potential use of microcap equity in lieu of private equity and publicly traded real estate investment trusts in lieu of private real estate. Historically, they have correlated returns with their alternative asset class peer, which make them an interesting option for further exploration. Although these may be appealing options, they too have their own limitations in improving risk-return characteristics to a broader portfolio.

Microcap Equity

Microcap equity, publicly traded companies with market capitalization of less than $300 million, are not typically covered in capital market assumptions by financial institutions. Since they are not represented in the data sets used for the optimization work, they are not represented in the All-Market or Public Only portfolios. Due to the smaller size of the companies that make up this portion of the market, there is a potential of higher growth like private equity. However, the segment has its own risks and challenges that make it difficult to fully substitute for private equity. The role of microcap equity can be a complement to portfolios along with alternatives like private equity.

Microcap equity is an attractive proxy for private equity due to several factors. Its returns have mirrored private equity returns for more than a decade. Since they are public assets, liquidity is also significantly improved. Private equity is typically held for years, while microcap equity can be typically sold within days. (McDonough, 2023) Performance between investment managers within microcaps is also less than within private equity. On a five-year basis, top-to-bottom quartile performance ranged from 20.4% to 7.6%, a 3x performance difference for private equity; while microcaps ranged from 30.7% to 23.2%, a 1.3x performance difference. (Meredith and O'Shaughnessy, 2017) However, these higher returns for microcap have not been persistent and microcap equity has had periods of underperforming private equity. (McDonough, 2023) All these attributes make microcap equity an attractive public option in lieu of private equity.

However, microcap has its own challenges. The size of the market is significantly smaller than private equity. The total market capitalization of microcaps is roughly $146 billion (Meredith and O'Shaughnessy, 2017). In comparison, the investable capital of private equity is at $2.59 trillion (Asif and Sabater, 2023). The available capital in private equity is more than 17.7x the size of the entire microcap market, which means all the money raised in private equity could purchase the entire

microcap market more than 17 times. From a practical perspective, this makes microcap markets a difficult substitute since there are not sufficient investable opportunities.

Microcap equity is an interesting complement to private equity. The size of the market is insufficiently large to allocate capital at scale for large pools of capital. For example, CalPERS total assets under management is $502.9 billion. (CalPers, 2024) A 10% stake in microcap would be over a third of the total microcap market by one investor. Its size is likely a result of the success of private markets, where raising inexpensive capital and lack of regulation has made companies stay private for longer. (De Fontenay, 2016) Although microcaps are a small market, its high correlation with private equity and higher liquidity allow it to be a tool for money managers to maintain exposure to private equity in managing allocation risk, while balancing liquidity needs.

REITs

Real estate investment trusts are public equities that own real estate. These include commercial real estate, residential real estate, farmland, and other real estate. Firms can be highly specialized, e.g., limited to only owning data centers, or own property across a range of use cases. They are also required to have least 75% of their assets in real estate, 75% of their revenue from rents or mortgage interest, and pay out at least 90% of their taxable income to investors making them exclusively real estate companies. Besides the 90% rule and required focus on real estate, the requirements placed on REITs are like other corporations including its corporate structure, board, and having shares. Given the structure of REITs, they lend themselves to be a natural proxy for private real estate.

REITs have advantages over private real estate as well. Since they are publicly traded, they are more liquid than private real estate. They also have lower investment minimums since investors can buy individual shares of REITs. (CFI Team) However, there are also downsides to public REITs. They tend to have lower debt-adjusted returns than their private real estate counterparts and higher correlation with public markets. (Binder, 2021) The latter reason is exactly why International Paper decided to use private real estate instead of REITs in their 401(k) structure they implemented in partnership with PGIM. Public REITs provided insufficient diversification benefits compared to their private market peers since they have higher correlation with public equity markets, so adding them to a portfolio of traditional assets did not improve risk-adjusted returns as a private real estate solution would have.

REITs, like microcap equity, make a good complement to their private market peer, but are not a perfect substitute. Rather they provide similar return streams and can help maintain strategic asset allocation levels while managing through liquidity requirements for those managing assets.

The Role of DC Plans

At this point, the dissertation has shown the potential of alternative asset classes in improving risk-return characteristics over a range of portfolio designs from low-risk, low-return regimes through high-risk, high-return regimes. The dissertation has also highlighted the challenges of adopting alternative asset classes given their complexity, lack of liquidity, high minimum investments, and high fee structures. It has also shown different approaches and structures in 529 and 401(k) plans that could help resolve the challenges to adoption. This section will summarize those findings that provide a framework for policy recommendations to encourage alternative asset class adoption.

Retirement plans including DC plans represent a major financial asset for most Americans. Using the Survey of Consumer Finances data in 2022, Table 10 shows the percentage of a household's wealth in retirement accounts relative to their total assets distributed by household net worth percentiles. For households in the lower quartiles, retirement accounts like DC plans represent a larger percentage of assets. If the set of available investments in limited, then we may be disproportionately impacting their access to these more optimal risk-return combinations.

	Less than 25%	**25-49.9%**	**50-74.9%**	**75-89.9%**	**90-100%**
Average Retirement Accounts ($ thousand)	12.7	33.9	106.2	328.6	1,296.7
Average Assets ($ thousand)	32.7	198.3	497.6	1,277.2	8,125.1
% of Assets	**39%**	**17%**	**21%**	**26%**	**16%**

Table 10: Retirement Accounts as a Percentage of Assets

The Fiduciary Standard and Pooling Assets

The dissertation explores the use of defined contribution plans because of the fiduciary standard placed upon employers through ERISA. As a fiduciary, employers are responsible for evaluating investments on behalf of their employees in defined contribution plans. They are responsible for the due diligence of each underlying investment and need to ensure managers meet the employer's predefined success criteria. Employers are also responsible for balancing the costs and benefits of investment choices. They are also responsible for what is the menu of investment choices are available to individual employees. Since, the dissertation shows that alternatives could play a role in that portfolio design. Employers would be responsible for the due diligence in finding strategies that best fit their employees.

Defined contribution plans, by definition, pool assets across employees. This pooling of assets addresses several key challenges to adopting alternatives for individuals. Pooled assets would meet the minimum investment thresholds of alternatives unlike direct access. Furthermore, with pooling of assets, plan sponsors can negotiate fee structures that are more competitive since they have greater negotiating power on behalf of their employees.

Managing Liquidity and Exposure

The PGIM 401(k) and Illinois 529 fund structures show different approaches to providing access to alternative asset classes. In designing a DC plan offering, employers can offer individual alternative strategies that uses the alternative paired with a public proxy to provide liquidity for employees. They could also move in another direction and not provide direct access to a strategy. As was the case for Illinois, where they provided "white label" fund strategies such as a high-risk tolerance strategy, which included funds that were not accessible as an individual strategy. This approach lets plan sponsors to include alternative investments without direct access and in turn not have to set investment maximum thresholds for employees.

This range of solutions has its own set of tradeoffs. By providing direct access to an alternative investment like with International Paper, employees could rationally choose to invest more in the

alternative asset class. Employers will have to include safeguards in their monitoring systems to alert employees of potential excessive risk. This is not dissimilar from existing monitoring systems where employers recommend employees adjust their investment allocation based on their age or other parameters. Employers often remind employees that they may have chosen a target-date fund that is not appropriate for their age.

Policy Implications

The policy implications of this work could range from broad adoption to continue limited access given the complexity to adjusting access in existing investment pathways. The SEC's Investor Advisory Committee has been engaging stakeholders on the definition of accredited investor particularly for angel and early-stage equity investors. Given the issues with adopting alternative investments, this dissertation explores the use of defined contribution plans with the Illinois 529 and PGIM 401(k) solution as examples for policy makers to refine adoption.

Challenges to Revising Accredited Investor Definitions

Expanding access could require changes to the SEC's Accredited Investor definition. Currently the definition for individuals is either meeting financial criteria or professional criteria. The financial criteria include net worth over $1 million, excluding primary residence, and income over $200,000 (for individuals) or $300,000 (with a partner) in each of the prior two years and reasonably expects the same for the current year. The professional criteria include investment professionals with certain licenses like Series 7, 65, or 82. These are general securities representative, investment adviser, or private securities offerings representative licenses, respectively. Executive of a company offering securities may also participate as an accredited investor. Clients of a family office, wealth adviser to wealthy families, and knowledgeable employees of a private fund may also participate as an accredited investor.

As required by the Dodd-Frank Wall Street Reform and Consumer Protection Act, the SEC is required to review the accredited investor definition every four years. As part of that work on September 21, 2023, the SEC's Investor Advisory Committee brought forth a panel of experts and stakeholders to discuss the accredited investor definition particularly for individuals. The panel discussed changes to the accredited investor definition over time such as the addition of the primary residence exclusion. The definition has also included more people over time. The financial thresholds were set in 1982 when it included 2% of the population, but now it includes 10% of people since the thresholds have not been inflation adjusted. Panelists also provided their perspectives on increasing or decreasing access to private markets and adjustments they would make to the definition. Those in favor of increasing access would allow more individuals to access these markets tended to favor broadening language around financial literacy as a professional inclusion. Conversely, those against recommended increasing financial thresholds given the inherent risks of private markets. (Investor Advisory Committee, 2023)

The definition and limitations to accessing private markets unless one is an accredited investor was highlighted during the discussion and by Professor Usha Rodrigues ongoing informal survey of her classes over time. Prior to the Global Financial Crisis, classes wanted to remove the accredited investor definition since it was an example of "the rich getting richer," but the other tension with accredited investors is that private market are inherently dangerous given their complexity. And

since the 2008 Global Financial Crisis, her classes have voted to maintain the accredited investor definition.

Regardless of the changes to Regulation D, alternative investments are still limited to most individuals. Most have minimum investment thresholds in the $5 million range, so although an individual may meet the Regulation D requirements, they would not meet the minimum threshold for most alternative investments. Furthermore, that would be for only a single investment with 100% of an individual's capital allocated to that strategy, which would eliminate any diversification benefits. As a result, any potential changes to policy that could increase access might not actually do so in practice as individuals would need to pool assets with others to have sufficient capital to access alternative asset classes.

ERISA Guidance

ERISA does not preclude the use of alternative investments. Rather Title I of ERISA states:

> that a fiduciary shall discharge that person's duties with respect to the plan solely in the interests of the participants and beneficiaries; for the exclusive purpose of providing benefits to participants and their beneficiaries and defraying reasonable expenses of administering the plan; and with the care, skill, prudence, and diligence under the circumstances then prevailing that a prudent person acting in a like capacity and familiar with such matters would use in the conduct of an enterprise of a like character and with like aims.

There are several critical requirements for employers who manage retirement plans governed by ERISA. The employer should manage the plan in the interests of participants and beneficiaries in finding the best investment options that fit the needs of the participants. Employers should consider the characteristics of their plan participants like whether the participants also have access to a pension. Employers should not use the defined contribution to their own benefit. The mandate is a two-fold consideration in not only the performance of products offered, but also consider the overall fee structures. This includes the fee structure underlying the management of the plan as well as the investment options and additional management fees like for target-date products in designing the glidepath of the underlying investments. Lastly, the employer is responsible in managing the plan in doing the due diligence to review all the components of a defined contribution plan. The employer must do what is in the best interest of the employee, balance performance with costs, and to execute these duties on behalf of employees as a professional investor who is responsible for due diligence of the investments, but also balance the requirements of the average employee. ERISA's broad mandate of employers allows employers to include a range of investments outside of traditional asset classes. If employers considered adding alternative asset classes to their defined contribution plans, they would need to consider the potential investments, their contribution to the risk-return characteristics of the plan offerings, implementation into the plan for employees, and negotiate the fee structure for the underlying investment. The same standards of care, skill, prudence, and due diligence expected of traditional investments would be expected of an employer considering alternative asset classes.

In a 2020 information letter from the Employee Benefits Security Administration (EBSA), the organization within the DOL and responsible for the implementation of ERISA, responded to

Pantheon Ventures, a private equity firm, on their use of their own private equity strategy in the firm's defined contribution plan. (Information Letter, 2020) EBSA states that offering private equity as a component of a 401(k) plan is consistent with Title I in that Pantheon Ventures would be allowed to include private equity in their defined contribution plan. However, EBSA also recognizes the challenges of implementing private equity as an offering in a 401(k) plan. As in the requirements of Title I, the risks and benefits of the investment must be evaluated. This includes the performance net of fees, potential diversification benefits, and impacts to employee liquidity in the defined contribution plan. As a plan fiduciary, the employer must also satisfy the due diligence requirement of Title I. Since alternative asset classes are different from traditional asset classes, the plan fiduciary must understand the underlying products and the nuances of the asset class to effectively implement the product into a plan. For example, given the liquidity constraints of private equity, the products need to have sufficient liquidity to provide daily pricing to plan participants or plan sponsors need to monitor exposure to private equity, if it is offered on a standalone basis, so that individuals are not over invested in a certain asset class.

The guidance from EBSA is particularly insightful since it highlights not only the potential of private equity, but the guidance could be expanded to alternative investments broadly for plan sponsors and their fiduciary responsibilities in managing a defined contribution plan that is considering adding alternative asset classes.

Potential Considerations of Broadening Access to Retirement Accounts

SECURE 2.0 Act of 2022 expanded automatic enrollment for employer-sponsored retirement plans. With the expansion, more employees will be automatically enrolled in employer-sponsored retirement plans. Broadening the base will increase total assets managed and increase savings for more employees. However, this may increase people that have chosen not to participate for their own reasons, such as the need for income as opposed to saving for retirement. This may lead to increased risk of liquidity requirements as individuals move jobs, the most likely reason why liquidity events happen in retirement savings. As a result, employers who consider alternative investments in their defined contribution plans should consider these implications in their plan design and prior expectations may not reflect future liquidity needs. The relative impact of additional liquidity needs ought to be balanced with the expansion of assets in fully evaluating the impact to asset allocation choices.

States are also expanding those eligible for retirement savings by auto-enrolling employees that do not have access to employer-sponsored retirement plans into state-sponsored individual retirement accounts. The expansion of individual retirement accounts is not wholly inconsistent with the findings of this dissertation. However, the fiduciary duty will be the most critical function in the state-sponsored plans and states will be the responsible party in selecting investments. These state-sponsored programs are still growing and developing with Oregon launching in 2017 and California launching in 2019. Oregon only offers target-date products and a money market fund, while California offers a few more including a bond fund and equity fund. California's program is larger than other states, but is only $1 billion in total assets, while Oregon has $300 million in assets. (State Auto-IRA Program Data & Trends, 2024) As these state-sponsored accounts grow their assets, plan sponsors will have additional requirements to meet the needs of their participants and alternative assets may also be a consideration for them.

An Inclusive Private Market

Expanding access to private markets could have unintended consequences. By providing access to significant pools of capital, this could lower returns for investors. However, this assumes that markets are static. There are several competing factors that could change this dynamic. The size of defined contribution plans continues to grow but these plans are relatively small compared to the total US institutional, those that are considered accredited investors, financial assets totaling $277 trillion. Defined contribution plans would compete with private banks totaling $234 trillion, defined benefit plans totaling $16.1 trillion, and non-profits including foundations and endowments totaling $3.8 trillion. In comparison, defined contribution plans total $9.5 trillion. (Williams, 2023) The demand for capital in this market continues to grow as firms have stayed private for longer avoiding issuing equity as an initial public offering. Furthermore, the dissertation is largely focused on an expansion of access through defined contribution plans. Since the employer acts as a fiduciary, they are responsible for selecting investments. This provides a layer of due diligence that forces a review of investments as a best fit for the employees of a respective firm. Given this layer of review, some employers may choose not to add alternative asset classes because they no longer deem them attractive for their employees. These dynamic relationships make predicting changes from this potential policy change difficult to predict.

Even if returns decline over time as more capital access private markets, the reasons why they are uncorrelated with public markets will continue to persist. Alternative asset classes are not liquid and not traded regularly. Given these characteristics, their volatility is dampened relative to traditional asset classes. The uncorrelated positive returns are still beneficial to an overall portfolio. Since alternative assets are uncorrelated to traditional markets, even at lower potential returns, they will be able to reduce the risk in a portfolio. In turn, this would mean at any given level of return, an investor could achieve lower risk with alternative assets.

Providing access at a retail-level may also have general equilibrium effects. By opening the alternative asset market to a broader group of investors, there would be more potential buyers of these assets. The increase of buyers would likely have fewer assets and less income and thus lower financial resiliency to absorb losses. There may also be less knowledge to understand the complexities of alternative securities. Due to the increase in capital, new products may also be introduced into the market for alternative assets. There are already unobservable quality differences in alternative assets. For example, the heterogeneity of returns within an asset class is much wider in alternative assets compared to public assets. The addition of new investments may not necessarily meet the current expectations. A broad-based expansion of the alternatives market could be problematic for retail investors.

Retail investors, particularly, would have potential challenges in investing in alternative assets. There are barriers to entry such as the lack of financial literacy, the need for potential liquidity, and high fees structures may not be considered in the net returns to investors. Without designating assets for a specific purpose like retirement, the assets could be liquidated sooner than their anticipated investment period. In turn, this could lead to significant reductions as the investments would need to be sold off at a discount before reaching their full value. These issues could be mitigated by expanding access through employers and defined contribution plans.

Many of the barriers described above could be mitigated by expanding access only in employer sponsored defined contribution plans. In these plans, the employer has a fiduciary duty to their employees. The employer will choose to include or not include alternative assets then have the discretion on how to implement those investments. As a result, like with public assets in defined contribution plans today, the actual investments would be selected, so that employees have a limited choice set that is optimized in terms of risk, fees, and performance for their own retirement savings.

Lastly, increased democratization of capital markets could be beneficial to society at large. The expansion of IRAs and 401(k) plans has provided greater access to capital markets for households. Conversely, the expansion of private capital markets has given smaller firms access to capital without the fluctuations of traditional markets. (Duca 2001) Opening up alternative asset classes to more households will not mean everyone will have purchase the next Facebook or Google, but it will allow more households to participate in the entirety of capital markets.

Conclusion

Summary

Alternative asset classes are poorly defined, but are characterized by their illiquidity, low correlation to public markets, high heterogeneity among managers, and lighter regulation than traditional asset classes. When broadening the investable universe from traditional asset classes, they consistently provide improved risk-return characteristics in that their lack of correlation and positive returns provide a diversification benefit to the overall portfolio. This was shown with the mean-variance optimization across a range of capital market assumptions. The novelty of the work expands the potential risk-adjusted returns to alternative asset classes broadly versus specific investments.

However, alternative assets also have their challenges to adoption in that they are complex, lack liquidity, have high minimum investment thresholds, and have higher fee structures than traditional investments. To address these barriers, regulators have developed an accredited investor definition, which uses wealth and income as a test for individuals to withstand the higher potential risk and complexity of private markets. While working within the limitations of the accredited investor definition, the dissertation considers a novel pathway to broader adoption through existing channels of defined contribution plans, where employers are fiduciaries to employees.

These pools of capital are considered qualified investors that are not precluded from investing in alternative assets. How an employer chooses to adopt alternative asset classes would be up to the employer and their employee base. Employees across the risk spectrum could benefit from alternatives. For those nearing or in retirement, hedge funds, private real estate, private debt, and commodities could provide returns that are uncorrelated with public fixed income portfolios, which can protect savings in the decumulation phase of their retirement assets. Conversely, for those early in their careers, alternatives like private real estate, private equity, and hedge funds can provide higher returns with lower correlation to public equity markets to improve returns in the accumulation phase of their retirement assets. Policy makers should be cognizant of both the opportunities and challenges to adoption and like in the case of International Paper and Pantheon Ventures continue to revisit EBSA policy, so that innovation in the space can continue to the benefit of employees.

Limitations

The work is based on forward-looking capital market assumptions from financial institutions. Other approaches to modeling the potential risk-return benefits such as using historical performance could further the work in evaluating the potential benefit of alternative asset classes. Although historical performance does not guarantee future performance, taking multiple approaches would provide further evidence on whether the optimization results hold.

The dissertation considers alternative assets that might improve risk-adjusted return for savers. It cannot determine whether this will improve employee savings for retirement. Adding alternatives to a portfolio can improve risk-adjusted returns, but employees could take these improved returns and reduce their savings rates. Conversely, some individuals may increase contributions as their defined contribution plans provide access to markets, they otherwise would not have access to. Changes in employee behaviors is another area worth further exploration if such changes were implemented to understand if changes were ultimately beneficial to employees.

The mean-variance optimization portion of the work does not include fees. Investment fees for alternative investments are higher than traditional asset classes. As a result, the benefit in the All-Market portfolio is also dependent on the fee structure of the alternative investment. Further investigation on how fees impact returns would inform the extent of improvement for individuals.

The dissertation also does not consider taxes. Alternative asset classes typically use partnership structures, where the fund manager is the general partner and investors are limited partners. These solutions then provide K-1s rather than the usual 1099 to individuals, which have more complex tax implications for the individual. In the defined contribution context, employees can often choose between Roth and/or Traditional 401(k) options, the former means that the employee uses after-tax savings to contribute to their plan, while the latter means that employees contribute on a pre-tax basis. In the Traditional 401(k), contributions are pre-tax, but are subsequently taxed at withdrawal, which means both the principal and the gains are taxed at the prevailing tax rate when funds are withdrawn. Further study of individual tax implications and fiscal policy impacts should be studied.

Implications for Policy

Existing ERISA policy has opportunity for enabling innovation in defined contribution plans through improved access to alternative asset classes. Although there is work on the periphery with one-off guidance for private real estate or private equity to individual firms, most employers do not use alternative asset classes in their plans today. Policy guidance from DOL to reinforce the fiduciary duties of employers citing the current examples would encourage employers to reconsider their existing offerings and evaluate potential additions that could improve employee risk-return opportunities in their defined contribution plans.

Policymakers should broaden the investable universe to alternative assets in defined contribution plans as it improves risk-adjusted returns on average. The mean-variance optimization consistently shows that a portfolio including alternative assets outperforms a public asset only portfolio on a risk-adjusted basis. However, alternative assets bring their own implementation challenges that an individual investor alone may not be able to mitigate. These investments are complex, lack liquidity, have high fees and minimums, and brining on new investors into the market could open new challenges. Defined contribution plans, which employers have a fiduciary duty to employees, is a way

to mitigate these challenges to adoption. Fiduciaries will be responsible for assessing the use of alternative assets and negotiate on behalf of employees to find the best fit. Given the challenges of adoption, target-date funds, as opposed to standalone products, balance the risks and benefits for employers and employees. Employers can select and monitor investments without watching each employee's investments in alternative assets to satisfy their fiduciary duty. In contrast, employees can access alternatives in a target-date fund, which, is designed to meet retirement needs for the average employee. Thus, employers and employees can both benefit of exposure to alternative assets without the challenges of investing on an individual basis.

Implications for Future Research

As previously mentioned, this dissertation took one approach across multiple data sets from different institutions to evaluate the potential of alternative asset classes. A historical performance analysis would also benefit the space.

The current plans such as International Paper and Pantheon are in their early stages of adopting alternative asset classes in their defined contribution plans. Comparing participant results between these with a traditional asset class peer could lead to further insights beyond the usual return results, but also plan participant benefits or costs such as withdrawal impacts from lower liquidity or reduced stress from lower volatility. From a fund sponsor perspective, understanding the implementation challenges will also be beneficial.

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Appendix I: Illinois 529 Investments

Table 11 below highlights the structure of the Illinois 529 by providing details around the individual portfolios and the risk-based portfolios. It does not show the target-date solutions as those are a combination of Table 11 components. The individual portfolios are only 17 of the 29 investable funds offered in the Illinois 529. The remaining 12 products are only available through an aggregation of products such as in the risk-based or target-date solutions. In terms of asset allocation, this difference is even greater. For example, if an individual chose the multi-firm equity portfolio, then only 51% of assets could be re-created using the individual portfolios, while the remaining 49% of assets would only be available through the risk-based portfolio. The other 49% is not directly available to investors.

	Risk-Based Funds					
	Index			Multi-Firm		
	Equity	Balanced	Fixed Income	Equity	Balanced	Fixed Income
Annual Asset-Based Fee	0.11%	0.12%	0.09%	0.40%	0.38%	0.17%
Available as Individual Portfolios						
Bank Savings 529 Portfolio			50.0%			50.0%
Vanguard Federal Money Market 529						
Baird Short-Term Bond 529 Portfolio					3.0%	10.0%
Vanguard Short-Term Inflation-Protected Securities Index 529 Portfolio		4.0%	15.0%		4.0%	15.0%
Vanguard Total Bond Market Index 529 Portfolio		20.0%	15.0%		10.5%	8.0%
Dodge & Cox Income Fund 529 Portfolio					9.5%	7.0%
Vanguard Total International Bond Index 529 Portfolio		2.5%				
DFA U.S. Large Cap Value 529 Portfolio				11.5%	7.5%	
Vanguard 500 Index 529 Portfolio						
Vanguard Total Stock Market Index 529 Portfolio	57.0%	36.0%				
T. Rowe Price Large-Cap Growth 529 Portfolio				11.5%	7.5%	
Ariel 529 Portfolio				3.0%	2.0%	
DFA U.S. Targeted Value 529 Portfolio				2.5%	1.5%	
Vanguard Explorer 529 Portfolio				5.5%	3.5%	
Vanguard Total International Stock Index 529 Portfolio	36.0%	20.0%		14.0%	8.5%	
DFA International Small Company 529 Portfolio				3.0%	1.5%	

Vanguard Real Estate Index 529 Portfolio	7.0%	4.0%				
Total of Available Individual Portfolios	**100.0%**	**86.5%**	**80.0%**	**51.0%**	**59.0%**	**90.0%**
Not Available as Individual Portfolios						
Vanguard High-Yield Corporate Fund		6.0%				
Vanguard Short-Term Bond Index Fund		6.0%	20.0%		3.0%	10.0%
Vanguard Emerging Markets Government Bond Index Fund		1.5%				
Vanguard Institutional Index Fund				23.0%	14.0%	
DFA Emerging Markets Core Equity Portfolio				7.0%	4.0%	
DWS RREEF Global Real Estate Securities Fund				7.0%	4.0%	
Dodge & Cox International Stock Fund				6.0%	3.0%	
Invesco Oppenheimer International Growth Fund				6.0%	3.0%	
BlackRock High Yield Bond Portfolio					3.5%	
BNY Mellon Global Fixed Income Fund					2.5%	
Nuveen Floating Rate Income Fund					2.5%	
RBC BlueBay Emerging Market Debt Fund					1.5%	

Table 11: Risk-Based and Individual Portfolios in Illinois 529 Plan