INDIANA PUBLIC RETIREMENT SYSTEM

Understanding INPRS's Investment Benchmarks

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Introduction

One of the biggest challenges that investors face is determining how well their portfolios are performing. To evaluate performance, investors must select one or more benchmarks and continuously monitor the portfolio's performance against the chosen benchmark(s).

In the article, "Are Manager Universes Acceptable Performance Benchmarks?"[1] Jeffery Bailey, CFA, provides investors with a framework for what makes a good benchmark. He outlines six criteria (the "Bailey Criteria") that an appropriate benchmark should display:

1. <u>Unambiguous</u> – The names and weights of all portfolio securities in the benchmark should be clearly defined.

2. <u>Investable</u> – The investors should have the option of adopting a totally passive approach by investing in the benchmark itself in which case the amount invested should not disrupt the market.

3. <u>Measurable</u> – The investor should be able to calculate returns to the benchmark reasonably frequently, but in any case, at least as frequently as its board or other responsible fiduciary measures the investor's results.

4. <u>Appropriate</u> – The benchmark chosen should be consistent with the style or risk profile of the investment manager whose performance is being gauged.

5. <u>Reflective of current investment opinions</u> – All participants in the market in which the investor is participating must be able to have current knowledge of the benchmark.

6. <u>Specified in advance</u> – The benchmark computation should be constructed prior to the start of an evaluation period.

There are many factors that impact the selection of a benchmark, and it is unlikely that any benchmark will be perfect. As a result, there are some instances where all criteria cannot be met. Nonetheless, using the criteria as an evaluation tool will improve benchmark selection[2].

The subsequent sections of this paper outline the various types of benchmarks available to investors, the decision(s) that each benchmark measures, and the benchmarks utilized by INPRS to evaluate investment performance.

[1] The Journal of Portfolio Management, Spring 1992.
[2] Please see the final page of the appendix for an evaluation of INPRS's benchmarks using the Bailey Criteria.

Types of Benchmarks

Benchmarks, generally, are identified as absolute or relative.

Type	Description	Examples
Absolute Benchmark	Measures the portfolio against a fixed (absolute) target.	(1) Portfolio versus a fixed return (e.g., 6.75%) (2) Portfolio versus a spread over cash[3]
Relative Benchmark	Measures the portfolio against a moving target.	(1) Portfolio versus an index (2) Portfolio versus a peer group (3) Portfolio versus another investment option (e.g., opportunity cost)

INPRS utilizes a mixture of absolute and relative benchmarks depending on the strategy or portfolio that is being evaluated. Relative benchmarks are the most common in the investment industry when evaluating individual managers. However, when a strategy with more flexible guidelines is being measured, an absolute benchmark may be more appropriate.

In addition to benchmark selection, it is also important to select a suitable method for calculating returns. The most common method of calculation is Time Weighted Return ("TWR"), which can also be referred to as geometric return. TWR excludes the impact of intra-period cash flows and is most suited for fully funded investment managers (e.g. public market investments) that have little to no control over when they receive cash flows. For private investments, it is often more appropriate to use Money Weighted Return, commonly referred to as the Internal Rate of Return ("IRR"). Private asset classes such as private real estate and private equity provide managers greater discretion in determining when to call capital to make investments. As a result, these asset classes may have large inflows/outflows intra-period, which are more accurately measured with IRR[4].

[3] A blend of a relative and absolute benchmark can also be referred to as a hybrid benchmark (e.g., an absolute spread over a relative benchmark).
[4] Please see appendix for more information on IRR versus TWR.

What decisions are the INPRS's benchmarks measuring?

INPRS Investment Staff uses a combination of relative and absolute benchmarks to measure the key decisions for which they have been given discretion.

Decision	Description	Measurement
Asset Allocation	INPRS Investment Staff recommends, for Board approval, an asset allocation to achieve the Target Rate of Return.	Absolute benchmark of the Target Rate of Return (currently 6.75%).
Tactical Shifts	INPRS Investment Staff can tactically overweight asset classes within the target allocation ranges.	Relative benchmark using the asset classes' benchmarks with weights equal to the target asset allocation.
Manager Selection	INPRS Investment Staff selects managers to increase the probability of achieving the Target Rate of Return through either (1) outperformance over a market index or (2) providing uncorrelated, positive returns.	Public Markets: Compare portfolio to a market index with similar exposure. Private Markets: Compare portfolio to a public market equivalent or to peers investing in similar strategies.

Different decisions are evaluated at each portfolio level. The focus of this paper will be asset allocation, tactical shifts, and manager selection at the INPRS Retirement Funds and global asset class levels. At the manager level, benchmarks are selected for individual strategies, with input from the Investment Team, Consultant, and manager for the strategy in question. Chosen benchmarks are intended to resemble the strategy employed by the manager and aid staff in evaluating manager performance and guideline compliance for the specific mandate in question.

INPRS Retirement Funds' Returns (e.g., Total INPRS Defined Benefit)

→ Asset Class Returns (e.g., INPRS Public Equity)

→ Investment Manager Returns (e.g., Ballie Gifford)

What are the benchmarks INPRS uses[5]?

Total INPRS Defined Benefit ("DB")

IPS Reference: Section 7.2, five year and ten year rolling annual rate of return equal to INPRS Target Rate of Return, and net of fees, three year and five year rolling investment rate of return of the Retirement Funds, no less than a weighted average of benchmark indices which best describe the Retirement Funds' asset allocation.

Benchmark	Reference	What is it measuring?
6.75% Return Index	IPS, Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection
DB Target Index	IPS, Board Presentation	Tactical Shifts, Manager Selection
DB Manager Selection Index	IPS, Board Presentation	Manager Selection

INPRS Investment Staff is continuously analyzing its ability to reach its target rate of return of 6.75% (the "Target Rate of Return"), which is one of the three imperatives for the INPRS Investment Staff [6]. Unfortunately, many other INPRS benchmarks are not as straightforward as the Target Rate of Return. In the DB Target Index, a representative asset class benchmark rolls up and the weighting is fixed to the approved INPRS Target Asset Allocation, as stated in the IPS. INPRS's global asset classes and their corresponding benchmarks can be found in the table below.

Global Asset Class	Global Asset Class Benchmark
Public Equity	MSCI ACWI IMI
Private Markets	Neutralized
Fixed Income – Ex Inflation-Linked	Total Global Bonds Ex-Inflation-Linked
Fixed Income – Inflation-Linked	Blended Global Inflation-Linked
Commodities	Bloomberg Commodity Index, Inflation-Linked Collateral
Real Estate	Neutralized
Absolute Return	HFRI Custom
Risk Parity	Neutralized

Private Equity, Private Credit, Real Estate, and Risk Parity lack public market indexes, often are associated with an illiquidity premium, and in some cases, are reported with a lag. These issues can introduce a significant amount of additional risk relative to the benchmark that is not necessarily reflective of the underlying portfolio holdings. To address this, INPRS has neutralized these asset classes in the DB Target Index and the DB Manager Selection Index. Neutralization is a process whereby the portfolio's holdings (and performance) are utilized as the asset class benchmark which eliminates risk and performance differences due to asset selection. INPRS uses other methods to evaluate manager selection and the efficacy of these programs described later in this paper.

The DB Target Index differs from the IPS Target because it incorporates the funding ramp-up period for the Private Credit asset class, a new asset class added following the 2015 asset-liability study. Annually,

[5] The analysis in the paper focuses on the Defined Benefit benchmarks. For a brief analysis of the DC benchmarks, please see appendix.
[6] (1) Achieve 6.75% Target Rate of Return (2) Achieve the return as efficiently and effectively as possible (3) Always have enough cash on hand to pay the bills

the DB Target Index updates the weight for this asset class based on the Consultant's pacing model estimate. The difference between the IPS target and the DB Target Index weight for Private Credit is proportionally added to all other global asset classes.

The variance between the portfolio return and the DB Target Index will be attributed to manager selection, but also to any asset class weight deviations from the fixed, Board-approved asset allocation. The table below presents the Board-approved asset allocation and the weights for the two previously described indexes.

Global Asset Class	IPS Target	DB Target Index
Public Equity	22.0%	22.7%
Private Equity	10.0%	10.3%
Private Credit	4.0%	1.0%
Fixed Income – Ex Inflation-Linked	20.0%	20.6%
Fixed Income – Inflation-Linked	7.0%	7.2%
Commodities	8.0%	8.3%
Real Estate	7.0%	7.2%
Absolute Return	10.0%	10.3%
Risk Parity	12.0%	12.4%

The asset class benchmarks that currently roll up for the DB Target Index are similar to the DB Manager Selection Index. The DB Manager Selection Index measures manager selection by, each month, adjusting the representative asset class benchmark weighting to the adjusted beginning market value of that asset class within the Plan. This monthly adjustment removes the tactical shift decision from the evaluation and isolates manager selection. January 2012 marks the merger of the Public Employees Retirement System ("PERF") and Teachers Retirement System ("TRF"). The DB Manager Selection Index's history prior to January 2012 is a market value weighted blend at a plan level between PERF's benchmark and TRF's benchmark.

Public Markets

IPS Reference: Section 9.3, The Investment Staff shall review the performance of each Public Investment Manager's Portfolio at least quarterly. Evaluation standards considered may include the following:

2. *Net of fee performance rates of return exceeding an appropriate market index benchmark, over quarter-to-date, year-to-date, one year, three-year, five year, and since inception time periods;*
3. *Sharpe ratio exceeding an appropriate market index benchmark over quarter-to-date, year-to-date, one year, three-year, five year, and since inception time periods.*

Public Equity

Benchmark	Reference	What is it measuring?
MSCI ACWI IMI Net Index	Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

The selection of the MSCI All Country World Investable Markets Net Index ("MSCI ACWI IMI") was made due to INPRS's desire to have exposure to global equity markets. Over time, the performance difference between the portfolio and the benchmark will be attributed to: (1) Manager Selection and (2) Region Selection.

Fixed Income Ex-Inflation-Linked ("Fixed Income ex ILB")

Benchmark	Reference	What is it measuring?
Custom Fixed Income ex ILB	Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

The portfolio invests in a custom combination of publicly traded treasury and credit opportunities across geographies, and as such, utilizes a static, custom benchmark to measure the performance of the portfolio. The sub-asset classes, their benchmarks, and weights can be found in the table below.

Fixed Income ex ILB Sub-Asset Classes	Custom Benchmark Component	Benchmark Weight
US Long Government	Bloomberg Barclays ("BB") Long Government	25.0%
US Long Credit	BB Long Credit	25.0%
Developed International Government (excluding US)	Citi World Government Bond Index, excluding United States, 25% Japan Capped, USD Hedged	25.0%
Emerging Markets Debt	50% JPMorgan EMBI (hard currency debt), 50% JPMorgan GBI (local currency debt)	15.0%
Opportunistic Credit	40% Credit Suisse Leverage Loan Total Return Index, 25% BofA ML US High-Yield Total Return Index, 25% BofA ML Non-Financial Developed Markets High-Yield Constrained Total Return Index, 10% Credit Suisse Western European Leveraged Loan Total Return Index	10.0%

Fixed Income Inflation-Linked ("Fixed Income ILB")

Benchmark	Reference	What is it measuring?
Custom Fixed Income ILB	Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

The current constituents of the Custom Fixed Income ILB benchmark can be found in the table below. The Custom Bridgewater Inflation-Linked Benchmark includes an allocation to US TIPS so the total portfolio allocation to domestic inflation-linked bonds is greater than the 64% implied by the benchmark component weights.

Fixed Income ILB Sub-Asset Classes	Custom Benchmark Component	Benchmark Weight
US TIPS	ICE BofA ML US TIPS 15+ Years	64.3%
Global Inflation-Linked	Bridgewater Custom[7]: 40% US, 30% Euroland, 15% United Kingdom, 10% Canada, 5% Sweden	35.7%

[7] The Bridgewater Custom Index is intended to replicate the individual country indexes of the Barclays Government Inflation-Linked Bond Index at the weights implied in the table. The index is rebalanced back to these weights monthly.

Commodities

INPRS's commodity managers utilize fully collateralized commodity futures positions to gain exposure to various commodity markets. When purchasing $100 worth of commodity exposure, for example, the entire $100 is not required but rather a set percentage, commonly referred to as collateral. This ratio is generally 85:15; so in the example above, $15 of the original $100 would be required to gain $100 in commodity exposure with the remaining $85 used as collateral and invested as the investor deems appropriate. Historically, INPRS collateral has been invested in treasury bills, but starting in July of 2012, an inflation-linked collateral program was initiated.

Benchmark	Reference	What is it measuring?
Commodities Custom Benchmark	Board Presentation, Internal Reporting	Manager Selection

INPRS utilizes a mixture of inflation-linked bonds and US treasury bills to collateralize its commodity investments. To reflect this decision in a benchmark, the Excess Return (Commodity only performance, excludes collateral performance) version of the Bloomberg Commodity Index is combined with Treasury Bill and inflation-linked collateral at the target weights found in the portfolio. Since INPRS's unique collateral is included in the benchmark, performance differences between the commodity portfolio and the custom benchmark will be a result of manager selection only.

Commodities Sub-Asset Classes[8]	Custom Benchmark Component	Benchmark Weight
Commodities	Bloomberg Commodity Excess Return Index	100.0%
US TIPS Collateral	BB US Treasury Inflation Notes 1-10 Years	37.5%
Global Inflation-Linked Collateral	BB Global Inflation-Linked 1-10 Years, ex US, ex Italy, ex Spain, USD Hedged	37.5%
T-Bill Collateral	FTSE 3-Month T-Bill	25.0%

Private Markets

IPS References: Section 10.4: Performance Objectives

Private Equity

1. *Relative Return: the median return for all Private Equity funds as measured by a reputable database provider; and*
2. *Public Market Equivalent: a custom index based on INPRS's target exposures and using public market indices.*

Private Credit

1. *Relative Return: the median return for all Private Credit funds within a corresponding sub-asset class as measured by a reputable database provider (e.g. middle market lending Investment Managers against the median of the middle market lending universe); and*
2. *Public Market Equivalent: a custom index based on INPRS's target exposures and using public market indices.*

[8] BNY Mellon utilizes an all-zeros offset with a -100% weight so that the weight of the benchmark components sums to 100%.

Benchmarking private investments presents numerous challenges for investors. It is difficult to identify the "market" because, by definition, the market is private, and information is not readily available. For performance reporting purposes, INPRS Investment Staff has identified a public equity market proxy, added an illiquidity premium, and lagged the returns of the PME by one quarter.

As mentioned in the IRR vs. TWR discussion, the most appropriate way to calculate private market returns is the IRR method, and as a result, the IRRs for both Private Equity and Private Credit are reported separately in the board presentation. However, the TWR for each of the private asset classes is still shown alongside the TWR for each of the public asset classes, merely for reference. In addition, the IPS states that the managers are to be measured against the median peer returns for similar strategies. There is no ideal way to capture the "market" index return for private asset classes. However, the peer-relative benchmark does provide measurement against the market of managers investing in similar strategies.

Private Equity

Benchmark	Reference	What is it measuring?
Relative Return: pooled IRR for private equity funds (excluding Real Estate, Timber, and Infrastructure) measured by Cambridge Associates	IPS, Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection
Public Market Equivalent ("PME"): 60% Russell 2000, 20% EAFE Small-Cap, 15% Credit Suisse High-Yield Index, 5% Credit Suisse Western Europe High-Yield Index (EUR Hedged), + 3.00%, lagged one quarter.	IPS, Internal Reporting	Asset Allocation, Tactical Shifts, Manager Selection

The Private Equity PME uses multiple public market proxies, including equity and fixed income exposures, designed to reflect the size, geographical, and capital structure opportunities targeted by the portfolio. The 3.00% that is added is a generally accepted illiquidity premium that investors demand for investments in private equity opportunities[9]. Additionally, INPRS compares itself to the PME lagged one quarter which lines up the performance of the PME with the valuation data received by INPRS and its managers.

[9] Please see appendix for more information on illiquidity premium.

Private Credit

Benchmark	Reference	What is it measuring?
Relative Return: pooled IRR for Senior Debt funds in the U.S. and Europe measured by Cambridge Associates	IPS, Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection
Public Market Equivalent ("PME"): 50% Credit Suisse Leveraged Loan Index, 33% Wells Fargo Business Development Company ("BDC") Index, 17% Credit Suisse Western Europe Leveraged Loan Index, +1.50%, lagged one quarter.	IPS, Internal Reporting	Asset Allocation, Tactical Shifts, Manager Selection

The Private Credit PME uses multiple public market proxies designed to reflect the size, geographical, and capital structure opportunities targeted by the portfolio. The 1.50% that is added is a generally accepted illiquidity premium that investors demand for investments in private credit opportunities[10]. Additionally, INPRS compares itself to the PME lagged one quarter which lines up the performance of the PME with the valuation data received by INPRS and its managers.

Real Estate

IPS Reference: Section 11.4: The following return objectives shall be reviewed:

1. *Absolute Return (net of fees): the absolute return objective is a real rate of return (adjusted for inflation) of five percent (5%);*
2. *Relative Return: Private real estate investments are expected to generate returns in excess of the National Council of Real Estate Investment Fiduciaries ("NCREIF") Open End Diversified Core Equity Index ("NCREIF ODCE"), net of investment management fees; and*
3. *Public Market Equivalent: a custom index based on INPRS' target exposures and using public market indices.*

Benchmark	Reference	What is it measuring?
5% Real Rate of Return (net of inflation)	IPS, Internal Reporting	Asset Allocation, Tactical Shifts, Manager Selection
NCREIF ODCE NFI Net 1 Qtr in Arrears	IPS, Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection
Public Market Equivalent ("PME"): 70% FTSE NAREIT All Equity REITs, 30% BB US CMBS Index	IPS, Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

[10] Please see appendix for more information on illiquidity premium.

The NCREIF ODCE NFI Index[11] is a market-capitalization weighted, gross of fee index that presents time-weighted returns. Much of the INPRS Real Estate portfolio is comprised of private investments, and it is difficult to capture the "market." The NCREIF ODCE NFI attempts to capture the performance of private, open-ended (infinite-life) core equity funds; however, this index is not an investable benchmark but is shown in the INPRS Board Presentation because it is a widely accepted core equity Real Estate benchmark.

Because the NCREIF ODCE NFI Index does not closely reflect the underlying exposure of Real Estate portfolio, Investment Staff has constructed a Custom Public Market Equivalent[12] ("PME") benchmark. The PME is constructed with two public indexes, weighted to approximately capture the target capital structure exposures of the INRPS Real Estate portfolio: 70% FTSE National Association of Real Estate Investment Trusts ("NAREIT") All Equity Real Estate Investment Trusts ("REITS") and 30% BB Commercial Mortgage Backed Bond Securities("CMBS") Index. This benchmark is reported separately in the Board presentation as an IRR calculation.

The IPS states that Real Estate investments should also be measured against an Absolute Benchmark of five percent (5%), adjusted for inflation. This benchmark is considered when evaluating potential opportunities internally.

Total Absolute Return

IPS Reference: Section 12.4, The aim in building the ARS Program is to select the highest-quality funds and vehicles to form a diversified portfolio capable of meeting targeted performance objectives. The risk and return objectives for the ARS Program, as noted below, shall be reviewed:

1. *Target annual return (net of fees): Cash + 4%;*
2. *Relative Return: a custom index based on the ARS Program target exposures and using HFRI indices.*

Benchmark	Reference	What is it measuring?
Cash plus 4.00%	IPS, Internal Reporting	Asset Allocation, Tactical Shifts, Manager Selection
Custom Hedge Fund Research Index ("HFRI")	Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

Within the INPRS Absolute Return portfolio, managers have flexibility in their investment process. This, along with not sharing holdings and proprietary information in real-time, contribute to benchmarking challenges. For these reasons, a cash plus 4.00% will be the absolute measuring stick for the portfolio. To capture relative performance versus a market, INPRS Investment Staff also measures the Absolute Return portfolio versus a Custom HFRI benchmark. HFRI collects returns from various hedge funds and attempts to bucket them into certain categories or strategies[13]. See below for the HFRI custom benchmark and corresponding static weights.

[11] Source: NCREIF.org
[12] Please see appendix for more information on PME benchmarks.
[13] Please see appendix for more information on HFRI Indices.

Absolute Return Sub-Asset Class[14]	HFRI Component	Benchmark Weight
Tactical Trading	Macro	35.0%
Relative Value	Relative Value	25.0%
Event Driven	Event Driven	20.0%
Fund of Funds	Fund of Funds	12.5%
None	Equity Hedge	7.5%

Risk Parity

IPS Reference: Section 13.4, The risk and return objectives for the RP Program, as noted below, shall be reviewed:

1. *Target annualized return (net of fees): The Target Rates of Return.*

Benchmark	Reference	What is it measuring?
INPRS Target Rate of Return	IPS, Internal Reporting	Asset Allocation, Tactical Shifts, Manager Selection
Global 60/40 Index	Board Presentation	Asset Allocation, Tactical Shifts, Manager Selection

Much like INPRS's target asset allocation, Risk Parity invests in multiple asset classes with an absolute goal of earning a better risk-adjusted return. Risk Parity attempts to achieve this goal by constructing a diversified asset allocation without making tactical bets. As a result of this quickly changing, diversified allocation, it is difficult to evaluate the manager selection within Risk Parity. Over the long-term, the Risk Parity portfolio will be judged against the INPRS Target Rate of Return, currently 6.75%.

In addition to the Target Rate of Return, a traditional asset allocation of 60% Equity (MSCI ACWI IMI Index) and 40% Bonds (Barclays Global Aggregate Bond Index) is used to measure the portfolio. Risk parity is often regarded as a more efficient way to construct investment portfolios while achieving a return similar to that of a traditional portfolio. As such, benchmarking against a global 60/40 allows staff to assess the opportunity cost of not investing in a more traditional portfolio. The Global 60/40 Index has a larger concentration in equity risk than the Risk Parity allocation, and consequently, there may be significant differences in returns at any point in time.

Conclusion

INPRS, in conjunction with the System's General Consultant, will continue to monitor and evaluate the suitability of its total plan benchmarks and global asset class benchmarks. In accordance with Section 7.2 of INPRS's IPS, any changes to the total plan and/or global asset class benchmarks will be communicated to the Board of Trustees at their next regularly scheduled meeting, following thorough research supporting such change(s).

[14] Source: BNY Mellon reporting as of June 30, 2020.

Appendix

Internal Rate of Return (“IRR”) versus Time Weight Return (“TWR”)

Chicago ILPA Members-Only Fall Conference 2009 Presentation by Adams Street Partners

IRR

- Take size and timing of cash flows into consideration
- Annualized Return
- Need to de-annualize or use change-in-value for return less than one year
- No simple way to compute a combined return from two IRR numbers without getting down to the cash flow level

TWR

- Time only; Size of cash flow is irrelevant
- Link daily, monthly, quarterly, or yearly returns
- Explicit step to annualize numbers
- Very easy to calculate weighted return for an aggregate portfolio and do performance attribution

IRR makes sense for Private Equity, Private Credit, and Private Real Estate

- Managers control size and timing of cash flows
- Helps to appropriately evaluate private portfolios with J-curve effect (J-curve is when the fund incurs negative returns for the first few years due to capital draw downs and an immature portfolio)
- Inability to rebalance

Example

INPRS makes a $1,000 investment at the beginning of the year for two shares of Company ABC for $500 per share. At the end of the first year of the investment, the valuation of ABC went to $400 per share, down 20%. INPRS makes an additional investment for 10 more shares of ABC at $400. Over the next year the valuation of ABC goes up to $460 per share, up 15%. INPRS decides to sell all the shares at the end of the second year. In order to calculate the TWR, the return for the first period and the return for the second period are geometrically linked. However, the large investment after the first year is not taken into account. Alternatively, the IRR calculation accounts for the fact that the investment was larger during the best return period.

Time	Action	Market Price / Share	Cash Flow	Position	IRR	TWR
January 1st 2012	Buy 2 Shares	$500	-$1,000	2 shares ABC @ $500		
January 1st 2013	Price Securities	$400		2 shares ABC @ $400	-20%	-20%
January 1st 2013	Buy 10 Shares	$400	-$4,000	12 shares ABC @ $400		
December 31st, 2013	Sell 12 Shares	$460	+$5,520			+15%
				Annualized Portfolio Return	+8.5%	-4.0%

Use IRR formula.
$\$0 = -\$1000 + -\$4,000/(1+IRR) + \$5,520/(1+IRR)^2$

Geometrically link the annual returns.
$[(1+(-20\%))*(1+15\%)]^{1/2} - 1 = -4.0\%$

Defined Contribution ("DC") Benchmark Analysis

The Defined Contribution plan is offered to members and either 1) supplements their defined benefit option or 2) serves as their only INPRS-provided retirement benefit. Within the DC plan, members are offered multiple funds to invest in at their discretion, found in the table below. The funds contain a mixture of active and passive management based on input from outside consultation and INPRS investment staff. The benchmarks shown below were selected to evaluate the funds and are reported to the INPRS Board of Trustees.

Fund(s)	Benchmark	Active Investment	Passive Investment	What is it measuring?
Target Date	Custom[15]	Varies	Varies	Asset Allocation, Manager Selection
Large Cap Equity*	S&P 500 Index	0.0%	100.0%	Manager Selection
Small/Mid Cap Equity*	Russell Small Cap Completeness Index	10.0%	90.0%	Asset Allocation, Manager Selection
International Equity*	MSCI ACWI ex-US IMI Index	40.0%	60.0%	Asset Allocation, Manager Selection
Fixed Income*	Bloomberg Barclays US Aggregate Bond Index	40.0%	60.0%	Asset Allocation, Manager Selection
Inflation-Linked Fixed Income*	Bloomberg Barclays US TIPS Index	0.0%	100.0%	Manager Selection
Stable Value*	3-Year Constant Maturity Treasury	100.0%	0.0%	Manager Selection
Money Market	Citigroup 3-Month T-Bill Index	100.0%	0.0%	Manager Selection

*Funds are included in the target date funds.

[15] The returns for the custom target date indices are sent to INPRS investment staff on a monthly basis from the consultant for the Defined Contribution. The custom target date index returns are calculated by keeping the similar weight but assume 100% passive investment in order to evaluate the active managers' performance.

Illiquidity Premium

The term “illiquidity premium” is often used to explain any difference in performance between liquid and illiquid markets, such as across public and private equity or public fixed income and private credit. A performance difference, or “premium,” of between 1.50% and 3.00% seems to be a defensible and standard assumption for private credit and private equity performance, respectively, above and beyond public markets. But research suggests that a wide variety of private market characteristics could be leading to this performance “premium,” rather than simply illiquidity. These characteristics include different levels of leverage (private equity managers tend to employ higher leverage), portfolio concentration (fewer investments within each vehicle), active manager skill, and style factor concentration in size and value factors (these managers tend to acquire small businesses that are cheap).

Cornelius, P., Diller, C., Guennoc, D., & Meyer, T. (2013). *Mastering Illiquidity: Risk Management for Portfolios of Limited Partnership Funds.* Wiley.

Franzoni, Francesco A. and Nowak, Eric and Phalippou, Ludovic, Private Equity Performance and Liquidity Risk (August 29, 2011). *Journal of Finance*, Forthcoming; Swiss Finance Institute Research Paper No. 09-43. Available at SSRN: http://ssrn.com/abstract=1517044 or http://dx.doi.org/10.2139/ssrn.1517044

Nesbitt, Stephen, Topor, Jeff, and Cheng, Roger. "Risk Premiums in U.S. Middle Market Lending." Cliffwater, LLC, December 6, 2016. Available at https://storage.googleapis.com/cdli/CliffwaterResearch-RiskPremiumsinMiddleMarketLending-Part1-Dec2016.pdf

Stafford, Erik. "Replicating Private Equity with Value Investing, Homemade Leverage, and Hold-to-Maturity Accounting." Harvard Business School Working Paper, No. 16-081, January 2016. https://www.hbs.edu/faculty/Publication%20Files/ReplicatingPE_201512_3859877f-bd53-4d3e-99aa-6daec2a3a2d3.pdf

Public Market Equivalent ("PME") Benchmarks

Henly, Samuel. PME Benchmark Methods (August 12, 2013). *PitchBook.* Available at http://blog.pitchbook.com/wp-content/uploads/2013/11/20131104-PME-Sam-Piece.pdf

The two most common measures of PE performance, IRR and cash multiples, are adequate measurements of fund performance when used judiciously. However, IRR and cash multiples cannot be directly compared to indices that use TWR to evaluate performance in mainstream asset classes. The purpose of public market equivalent benchmarks (PMEs) is to make fund performance directly comparable to the performance of indexed asset classes.

PME metrics benchmark the performance of a fund (or group of funds) against an indexed alternative investment. For example, one could use a PME to compare the performance of a PE fund to the performance of publicly traded stocks indexed by the Russell 3000 Index. When PMEs are generated for many funds, the PME values can be used to rank fund performance controlling for broader market behavior.

First proposed in 1996, the Long-Nickels PME (hence, simply 'PME') benchmark answers the question: if an investor had made contributions to an indexed fund instead of a PE fund, and if these contributions (and the resulting distributions) were the same size and made at the same time as they were for the PE fund, what would the return be? In this sense, it is a relative measure of performance. When using PME benchmarks, a PE fund is compared to a hypothetical alternative investment, the PME vehicle. The idea is to take cash flows of a PE fund, redirect them to (or from) the PME vehicle, and obtain the vehicle's net asset value (or NAV) for use in an IRR calculation.

Hedge Fund Research Indices (“HFRI”)

www.hedgefundresearch.com

HFRI Monthly Indices Methodology and Construction

The HFRI Monthly Indices are a series of benchmarks designed to reflect hedge fund industry performance by constructing equally weighted composites of constituent funds, as reported by the hedge fund managers listed within the HFR Database. The HFRI range in breadth from the industry level view of the HFRI Fund Weighted Composite Index, which encompasses over 2200 funds, to the increasingly specific level of the sub-strategy classifications.

In order to be considered for inclusion in the HFRI, a hedge fund manager must submit a complete set of information to HFR Database (the listing of required fields for Database inclusion are available here). Funds are eligible for inclusion in the HFRI the month after their addition to HFR Database. For instance, a fund that is added to HFR Database in June is eligible for inclusion in the indices upon reporting their July performance. Additionally, all HFRI constituents are required to report monthly, net of all fee’s performance and assets under management in U.S. dollars. Constituent funds must have either (a) $50 million under management or (b) a track record of greater than twelve (12) months.

The HFRI are fund-weighted (equal-weighted) indices. Unlike asset-weighting, the equal-weighting of indices presents a more general picture of performance of the hedge fund industry. Any bias towards the larger funds potentially created by alternative weightings is greatly reduced, especially for strategies that encompass a small number of funds.

Benchmark Quick Reference

Asset Class	Benchmark	#1	#2	Bailey Criteria[16] #3	#4	#5	#6	Description
Total INPRS DB	6.75% Return Index	Yes	No	Yes	Yes	Yes	Yes	INPRS's Target Rate of Return.
Total INPRS DB	DB Target Index	No	No	Yes	Yes	No	No	The individual asset class benchmarks roll up with the weights fixed to the INPRS Target Asset Allocation. The private credit allocation is adjusted annually with the difference between current pacing target and IPS target proportionally added to other asset classes.
Total INPRS DB	DB Manager Selection Index	No	No	Yes	Yes	No	No	The individual asset class benchmarks roll up with their weights adjusted to the market value weight of that asset class within the Plan monthly.
Total Global Public Equity	MSCI ACWI IMI Market Net Index	Yes	Yes	Yes	Yes	Yes	Yes	A global equity market index.
Total Private Equity	Private Equity Custom PME	Yes	No	Yes	No	Yes	Yes	Utilizes public indexes in an attempt to best capture INPRS's exposure, adds 3.00% reflecting the illiquidity premium, and lags returns to align with manager reporting.
Total Private Equity	Cambridge Associates Peer Index	No	No	Yes	No	No	No	The median peer's return as measured by Cambridge Associates.
Total Private Credit	Private Credit Custom PME	Yes	No	Yes	No	Yes	Yes	Utilizes public indexes in an attempt to best capture INPRS's exposure, adds 1.50% reflecting the illiquidity premium, and lags returns to align with manager reporting.
Total Private Credit	Cambridge Associates Peer Index	No	No	Yes	No	No	No	The median peer's return as measured by Cambridge Associates.
Total Fixed Income Ex Inflation-Linked	Fixed Income ex Inflation-Linked Custom Benchmark	Yes	Yes	Yes	Yes	Yes	Yes	Custom benchmark constructed with sub-asset class benchmark components.
Total Inflation-Linked Fixed Income	Inflation-Linked Custom Benchmark	Yes	Yes	Yes	Yes	Yes	Yes	A global inflation-linked and US inflation-linked custom benchmark weighted to match INPRS's allocation.
Total Commodities	Commodities Custom Benchmark	Yes	Yes	Yes	Yes	Yes	Yes	A cross sector commodity index with collateral invested in 3-month US Treasury bills.
Total Real Estate	NCREIF NFI-ODCE Net 1 Qtr in Arrears	No	No	Yes	No	No	No	NCREIF is a not for profit organization that collects real estate data. NFI-ODCE Net 1 Qtr in Arrears is a core equity index they compile.
Total Real Estate	Real Estate Custom PME	Yes	Yes	Yes	Yes	Yes	Yes	A PME benchmark makes contributions to appropriate public indices in line with capital calls for the private real estate managers.
Total Real Estate	5% Real Rate of Return	Yes	No	Yes	Yes	Yes	Yes	Absolute real (excluding inflation) return target.
Total Absolute Return	Cash plus 4.00%	Yes	No	Yes	Yes	Yes	Yes	Absolute benchmark reflecting the additional return, above cash, absolute return managers are expected to generate.
Total Absolute Return	HFRI Custom	No	No	Yes	No	No	No	The index has evolved over time to attempt to capture the absolute return portfolio exposure.
Total Risk Parity	INPRS Target Rate of Return	Yes	No	Yes	Yes	Yes	Yes	Absolute return target equivalent to INPRS's target rate(s) of return.
Total Risk Parity	Global 60/40 Index	Yes	Yes	Yes	No	No	Yes	A commonly cited general asset allocation approach used to measure the efficacy of risk parity through time.

[16] Bailey Criteria: (1) Unambiguous (2) Investable (3) Measurable (4) Appropriate (5) Reflective of current investment options (6) Specified in advance
INPRS staff completed Bailey Criteria evaluation. As with any analysis, there is room for subjectivity.