




RETIREMENT BOARD CALENDAR SHEET
Retirement Board Meeting of November 14, 2018

To: The Retirement Board


Through: Jay Huish 
Executive Director

William J. Coaker, Jr. – CFA 
Chief Investment Officer

From: Kurt L. Braitberg – CFA, CAIA 
Managing Director, Public Markets

Han N. Pham 
Senior Portfolio Manager, Public Equity

Anna Langs – CFA, FRM
Managing Director, Asset Allocation, Risk
Management and Innovative Solutions

Alo J. Martins – CFA 
Security Analyst, Public Equity

Date: November 14, 2018

Agenda Item:

Recommendation to convert SFERS' existing investment in Arrowstreet's Global Equity-ACWI long-only strategy ("Global Long-Only") to Arrowstreet's Global Equity-ACWI Alpha Extension 130/30/20 strategy ("Global Alpha Extension").

Recommendation:

Staff and NEPC, SFERS' general consultant, recommend that SFERS' existing investment of \$657.5 million (preliminary as of 10/31/18) in the Arrowstreet Global Equity-ACWI strategy be converted to the Arrowstreet Global Equity-ACWI Alpha Extension 130/30/20 strategy. Arrowstreet emerged as a top candidate from the Equity Active Extension search that SFERS initiated in August 2018 with responses from 12 managers.

Arrowstreet was founded in 1999 by three seasoned investment professionals from PanAgora Asset Management. The Firm employs a systematic investment process using signals grounded in investment theory.

If the Retirement Board agrees with this recommendation, the following motion should be adopted:

Move that the Retirement Board of the San Francisco City and County Employees' Retirement System approve the conversion of Arrowstreet Global Equity-ACWI long-only to Arrowstreet Global Equity-ACWI Alpha Extension 130/30/20.

Attachments:

- Staff Memorandum; and
- Consultant Analysis – NEPC
- Staff Memorandum from May 2014 Board Meeting



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Through: Jay Huish *JH*
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William J. Coaker, Jr. – CFA *WJC*
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Managing Director, Asset Allocation, Risk
Management and Innovative Solutions

Alo J. Martins – CFA *AM*
Security Analyst, Public Equity

Subject: Arrowstreet Global Equity – Recommendation to Convert Strategy:
“Global Long-Only” to “Global Alpha Extension”

Overview

Investment Staff (“Staff”) is recommending a conversion of SFERS’ existing investment (\$657.5 mn¹) in Arrowstreet’s Global Equity–ACWI Long-Only strategy (“Global Long-Only”) to Arrowstreet’s Global Equity–ACWI Alpha Extension 130/30/20 strategy (“Global Alpha Extension”).

The Global Alpha Extension strategy relaxes the long-only constraint in SFERS’ existing Arrowstreet investment. Removing the long-only restriction allows Arrowstreet to implement select short positions and generate stronger returns from stocks they find unattractive by going beyond benchmark underweights. The Global Alpha Extension strategy uses the same forecasting models as the Global Long-Only strategy on an expanded opportunity set (long and short), which should improve portfolio return potential. Arrowstreet targets outperformance (relative to the MSCI ACWI IMI) of 5.5% with a tracking error of 4.0-9.0% for the Global Alpha Extension strategy as compared to 3.0% and 3.0%-7.0% for the existing Global Long-Only strategy. The expected information ratio² increases from 0.55 to 0.79.

Arrowstreet Strategy <i>Preferred Benchmark</i>	Strategy Inception	Targets		
		Value Add	Track. Error	Info Ratio
Long-Only Global Equity <i>MSCI ACWI IMI</i>	Feb-06	3.0%	3.0-7.0%	0.55
Alpha Extension Global Equity <i>MSCI ACWI IMI</i>	Jul-12	5.5%	4.0-9.0%	0.79

¹ Preliminary estimate as of October 31, 2018.

² Information Ratio is a measure of a fund’s excess return over a benchmark per unit of risk taken to that benchmark.

The “20” in the strategy name refers to Arrowstreet’s ability to go long or short 20% in equity index futures, which allows for more efficient management of market beta. Since individual stock portfolio can exhibit higher beta (more market risk) or lower beta (lower market risk), trading equity indices to adjust market sensitivity of the overall portfolio provides Arrowstreet additional flexibility in portfolio construction and has historically contributed positively to overall returns.

Background

Staff’s original memo recommending the investment in Arrowstreet’s Global Long-Only product (from the May 2014 Board meeting) is attached at the end of this section for reference. Below we summarize the key points and note any updates.

Firm History – Arrowstreet Capital (“the Firm”) was founded in 1999 by Peter Rathjens, John Campbell and Bruce Clarke. The three founders had worked together at PanAgora Asset Management since the early 1990s. Clarke retired at the end of 2014 after a well-orchestrated transition of his CEO responsibilities to Anthony Ryan who had joined the Firm in 2011. Clarke remains involved as the Chairman of the Board and a Non-Executive Director of the Firm.

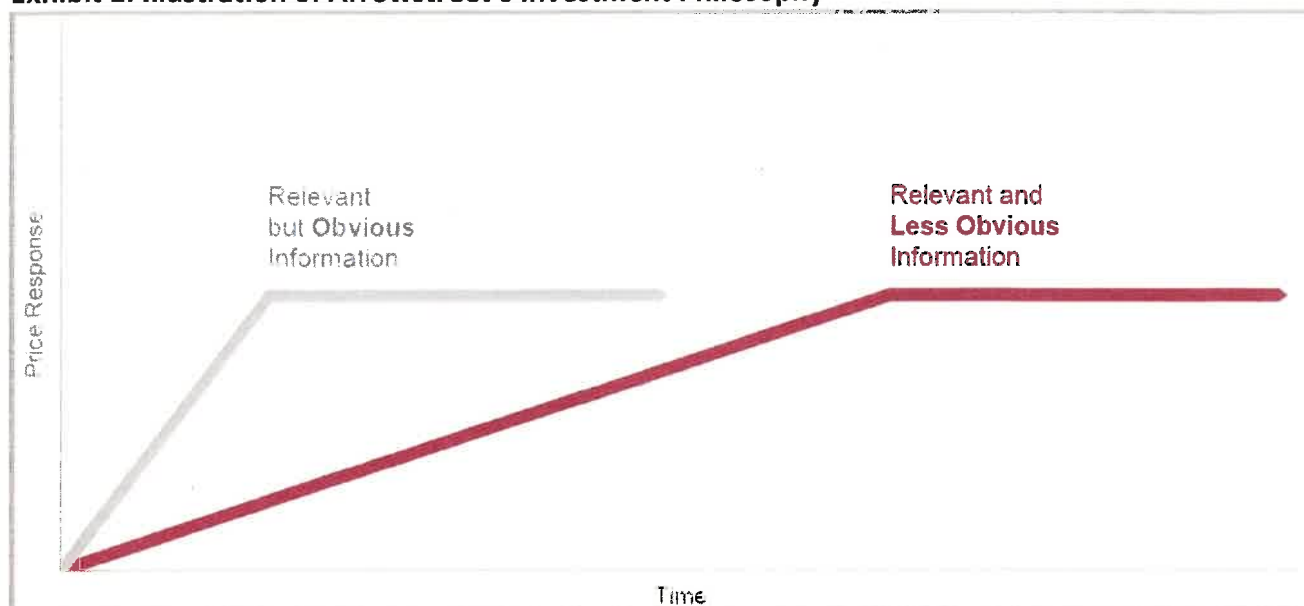
In 2008, Arrowstreet bought out the remaining stakes of two outside investors; CalPERS and Lovell Minnick (each initially owned 15% of the Firm). Today, Arrowstreet is 100% employee-owned (by 23 partners). Key team members are regularly offered opportunities to participate in Firm ownership.

Assets – As of September 30, 2018, Firm assets stood at \$102 billion (bn) with \$80.3 bn in Long-Only equity strategies, \$19.9 bn in Alpha Extension equity strategies, and \$1.3 bn in Long/Short equity strategies. Arrowstreet offers 24 strategies across various regions (Global, International, US and Emerging) and styles (long-only, alpha extension, minimum volatility, etc.). All strategies are managed by the same team and use the same research, forecasts and back office infrastructure.

Arrowstreet measures capacity as a percentage of the total index market capitalization. Arrowstreet estimates they can run their ACWI strategies with 35 basis points of assets relative to the total global (ACWI) market capitalization. They are currently at approximately 20 basis points with 15 basis points of remaining capacity. Capacity limitation is driven by exposure of the ACWI products to international developed and emerging market products. Presently Arrowstreet’s Emerging Markets Equity strategy is closed to new investment with capacity being reserved for the emerging markets sleeves of Arrowstreet’s global products.

Philosophy and Process – All of Arrowstreet’s strategies use a quantitatively oriented investment process centered around the identification of material and non-obvious signals (Exhibit 1). The signals are broadly grouped into the following categories: value, quality, momentum, catalyst, extreme sentiment and high frequency. Signals are selected based on their intuitive investment appeal, historical efficacy at forecasting returns, statistical/economic significance, and effectiveness across various market environments and equity universes.

Exhibit 1: Illustration of Arrowstreet's Investment Philosophy



Note: Reproduced with Arrowstreet's permission. Sourced from Arrowstreet's Internal Databases. Diagram is for illustrative purposes only.

The value signals position the portfolio towards cheap stocks and away from expensive stocks using several fundamental valuation measures such as price-earnings ratios and price-book ratios. The quality signals look for companies with low risk, sustainable growth and high profitability on the long side and companies with the inverse characteristics (high risk, unsustainable growth and low profitability) on the short side. Momentum signals analyze share price changes across multiple time frames seeking to benefit from trends (up trends on the long side and down trends on the short side). Catalyst signals are broadly similar to momentum signals but use company news to identify potential up or down trends; catalyst signals are typically used in timing entries/exits to/from longer term trades. The extreme sentiment signals complement the catalyst signals; they measure the level of the sentiment and indicate when the price movement has gone to an extreme (and has likely played out). The high frequency signals identify short-term market opportunities and are useful in timing longer term trades driven by more persistent signals.

Each signal is dynamic, reflecting changing market opportunities as well as Arrowstreet's assessment of the prospective effectiveness of the signal. Arrowstreet employs these investment signals across two dimensions – Direct and Indirect. Direct effects drive approximately 30-40% of Arrowstreet's alpha and have valuable diversification benefits when combined with Indirect effects. Indirect effects are reflected more slowly in the market and Arrowstreet expects that they will drive approximately 60-70% of alpha.

As its name suggests, Direct effects are insights directly generated from a company and applied to that same company to derive investment conviction. For example, an upward trend in stock price for a company may get picked up by Arrowstreet's Momentum signals leading to a long position in that company.

Indirect effects, a key differentiating feature of Arrowstreet's process, help to build investment conviction by analyzing the signals generated by companies with similar characteristics, such as firms in the same country, same sector or that have economic linkages. Initially, the Arrowstreet model applied the Indirect effects only to companies in the same country and/or sector. In 2006, Arrowstreet added an Expanded Linkages framework to the model; this framework groups companies by characteristics such as cash flow correlations, customer/supplier/competitor relationships, common board membership, debt structure and headquarter locations.

For example, take a hypothetical Mexican burrito company that reports upward trending demand for its product. Arrowstreet believes that investing in this company would lead to limited success since the signal is too obvious and the sudden influx of investors would hamper excess return potential. Instead, the Indirect effect component of Arrowstreet's forecast model looks to take advantage of moves in related companies such as, a Mexican bean company (supplier), an American fast food company (customer) or an Argentinian burrito company (competitor).

Applying the alpha models to a universe of linked companies (constructed using the expanded linkages framework) increases the predictive power and robustness of Arrowstreet's model. Arrowstreet's application of Indirect effects, in particular their expanded linkages framework, differentiates them relative to their peers and is an important area of ongoing research for the Firm.

Portfolio Construction – The signals suggest tilts for each stock in the universe. The tilts for all the models are aggregated to determine the overall weight for each stock. These weights are then fed into Arrowstreet's portfolio optimizer, which assesses the expected tracking error contribution and transaction cost of each position and assigns a commensurate adjustment (positions that contribute larger amounts of benchmark relative tracking error are assigned a higher penalty and vice versa). Arrowstreet computes tracking error variance using a proprietary risk model which decomposes stock return into a component associated with common risk factors and an idiosyncratic component representing a security's uncorrelated return. Arrowstreet's risk model and optimizer are aligned with their alpha factors resulting in more efficient risk-reward trade-off decisions and higher transfer coefficients (i.e., more of the predictive power is transferred into portfolio positions).

Portfolio limits are applied in the optimization process constraining the portfolio's benchmark relative active weights. These limits are applied (on a net basis³) to individual stocks (constrained to +/-3% of benchmark weight), country/sector baskets (+/-5%), countries (+/-10%) and sectors (+/-15%). Positions may drift outside of these limits in which case the positions are brought back in line at the next optimization. Position limits allow the strategy to maintain a diversified active portfolio while protecting against event risk.

An additional step of Arrowstreet's portfolio construction involves the active management of factor betas. Arrowstreet monitors the portfolio's exposure to the standard Market beta as well as the sensitivity of the portfolio to factors such as Value, Quality, Momentum, Small Cap, Emerging Markets and Fixed Income. If the models suggest a compelling investment case for maintaining a

³ Net exposure = Long exposure – Short exposure

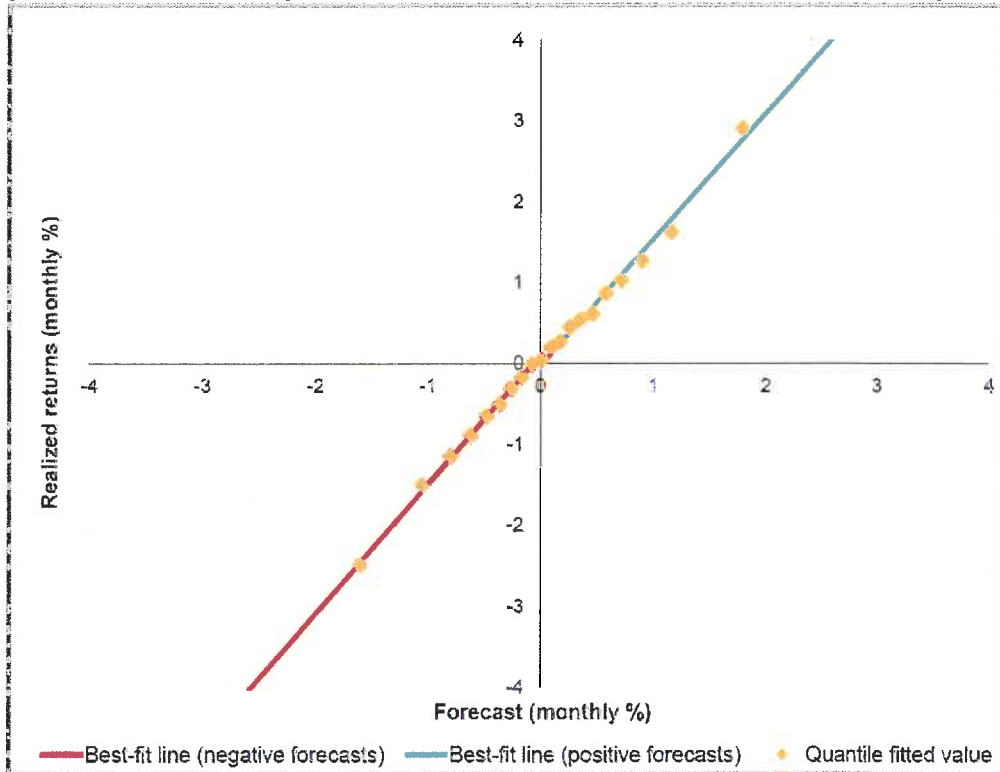
specific factor tilt, the optimizer will allow tactical benchmark deviation. If there is no compelling investment case for a beta/style tilt, the optimizer will bring the portfolio's factor exposures to be in line with the benchmark's.

Arrowstreet's disciplined quantitative-based approach helps to avoid emotional overrides in their investment process. However, all trades need to be reviewed, for sensibility, by a human before the system takes any trading action, which introduces an element of oversight into their system. The portfolio is reoptimized and traded nearly every day.

Differences between Global Alpha Extension and Global Long-Only

Arrowstreet has demonstrated an ability to forecast short returns with the same efficacy as their ability to forecast long returns (Exhibit 2). As such, adding the ability to short expands Arrowstreet's opportunity set allowing for more meaningful underweight in stocks expected to underperform.

Exhibit 2: Symmetric Forecasting Power in Generating Successful Positive and Negative Forecasts



Note: Reproduced with Arrowstreet's permission. Sourced from Arrowstreet's Internal Databases. Represents current model integrated forecasts for the MSCI IMI universe. January 1996 through February 2018.

Removing the constraint on short selling also allows the portfolio to take advantage of different market environments (alpha diversification).

Arrowstreet's Global Alpha Extension strategy uses a 130/30/20 structure. "130" refers to the percent of the portfolio's assets invested in long stocks and "30" refers to the percent of the portfolio's assets invested in short stocks. The strategy can invest more than 100% of assets into long

positions by short selling 30% of assets and collecting the proceeds up front. While the strategy can deviate from a base of “130/30” to a base of “120/20” or “110/10”, and so on, the Arrowstreet team expects the base to mainly be around 130/30.

The “20” refers to long or short positions in equity index futures (primarily regional or single-country equity indices) which allow Arrowstreet to manage the market beta (sensitivity) of the portfolio. In different market environments, Arrowstreet’s process may favor low or high beta stocks. By investing up to 20% of capital in equity index futures, Arrowstreet can maintain a market beta close to one. Because of the futures positions, the net equity exposure of the strategy can range between 80% and 120% (typically on the higher end) while gross equity exposure ranges from 160% to 180%. Arrowstreet expects that the 130/30/20 strategy (with 20% index futures) will outperform their 130/30 strategy (without the equity index futures) by 50 basis points although the historically achieved value added has been higher.

Performance

Please refer to Appendix B on page 12 for exhibits reflecting the net-of-fees performance of the Arrowstreet Global Alpha Extension strategy relative to the Arrowstreet Global Long-Only strategy and MSCI All Country World Index (ACWI).

In every calendar period (except 2016) and over all trailing time periods the Global Alpha Extension strategy has outperformed the Global Long-Only strategy. Both strategies have also consistently outperformed the index. Since inception of the Global Alpha Extension strategy, it has outperformed the index by 8.1% annually while the Long-Only strategy has outperformed by 4.0% annually. The Alpha Extension strategy has outperformed the Long-Only strategy by 4.0% annually while exhibiting a similar level of volatility (standard deviation of 10.9 vs 10.0).

Role in Portfolio – The Alpha Extension strategy has displayed strong correlation benefits. In this context, correlation is used as a measure of how closely the strategy moves in relation to the MSCI ACWI. The correlation of the Arrowstreet Long-Only strategy to the broad equity market has ranged between 0.94 and 0.97 while the corresponding range for the Arrowstreet Alpha Extension strategy has been 0.85 to 0.91. Converting to the Alpha Extension strategy will decrease some of the equity beta risk in the SFERS portfolio.

The Alpha Extension strategy also has a more attractive Correlation of Value Added profile. Correlation of Value Added reflects the degree to which two managers’ excess benchmark returns are related. A low correlation of value added between two managers reflects an uncorrelated pattern of excess returns. Arrowstreet’s Alpha Extension strategy has an average value added correlation of 0.01 relative to the rest of SFERS’ active public equity managers, less than that of Arrowstreet’s Long-Only strategy (Appendix C on page 13).

Additionally, the Alpha Extension strategy has exhibited higher tracking error to ACWI than the Long-Only strategy; a track record that is more differentiated relative to the index has a higher potential to add value over time.

While both Arrowstreet products have generated alpha relative to the broad ACWI index, the Alpha Extension strategy has clearly exhibited a stronger return profile with better portfolio diversification benefits.

Staff Due Diligence

SFERS has been invested with Arrowstreet via the Global Long-Only product since 2015. Prior to SFERS' investment, Staff had known Arrowstreet for several years. Since then, Investment Staff have met with various members of the Arrowstreet team to review the investment in the Global Long-Only product as well as discuss the conversion to the Global Alpha Extension product. As part of the due diligence on the conversion, Staff held numerous phone conversations with Arrowstreet and conducted onsite due diligence at Arrowstreet's Boston headquarters in June, September and October of 2018, with NEPC joining for the October meeting. Staff has met with the following individuals from Arrowstreet:

- Peter Rathjens – Partner, CIO
- Manolis Liodakis – Partner, Head of Portfolio Management
- Alex Ogan – Partner, Investment Strategy Implementation
- Anne Luisi – Manager, Investment Strategy Implementation
- Derek Vance – Partner, Risk Model and Forecasting Development
- Jon Simon – Head of Client Relationship Management
- Judy Donovan – Client Relationship Manager

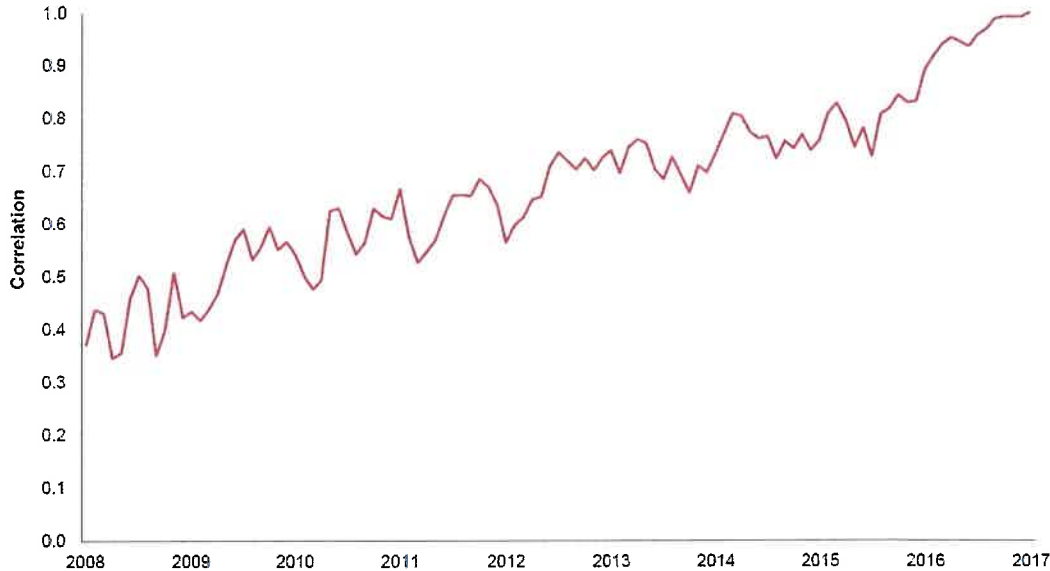
Staff has conducted several reference checks on both the Global Long-Only product and the Global Alpha Extension product. Staff also spoke with several investors who converted their mandate from Global Long-Only to Global Alpha Extension. The results of the due diligence have been very positive and have provided Staff with a high-level of conviction in the team, process, and strategy.

Conversion Highlights

- *Expanded Opportunity Set* – Adding the ability to short allows Arrowstreet to express their bearish (negative) views on stocks in addition to their bullish (positive) views. Their investment process is designed to forecast negative returns as persistently as it forecasts positive returns.
- *Portfolio Diversification Benefits* – The Global Alpha Extension strategy has a lower correlation to the broad equity market and should do more to protect the SFERS portfolio in the event of a market downturn than the Global Long-Only strategy.
- *Keep Pace with Cutting Edge Research* – The Arrowstreet team is continuously working on innovations to maintain their position as a market leader. Comparing the forecasts produced by the model today versus the forecasts from the model 10 years ago results in a correlation of 0.4 indicating a significant change in the model (Exhibit 3). Additionally, the Global Alpha

Extension's 130/30/20 structure represents an innovative approach to earning alpha relative to the Global Long-Only structure.

Exhibit 3: Correlation Between As-Reported and Current Model Forecasts



Note: Reproduced with Arrowstreet's permission. Sourced from Arrowstreet's Internal Databases.

- *Greater Alpha Potential* – The Global Alpha Extension strategy has higher excess return and information ratio targets of 5.5% and 0.79, compared to 3.0% and 0.55 for the Global Long-Only strategy. Over their longest common time period, the Global Long-Only strategy and the Global Alpha Extension strategy have achieved excess returns of 4.0% and 8.1%, respectively, and information ratios of 1.36 and 1.53, respectively.

Conversion Considerations

- *Account Structure* – By converting from a separate account structure to a commingled structure, SFERS would lose the ability to vote proxies and would not be able to avoid any potential positions in companies on SFERS' restricted lists.
- *Growth in Assets Under Management (AUM)* – At approximately \$102 bn in AUM, Arrowstreet is among the largest managers in the SFERS portfolio. Arrowstreet monitors their strategies closely and have closed strategies once they reach their target capacity. Target capacity is measured as a percentage of the investable universe rather than a static dollar figure – Arrowstreet believes that this method is superior since it scales with the overall market level and liquidity. Arrowstreet's fee structure is heavily tilted towards the incentive portion (20% applied on outperformance over the benchmark) as opposed to the fixed management fee portion (20 basis points). Staff believes that this type of fee structure should incentivize Arrowstreet against asset gathering at the cost of alpha generation.

- *Prime Broker Relationship / Counterparty Risk* – Adding shorting capability introduces an element of prime broker risk into the process. Prime brokers serve a market need for short investors by providing a centralized securities clearing facility. Prime brokerage became an issue in the Global Financial Crisis when Lehman Brothers collapsed – investors were not able to withdraw their margin collateral which led to the massive deleveraging of financial markets. Arrowstreet regularly evaluates its prime brokers across several factors including counterparty credit risk, stock loan pricing, financing rates, stock loan availability, capital requirement efficiencies and technological capabilities. In addition, Arrowstreet uses a multi-prime structure thereby spreading its prime broker risk across 5 prime brokers – UBS AG, UBS Securities, Deutsche Bank, JP Morgan and Merrill Lynch.
- *Short Sale Complexity* – Short selling is more complex for investment managers than traditional long-only strategies – shorts can have higher costs (see below), can be subject to short squeezes, and unlike long positions, short positions will become larger when the price goes in the adverse direction. Arrowstreet has been managing short positions for 14 years – they launched a global long/short strategy in 2004. Staff believes that Arrowstreet has the knowledge, infrastructure and experience to successfully manage short positions.
- *Short Sale Costs* – There are typically higher expenses associated with short selling, including variable short rebates, collateral requirements and turnover costs, which can reduce strategy alpha. Higher short sale costs are factored into the optimization process: all else being equal, a stronger conviction is needed for the strategy to take on a short position versus a long position. Additionally, Arrowstreet mitigates some of the short selling costs by executing orders over block trading networks, tailoring trading strategies for individual markets, implementing trading algorithms and leveraging the global capabilities of program trading desks. Arrowstreet attempts to remain market neutral when trades are being executed by instructing brokers to simultaneously coordinate buys and sells. They also seek out brokers that have the opposite side of any trade, which creates a natural flow and reduces the impact of execution. The Portfolio Management team performs real-time trade analytics to monitor broker executions against various market measures and ensure best execution.
- *Varying Net Exposure and Beta* – Because of the ability to use up to 20% of capital in long or short equity index futures, the portfolio can have a net exposure ranging between 80% and 120% and beta ranging between 0.85 and 1.15. While Arrowstreet tries to maintain a market beta close to 1, these ranges allow the team to traverse different market environments and best position the portfolio to capture alpha. The variances pose considerations for Staff with respect to monitoring overall portfolio exposures and sensitivities.
- *High Turnover* – As expected with systematic quantitative managers, Arrowstreet’s annual turnover is high. The Global Long-Only strategy’s annual turnover of 178% is one of the highest among SFERS’ Public Equity managers. The Global Alpha Extension strategy has a higher expected turnover rate, ranging from 150% to 300%. Arrowstreet’s approach places no emphasis on tax sensitivity, however, there are no tax implications for SFERS owing to the plan’s tax-exempt status.

Appendix A: Summary of Key Terms and Guidelines

Investment	Arrowstreet Global Equity – Alpha Extension Fund
Firm	Arrowstreet Capital, LP
Investment Type	Global Public Equity – Active Extension
Assets Under Management	Firm AUM as of 9/30/18: \$102 bn Strategy AUM as of 9/30/18: \$8.6 bn
Geography	Global
Benchmark	MSCI All Country World Investable Market Index, Net (unhedged), in USD
Investment Objective	Produce returns in excess of the benchmark with expected tracking ranging from 4.0% to 9.0% over rolling 5 year periods
Investment Universe	Equity securities that are primarily within the Benchmark. As permitted by client guidelines, Arrowstreet will also include non-benchmark securities that are publicly traded on regulated security exchanges worldwide.
Capitalization Range	All Cap
Position Limits	+/- 3% of stock weight in benchmark
Country Limits	+/- 10% of country weight in benchmark
Sector Limits	+/- 15% of global sector weight in benchmark
Cash Holdings	Typically between 0.5% and 2.0% with a maximum of 5%
Private Investments	Permitted but not generally expected
Holdings	Longs: 400-1,000 Shorts: 50-400
Derivatives Usage	Foreign currency exchange forward contracts are used for active currency management Exchange traded equity index futures used to manage portfolio beta
Leverage	Yes
Time to be Fully Invested	Typically less than 5 business days Potentially less for SFERS given the existing long-only mandate may allow for an in-kind transfer of assets
Lock-Up	None
Withdrawals/Redemption	Beginning of month and middle of month with 9 business days' notice Payment within 10 business days
Fee Schedule	Management fee: - 0.20% Incentive Fee: - 20% performance fee in excess of the return of MSCI ACWI IMI
Reporting	- Monthly statement of performance, Quarterly letters

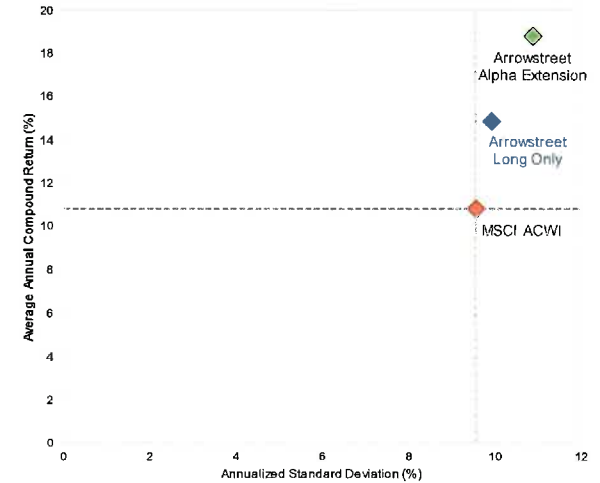
Appendix B: Arrowstreet Global Alpha Extension Performance

Calendar Year Returns	9 mos												
	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Arrowstreet Global Alpha Extension (Net)	10.1	33.0	8.7	3.8	11.4	45.2	---	---	---	---	---	---	---
Arrowstreet Global Long Only (Net)	7.2	28.1	9.6	-0.6	7.9	33.7	17.0	-7.3	14.2	43.0	-38.7	12.0	9.9
MSCI ACWI (ND)	3.8	24.0	7.9	-2.4	4.2	22.8	16.1	-7.3	12.7	34.6	-42.2	11.7	13.1
Value Added: Alpha Extension - Long Only	3.0	4.9	-0.9	4.3	3.5	11.6							
Value Added: Alpha Extension - MSCI ACWI	6.3	9.0	0.8	6.1	7.2	22.4							

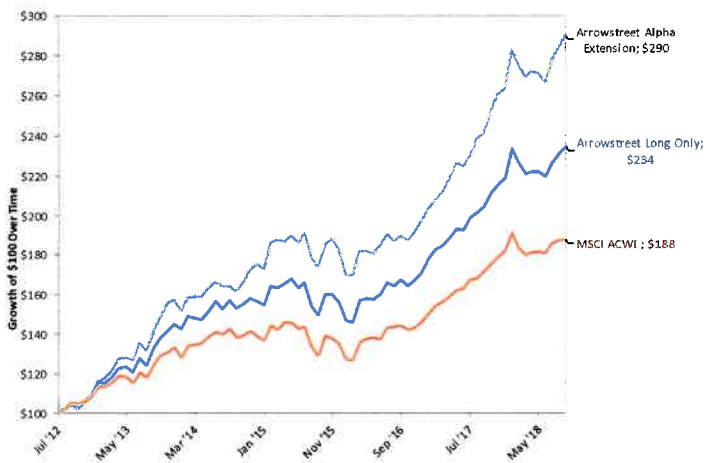
Annualized Returns	Maximum Drawdown (Peak to Trough)					
	1 Yr	2 Yr	3 Yr	4 Yr	5 Yr	6.2 Yr ¹
Arrowstreet Global Alpha Extension (Net)	20.2	23.6	18.7	15.8	15.4	18.8
Arrowstreet Global Long Only (Net)	14.7	18.4	16.2	11.2	12.1	14.8
MSCI ACWI (ND)	9.8	14.1	13.4	8.0	8.7	10.8
Value Added: Alpha Extension - Long Only	5.5	5.2	2.5	4.5	3.3	4.0
Value Added: Alpha Extension - MSCI ACWI	10.4	9.4	5.3	7.8	6.7	8.1

Start	Duration	Return	Recover Time
Aug 1, 2015	7 mos.	-11.1	9 mos.
Jun 1, 2015	9 mos.	-12.9	10 mos.
May 1, 2015	10 mos.	-13.4	10 mos.

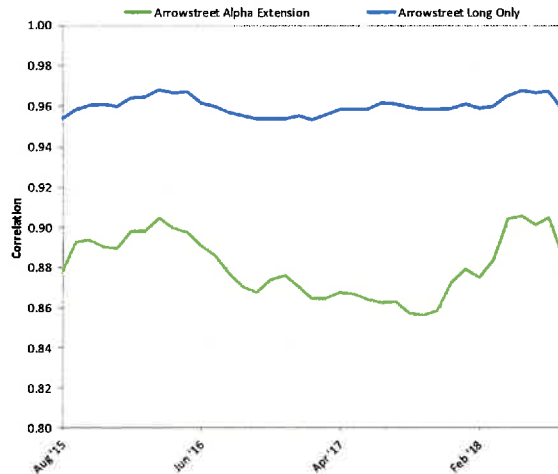
Risk / Return Analysis (Trailing 6.2 years¹)
August 1, 2012 through September 30, 2018



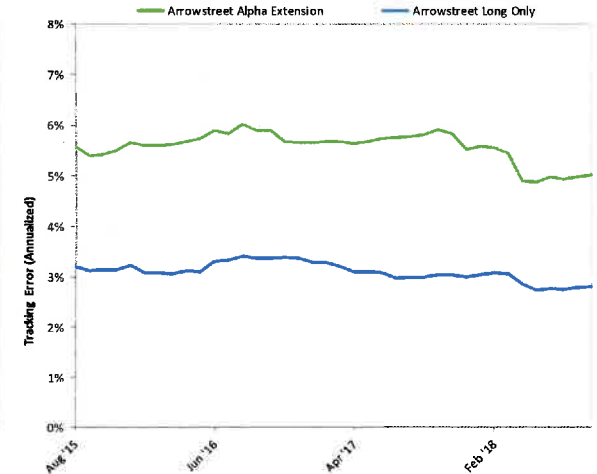
Growth of \$100¹
August 1, 2012 through September 30, 2018



Rolling 3 Year Correlation vs MSCI ACWI¹
August 1, 2012 through September 30, 2018



Rolling 3 Year Annualized Tracking Error vs MSCI ACWI¹
August 1, 2012 through September 30, 2018

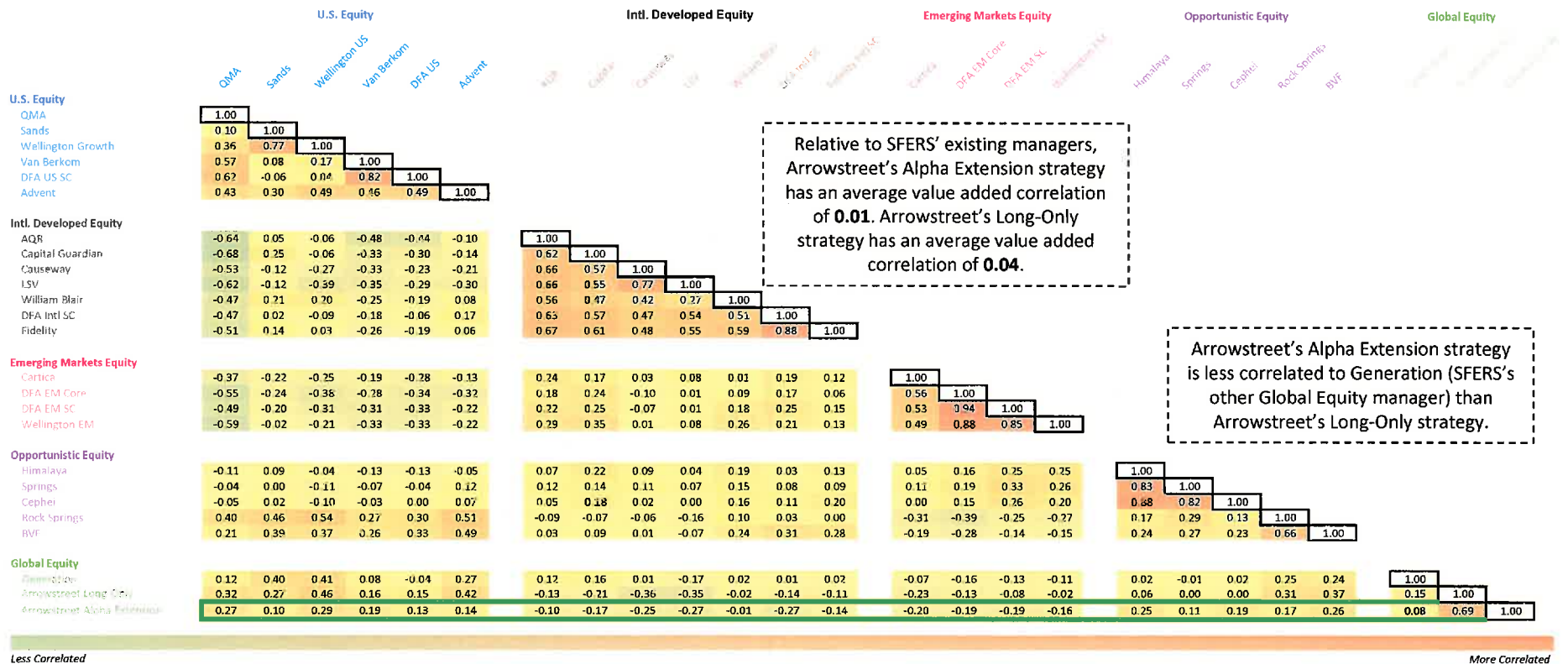


Notes: Arrowstreet returns are presented net of all fees. Arrowstreet Long Only performance reflects returns experienced by SFERS since July 2015 (first full month since investment). Prior to that date, performance reflects composite level returns. MSCI data copyright MSCI 2018, all rights reserved.

¹ Since the first full month following the inception of the Arrowstreet Global Alpha Extension strategy.

Appendix C: SFERS Public Equity Managers – Correlation of Value Added

Correlation of Value Added (Trailing 5 years)
 October 1, 2013 through September 30, 2018



Notes: All returns are presented net of all fees. Manager performance reflects returns experienced by SFERS beginning the first full month since investment. Prior to that date, performance reflects composite level returns. Correlation of Value Added represents the degree to which the value added of a manager (manager's return – MSCI ACWI return) is correlated with the value added of another manager. MSCI data copyright MSCI 2018, all rights reserved.



SFERS

San Francisco Employees' Retirement System

City and County of San Francisco
Employees' Retirement System

Date: November 14, 2018

To: The Retirement Board

From: Andrew Collins *AC*
Director, ESG Investing

Subject: Environmental, Social, and Governance (ESG) Commentary for:
Equity Active Extension Recommendation: Arrowstreet Capital, L.P.

Overview

Investment Staff conducted an assessment of Arrowstreet Capital, L.P.'s ("Arrowstreet" or the "Firm") ESG practices to understand how these factors may contribute to Arrowstreet's quality as an investment manager. Staff's assessment of ESG factors focused on (1) the manager's investment process in Arrowstreet's Global Equity – ACWI Alpha Extension 130/30/20 strategy (the "Alpha Extension Strategy" or the "Fund"), and (2) general firm operations.

To evaluate each area, Staff solicited responses to ESG-related questions as part of the Request for Information (RFI) process, reviewed other firm materials (including Arrowstreet's Principles for Responsible Transparency Report), and held discussions with Arrowstreet personnel.

1. ESG in the Investment Process

As a model-driven manager, Arrowstreet's investment strategy relies on a variety of quantitative tools to analyze sources of alpha, forecast returns, select stocks, and construct its portfolio. The Alpha Extension Strategy does not currently include any specific ESG information into its return forecasting model. Arrowstreet explained that it conducted extensive research into the inclusion of ESG data points into its model but found little evidence of a meaningful signal. Arrowstreet notes, however, that some of its existing measures of quality are correlated with governance factors (the "G" pillar as defined by MSCI within its ESG framework). It is Arrowstreet's belief that ESG information is relevant to stock price movement, but that this fact is obvious to most market participants and thus incorporated into stock prices quickly.

Arrowstreet reports that it periodically evaluates new ESG data and tests its efficacy in its return forecasting model, holding it to the same standards as all other and information. The Firm's reports that it is challenged in accessing ESG data of the necessary breadth and depth to include in its model. Staff recognizes the value of this measured approach and is encouraged by the Firm's willingness to explore new and diverse datasets.

Arrowstreet's risk model does incorporate signals related to investor behavior around ESG information. Arrowstreet believes there is a risk of greater correlation among stocks favored by ESG-sensitive investors and ESG is taken into consideration in this context. Currently, this factor is not meaningfully active in the risk

model and Arrowstreet has not observed significant crowding into ESG stocks, but the Firm notes that this could occur in the future.

Arrowstreet has a publicly available ESG policy, its "[Statement Regarding Environmental, Social and Corporate Governance \(ESG\)](#)"¹. Within separate account structures, the Firm has the capability to accommodate ESG motivated investment restrictions and certain other client-requested ESG constraints or tilts.

2. ESG at the Firm

Arrowstreet is a private partnership with approximately 250 staff. It describes its firm culture as entrepreneurial and collaborative, stating:

"We believe that investment success is best achieved by using the collective insights of a diverse team of high quality investment professionals rather than relying on any one individual. In addition, we believe that sustainable investment success requires a continual re-investment in research, infrastructure, tools, and controls. Our corporate ownership structure, a partnership owned and controlled by management, is an integral part of the culture as it allows us to take a long-term view and make the appropriate business decisions to align our interests with those of our clients."

Arrowstreet is a signatory to the Principles for Responsible Investing (PRI). It has established a Responsible Investing Committee, which is comprised of senior members of Portfolio Management, Research, Legal and Compliance, and Client Relationship Management that meets semi-annually to discuss the Firm's approach to various ESG related issues, both in its investment process and its internal business practices.

Summary

In summary, while Arrowstreet currently incorporates minimal ESG information into its investment process, the Firm shows a willingness to monitor new and emerging ESG datasets and consider their inclusion in its return forecasting model in the future. Staff finds value in the rigor and scrutiny Arrowstreet applies to evaluating the efficacy of ESG and other data sources.

In interactions with Arrowstreet personnel, Staff observed the Firm's team-based and collaborative culture. Staff believes that this corporate culture contributes to a strong intellectual capital base at the Firm.

¹ <https://www.arrowstreetcapital.com/sites/default/files/Arrowstreet%20ESG%20Policy%20Final%20%28April%202018%29.pdf>

NEPC Tear Sheet

Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

November 2018



BOSTON | ATLANTA | CHARLOTTE | CHICAGO | DETROIT | LAS VEGAS | PORTLAND | SAN FRANCISCO

Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

NEPC Recommendation

NEPC supports Staff's recommendation to the San Francisco City and County Employees' Retirement System ("SFERS" or the "Plan") to adjust the Global Mandate with Arrowstreet to the Global Equity - ACWI 130/30/20 Strategy.

The recommendation is subject to successful negotiation of both contract and investment management guideline language.

THIS MEMO PROVIDES A SUMMARY OF INFORMATION AND DOCUMENTATION RECEIVED BY NEPC FROM THE MANAGER THROUGH PHONE CALLS, MEETINGS AND AN ONSITE VISIT. THE PRODUCT HAS NOT BEEN RATED BY NEPC'S DUE DILIGENCE COMMITTEE OR ALTERNATIVE ASSETS COMMITTEE.

Firm Overview

Firm Name	Arrowstreet Capital LP
Firm Address	200 Clarendon Street, 30th Floor, Boston, Massachusetts 02116
Firm AUM	\$95,569 million as of June 30, 2018
Inception Date Firm	June 1999

Strategy Overview

Strategy Name	Global Equity – ACWI Alpha Extension 130/30/20 Strategy
Strategy AUM	\$7,834 million as of June 30, 2018
Inception Date Fund	July 2012
Closed or Open	Open
Standard Management Fee	30bps
Standard Performance Fee	20% of outperformance over MSCI ACWI IMI



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Firm & Strategy Evaluation

Firm History

Arrowstreet was founded in June 1999 with senior partners from PanAgora- Bruce Clarke (CEO), Peter L. Rathjens (CIO) and John Campbell (Co-Head of Research) the firm's founders. In 2008 Arrowstreet completed the second transaction to repurchase shares from outsider owners and became 100% employee owned. In 2014 Mr. Clarke stepped down as CEO becoming Executive Chairman, and in 2015 became non-executive Chairman of the Board. As of June 30, 2018, Arrowstreet employed 249 professionals.

Investment Strategy Overview

Arrowstreet's 130/30/20 strategy combines two aspects of portfolio management at Arrowstreet. The core of the portfolio is their systematic 130/30 active extension strategy which utilizes the firm's Alpha engine to systematically construct a portfolio of securities to outperform the MSCI ACWI IMI benchmark. Arrowstreet uses a linkages framework which look at securities both within country and within sector to determine the appropriate peer comparison companies.

Arrowstreet 130/30

The Arrowstreet 130/30 strategy utilizes Arrowstreet's proprietary alpha engine, a combination of alpha signals developed by the team, to systematically construct portfolios based on forecasts of individual security returns.

Arrowstreet 20

Unlike many 130/30 or 140/40 strategies that are optimized to 100% net long and attempt to be beta 1, Arrowstreet allows the strategy a few more degrees of freedom to overweight and underweight various factors. For example, a strategy that is currently biased towards lower volatility stocks at the expense of higher volatility stocks may exhibit a beta below 1.0. In this instance Arrowstreet would use the equity futures to increase the portfolio exposure above 100% to adjust the beta back towards 1.0.

Portfolio Process

Arrowstreet's investment process is quantitative in nature but utilizes elements of qualitative intuition across signal development, risk management and other aspects of the strategy. Arrowstreet believes that securities should be evaluated across both direct (company specific) and indirect (country, sector and other) effects

Direct Effects

- Characteristics specific to the company such as balance sheet, cash flow or price based measures

Indirect Effects

- Other companies related to company through linkages identified by Arrowstreet
- Companies in same country
- Companies in same global sector
- Companies in same country/sector basket

Arrowstreet uses a variety of signals in the Alpha Engine across the following characteristics:

Valuation: Fundamental measure of company, sector or industry information

Momentum: Price based signals



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

	<p>Quality: Companies with low risk, sustainable growth and high profitability</p> <p>Catalysts: measures the change in sentiment</p> <p>Extreme Sentiment: measures the level of sentiment</p> <p>High Frequency: identify short term opportunities; help time longer term signals</p>
	<p>Unlike a fundamental firm where analysts research individual stocks; Arrowstreet’s research team focuses on signal or model development.</p>
Signal Development Process	<p><i>Idea Generation</i></p> <p>Ideas are generated from academic articles, investment team members or many other avenues. Each idea is prioritized by senior research team members who allocate resources.</p>
	<p><i>Research</i></p> <p>The prioritized projects are assigned to research team members - often the person who originated the ideas.</p> <p>In the first stage Arrowstreet focuses their effort on killing ideas. The team creates an investment thesis and looks to reject the thesis using empirical tests. This limits the number of ideas that qualify for further research.</p> <p>The second stage focuses on how to measure the investment idea. This will focus on statistical tools to evaluate the signals:</p> <ul style="list-style-type: none"> • ability to forecast returns • improvement over current signals • economic intuition • real world implementation (with trading costs and market liquidity)
	<p><i>Review and Approval</i></p> <p>The third stage of the process is a critical peer review. The researcher will present to peers and the Investment Committee on the signal. Additional follow up work may result from this meeting so it is not a pure pass-fail result.</p>
	<p><i>Implementation and Production</i></p> <p>The final stage after passing peer review is called Implementation and Production. The signal is now transitioned to the production team and prioritized based on initial findings and attractiveness. The focus on this stage is across data acquisition, integration and cleansing of inputs. Arrowstreet would call this process making enhancements to the original model.</p>
Portfolio Construction	<p>At Arrowstreet Portfolio Construction is the optimization of the collective signals to create an optimal portfolio when taking into consideration alpha forecasts, risks, transaction costs and portfolio constraints amongst other factors. Arrowstreet forecasts daily alpha expectations for 25,000 securities.</p> <p>Additionally, for active extension strategies Arrowstreet incorporates security shorting information to the</p>



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

	optimizer: counterparty credit risk, stock loan pricing, debit/credit financing rates, stock loan breadth and depth, portfolio capital requirement efficiencies and technological capabilities.	
Portfolio Characteristics	Types of Investments	Equities and Futures
	Gross Equity Range	160% to 180%
	Net Equity Range	80% to 120%
	Futures Usage	Equity Index Futures are used to adjust the market beta of the strategy from 100% net to a low of 80% and a high of 120% based on forecasted market conditions.
	Number of Securities	Long: 400-1000 Short: 50-400
	Maximum Cash %	5% of Market Value
	Active Stock Limit	+/- 3% of benchmark
	Country Limits	+/- 10% of benchmark
	Sector Limits	+/- 15% of benchmark
	Country Sector Basket Limit	+/- 5% of benchmark



Preliminary Positives & Negatives

Preliminary Positives

- **Indirect Effects:** Arrowstreet’s alpha engine combines fundamental factors with proprietary indirect effects. The indirect effects look to identify securities that will behave in a highly correlated fashion with a target stock, often through a first derivative effective.
- **Factor Exposures:** This is both a positive and a concern. Some quantitative strategies look to remove any factor exposure from their portfolio. The goal of these strategies is to provide residual alpha or alpha unexplained by the common risk factors. Arrowstreet does allow the portfolio to exhibit some factor exposures, such as when certain factors are cheap or expensive. This is an important distinction for investors to understand - which should cause the tracking error of the Arrowstreet strategy to be slightly higher than some peers. Historically this has also added to performance - which is inherently its goal.
- **Firm Resources:** It is NEPC’s view that for quantitative strategies more assets and more staff can provide a competitive advantage. The hiring of talented researchers is competitive and can be expensive so firms with scale and a strong culture are able to hire a limited, talented pool of applicants.
- **Futures Exposure:** The addition of the 20 percent exposure to adjust the beta of the portfolio has been additive since its inception and provides a differentiator compared to other firms.

Preliminary Concerns

- **Firm Assets:** Arrowstreet utilizes the same alpha model across all strategies. There will exist some alpha generating models that would be beneficial to the strategy at its current size that will not be scalable across the entire \$50 billion complex, and therefore will not be added to the alpha engine.
- **Not Factor Neutral/Higher Tracking Error:** Some quantitative strategies look to remove any factor exposure from their portfolio. The goal of these strategies is to provide residual alpha or alpha unexplained by the common risk factors. Arrowstreet does allow the portfolio to exhibit some factor exposures, such as when certain factors are cheap or expensive. This is an important distinction for investors to understand- which should cause the tracking error of the Arrowstreet strategy to be slightly higher than some peers. Historically this has also added to performance - which is inherently its goal.

Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Key Biographies					
Name	Title	Year Joined Firm	Yrs. of Experience	Degrees	School
Peter Rathjens, Ph.D.	Partner, CIO	1999	37	Ph.D. in Economics: 1990 B.A. in Economics and Mathematics: 1981	Princeton University Oberlin College
John Capeci, Ph.D.	Partner, Portfolio Management	1999	24	Ph.D. in Economics: 1990 A.B. in Economics: 1984	Princeton University Harvard University
George Pararas-Carayannis, CFA	Partner, Trading	2002	22	M.B.A.: 2011 B.S. in Business Administration: 1996	Babson College Georgetown University
Alex Ogan	Partner, Portfolio Management	2005	13	A.B. in Economics: 2005	Harvard College
Michael Zervas, CFA	Partner, Trading	2004	17	B.S. in Finance: 2001	Stonehill College
Zach Vernon, CFA	Partner, Trading	2009	12	B.S. in Finance: 2006	Boston College
Manolis Liodakis, Ph.D.	Partner, Head of Portfolio Management	2012	20	Ph.D. in Finance: 1999 M.B.A. in Finance: 1996 B.S. in Economics & Business: 1994	City University, London University of Birmingham Athens University of Economics & Business
Anne Luisi	Manager, Portfolio Management	2014	12	M.B.A. in Business Administration: 2012 B.S. in Economics: 2002	Darden School of Business Dartmouth College
Sam Thompson, Ph.D.	Partner, Head of Investment Processes	2006	13	Ph.D. in Economics and M.A. in Statistics: 2000 B.A. in Economics: 1995	University of California at Berkeley Yale University
Marta Campillo, Ph.D.	Partner, Investment Processes	1999	22	Ph.D. in Economics: 2000 M.A.: 1992 M.A.: 1990 B.S.: 1989	Boston University Universidad Complutense Institute of Fiscal Studies Universidad de Autonoma
Hui Wang, Ph.D.	Partner, Investment Processes	2012	6	Ph.D. in Physics: 2012 B.S. in Physics: 2006	University of Rochester University of Science and Technology of China
John Campbell, Ph.D.	Partner, Co-Head of Research	1999	26	Ph.D. in Economics: 1984 B.A. in Economics: 1979	Yale University Oxford University



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Tuomo Vuolteenaho, Ph.D.	Partner, Co-Head of Research	2004	15	Ph.D. in Finance: 2000 M.S. in Economics: 1995	University of Chicago Helsinki School of Economics and Business Administration
Alex Merlis, CFA	Partner, Research	2006	17	M.A. in Mathematical Finance: 2006 A.B. in Physics and S.M. in Engineering Sciences: 1996	Boston University Harvard University
Derek Vance, CFA	Partner, Research	2008	11	A.B. in Economics: 2007	Harvard University
Yijie Zhang, Ph.D.	Partner, Research	2006	12	Ph.D. in Finance: 2006 M.S. in Economics: 2000 B.A. in Finance: 1997	Yale University Rutgers University Tsinghua (Qinghua) University
Yosef Klein	Partner, Research	2012	10	M.B.A., Analytic Finance, Econometrics, & Statistics: 2008 M.S. in Mathematics: 2005 B.A. in Mathematics: 2000	University of Chicago University of Illinois at Chicago University of Chicago
Katherine (Katie) McHardy	Partner, Head of Investment Services	2010	18	B.B.A. in Accounting: 2000	University of Massachusetts Amherst



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Operations		
Firm	Ownership	100% Employee Owned
	Staffing & Retention	Employees may be offered opportunity to join partnership; no individual owns more than 25%
	Product Offerings	24 Strategies; As a quantitative Firm all strategies are fed from alpha engine. Employees create signals that will be used across all products
	Conflicts of Interest	Strategies are managed in a team approach; All strategies draw from same return forecasts and alpha engine
Strategy	Trade Allocation	Trade Orders are generated at the individual account level; these trades are aggregated and executed as a block order. Unless client places restrictions (such as broker restrictions) trades are then allocated pro-rata to the representative accounts. Portfolio Management Team also performs monthly post-trade analytics.
	Risk Management	Integrated into investment and portfolio construction process. Arrowstreet sets position limits, controls around style betas and utilizes a risk model through the optimization process.
	Liquidity	The global equity strategies use listed cash equities and futures. Arrowstreet looks at liquidity when determining optimal size for strategies. Liquidity is also an important factor for minimizing trading costs
	Expenses	Fund expenses have been higher than long only strategy due to higher cost of dividends on securities sold short, prime broker fees. 2016 Financials showed 23bps operating expenses and 26bps from dividends on securities sold
	Valuation	Majority of assets have historically been Level 1. Some Level 2 Assets exist through foreign currency contracts
	Service Providers	Prime Brokers: UBS, Deutsche Bank, JP Morgan, BofA Merrill Lynch
	Regulatory Registrations	Registered with the SEC; Registered as a Commodity Trading Advisor and commodity pool operator with the U.S. Commodity Futures Trading Commission (CFTC);
	Form ADV Disclosures	No Form ADV Part 1A- Item 11 Disclosures; No DRPs (Disclosure Reporting Page)



Arrowstreet Capital LP

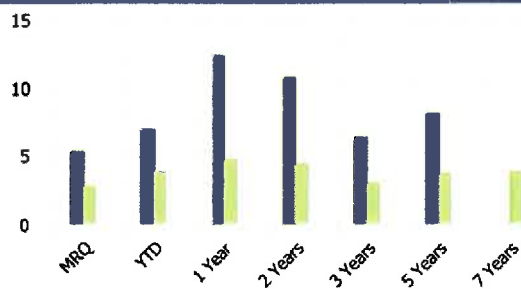
Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Arrowstreet Capital, Limited Partnership
Global Equity - ACWI Alpha Extension 130/30/20

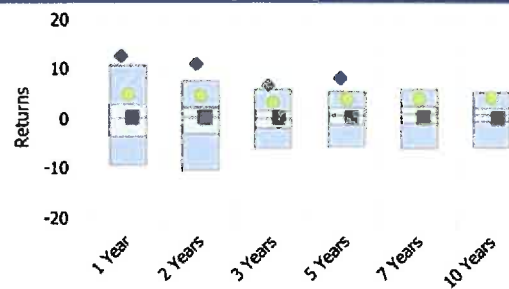
9/2018
MSCI ACWI IMI-ND

Excess Returns													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
2018	2.0	1.6	-0.5	0.3	-0.8	-1.1	1.8	1.3	2.1	---	---	---	6.9
2017	0.4	-0.7	0.7	1.3	1.7	-1.2	-0.4	3.4	-1.0	3.0	0.9	0.5	10.8
2016	-0.4	0.5	-0.2	-1.8	-0.9	3.2	-1.1	-2.4	0.9	0.5	1.6	1.2	0.9
2015	0.2	1.9	2.3	-3.4	1.5	0.3	2.2	0.3	0.7	-1.0	2.4	-0.8	6.8
2014	-0.2	-0.2	0.2	-0.7	0.7	-0.2	0.3	-2.3	1.9	2.0	2.4	4.3	8.7
2013	2.7	0.8	1.2	2.7	0.8	1.6	2.3	-1.1	2.4	0.8	3.5	1.1	24.4
2012	---	---	---	---	---	---	---	0.0	-1.6	-1.0	1.7	1.0	0.1

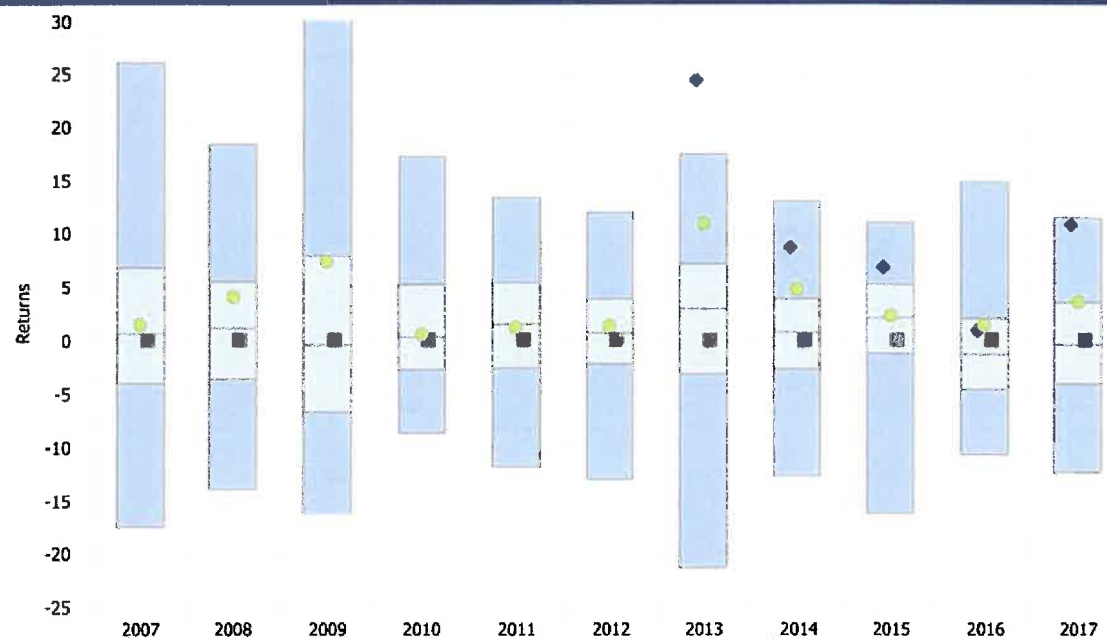
Excess Return: Performance vs. Benchmark



Excess Return- Trailing Periods



Excess Return by Calendar Year



Universe: eVestment All Global Equity

- ◆ Arrowstreet: Global Equity - ACWI Alpha Extension 130/30/20
- Arrowstreet: Global Equity - ACWI
- MSCI Index: MSCI ACWI IMI-ND
- + Universe Median

²ICE BofAML US 3-Month Treasury Bill
All results in Base Currency.



Arrowstreet Capital LP

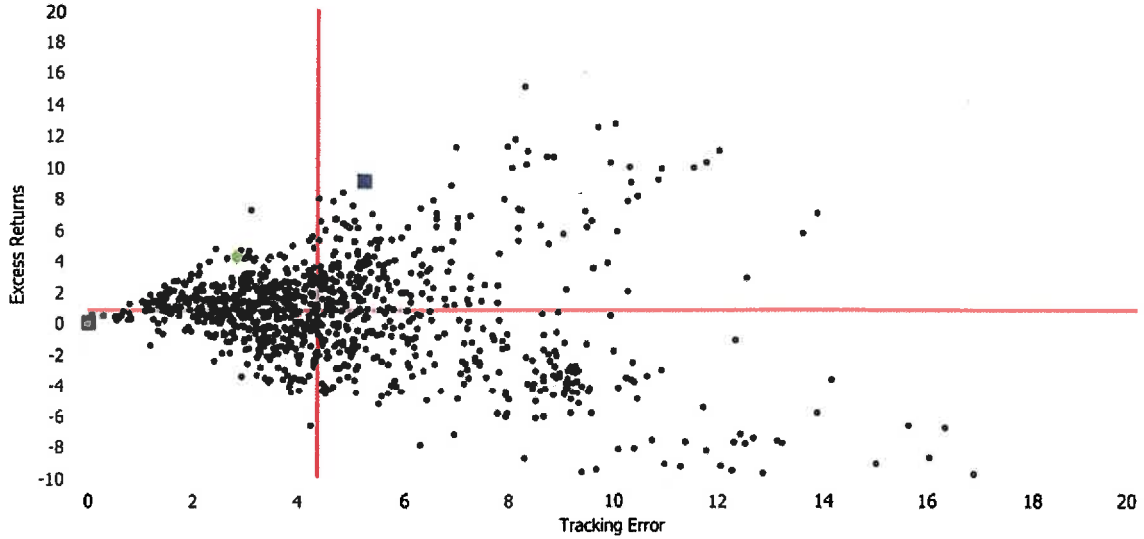
Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Arrowstreet Capital, Limited Partnership
Global Equity - ACWI

9/2018
MSCI ACWI IMI-ND

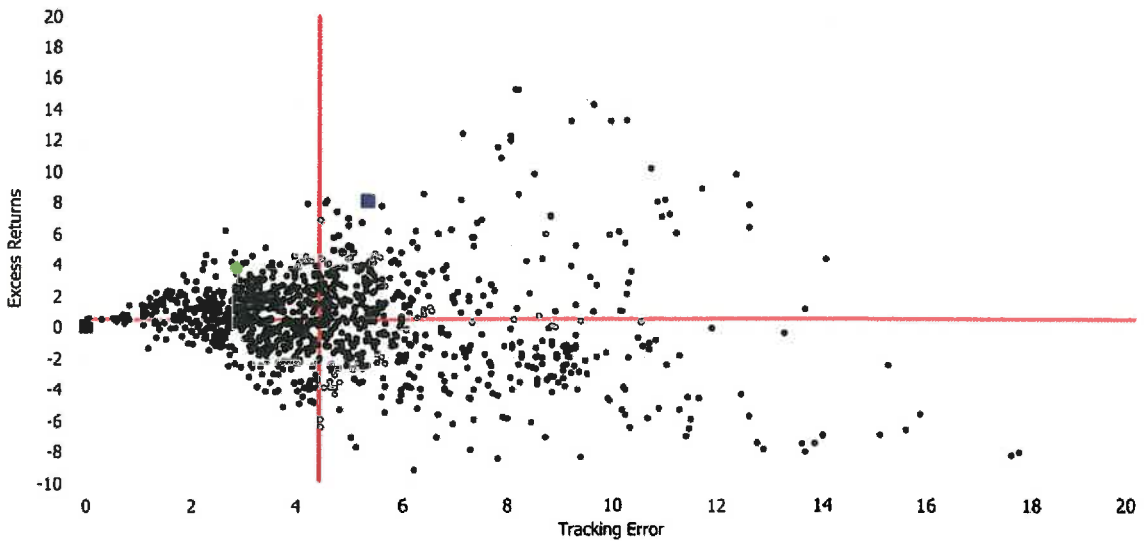
Risk vs. Return

Since Inception 6.17 Years 08/2012 - 09/2018 As Of: 9/30/2018



Risk vs. Return

5 Years As Of: 9/30/2018



Universe: eVestment All Global Equity

- ◆ Arrowstreet: Global Equity - ACWI
- MSCI Index: MSCI ACWI IMI-ND

- Arrowstreet: Global Equity - ACWI Alpha Extension 130/30/20
- + Universe Median

²ICE BofAML US 3-Month Treasury Bill
All results in Base Currency.

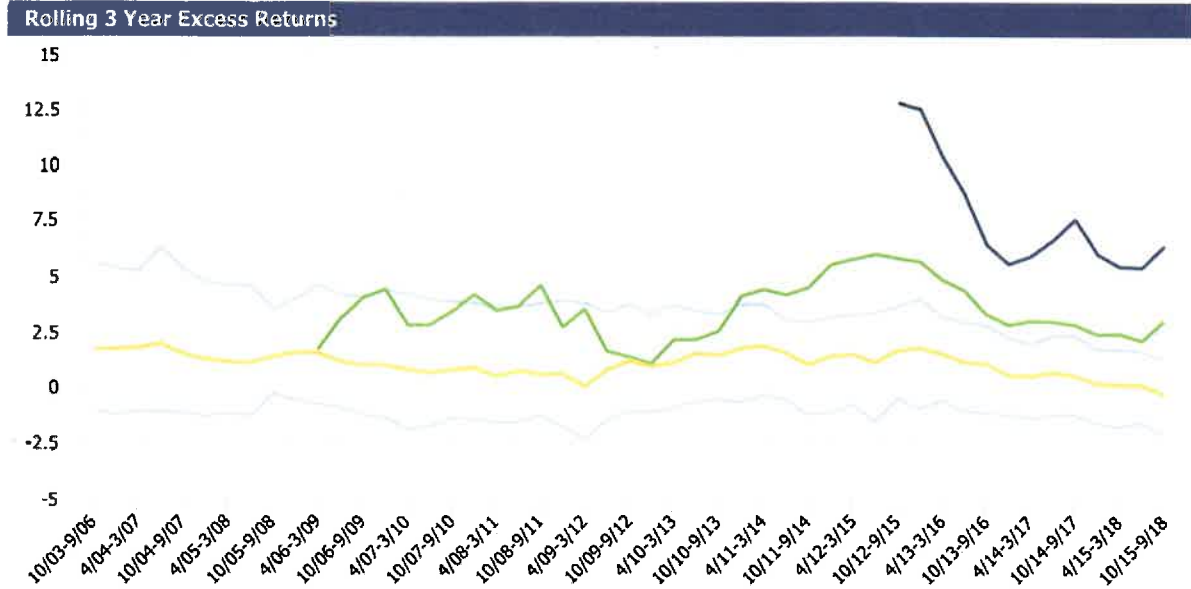


Arrowstreet Capital LP

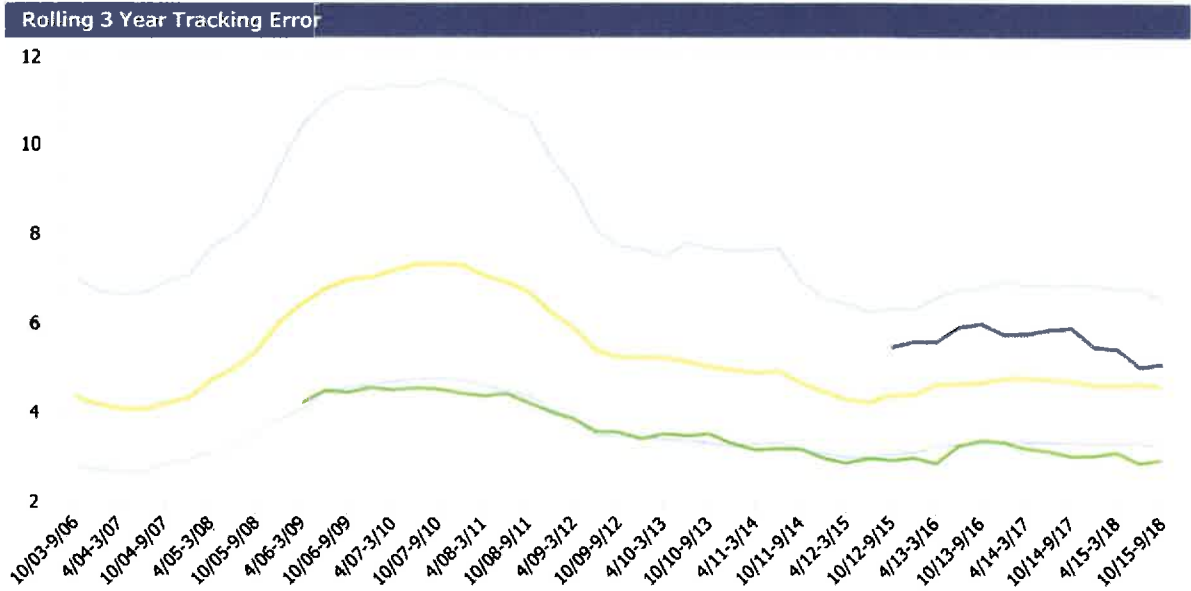
Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Arrowstreet Capital, Limited Partnership
Global Equity - ACWI

9/2018
MSCI ACWI IMI-ND



The chart above shows the rolling 3 year alpha vs. Benchmark. The blue lines are the 25th and 75th Percentiles for the selected Peer Universe, while the light orange is the median.



The chart above shows the rolling 3 year beta vs. Benchmark. The blue lines are the 25th and 75th Percentiles for the selected Peer Universe, while light orange is the median.

Universe: eVestment All Global Equity

◆ Arrowstreet: Global Equity - ACWI
■ MSCI Index: MSCI ACWI IMI-ND

● Arrowstreet: Global Equity - ACWI Alpha Extension 130/30/20
+ Universe Median

²ICE BofAML US 3-Month Treasury Bill
All results in Base Currency.



Arrowstreet Capital LP

Global Equity – ACWI Alpha Extension 130/30/20 Strategy

Disclaimers and Disclosures

- Past performance is no guarantee of future results.
- The opinions presented herein represent the good faith views of NEPC as of the date of this report and are subject to change at any time.
- Information on market indices was provided by sources external to NEPC, and other data used to prepare this report was obtained directly from the investment manager(s). While NEPC has exercised reasonable professional care in preparing this report, we cannot guarantee the accuracy of all source information contained within.
- This report may contain confidential or proprietary information and may not be copied or redistributed to any party not legally entitled to receive it.

In addition, it is important that investors understand the following characteristics of non-traditional investment strategies including hedge funds, real estate and private equity:

1. Performance can be volatile and investors could lose all or a substantial portion of their investment
2. Leverage and other speculative practices may increase the risk of loss
3. Past performance may be revised due to the revaluation of investments
4. These investments can be illiquid, and investors may be subject to lock-ups or lengthy redemption terms
5. A secondary market may not be available for all funds, and any sales that occur may take place at a discount to value
6. These funds are not subject to the same regulatory requirements as registered investment vehicles
7. Managers may not be required to provide periodic pricing or valuation information to investors
8. These funds may have complex tax structures and delays in distributing important tax information
9. These funds often charge high fees
10. Investment agreements often give the manager authority to trade in securities, markets or currencies that are not within the manager's realm of expertise or contemplated investment strategy





**City and County of San Francisco
Employees' Retirement System**

To: Retirement Board

Through: Jay Huish
Executive Director

William J. Coaker, Jr – CFA, MBA
Chief Investment Officer

From: Robert L. Shaw, CFA
Managing Director, Public Markets

Tony J. Lee
Senior Portfolio Manager, Public Equities

Date: May 14, 2014

Re: Arrowstreet Capital - Global Equity Investment Recommendation

SFERS' Investment Staff ("Staff") recommends an investment in the following strategy for SFERS' Public Equity portfolio:

- Arrowstreet Capital: Global Equity

Background:

Arrowstreet Capital ("Arrowstreet" or the "Firm") was founded in 1999 and currently manages in excess of \$50 billion across six equity strategies that include traditional long-only as well as long-short products. The Firm employs a quantitative investment process that leverages insights into the expected returns for individual securities and then optimizes the portfolio with the highest level of expected return for a specified level of risk.

Arrowstreet emerged as the top candidate from the Global Equity search that was initiated by SFERS in 2013 - with responses received from 44 firms. Arrowstreet's process, which employs a mix of direct (company specific valuation and momentum) and indirect factors (country-sector baskets, spillover effects and expanded linkages) is more advanced than the vast majority of other quantitative managers. Staff believes that Arrowstreet's Global Equity product is a compelling strategy that offers the opportunity for exceptional performance over the long-run.

The Arrowstreet strategy would be part of SFERS' Public Equity portfolio. The strategy fits SFERS' investment criteria for the following reasons:

- **Very distinctive:** Arrowstreet selects securities from a global landscape of investment opportunities, which increases the potential for a best ideas portfolio and avoids dilution of returns. This perspective is seen through the high level of active share in all of Arrowstreet's portfolios.

-
- **Unique investment process:** Arrowstreet's investment process is a major competitive advantage for the Firm. From Arrowstreet's perspective, many quantitatively oriented firms rely too much on relevant, but also obvious return factors, which can result in crowded trades and benchmark like performance results. Arrowstreet believes that the key to investment success is to focus on relevant, non-obvious and differentiated insights. To this end, the Firm evaluates direct (company specific valuation and momentum) and indirect factors as well as what the Firm describes as expanded linkages. We think the investment process is compelling.

Investment Staff recommends the investment in Arrowstreet's Global Equity product for the following reasons:

Excellent Organization:

Arrowstreet is an impressive organization. Key attributes of the organization are as follows:

- The firm is well established and managed. Arrowstreet was founded in 1999 by Peter Rathjens, Bruce Clarke and John Campbell. These three executives have an average of 29 years investment experience – with a minimum of 21 years (Mr. Campbell). In January 2014, Mr. Clarke stepped down from his roles as President and CEO (he now serves as Executive Chairman). He was replaced by Anthony Ryan – the Firm's Chief Operating Officer. This transition has been well received by investors. Reference checks regarding Mr. Ryan were very favorable. The Firm has over 30 investment professionals and more than 150 employees (January 2014). The key investment professionals have an average of 15 years investment experience.
- 100% employee owned. This helps eliminate potential conflicts between the best interests of clients and external shareholders.
- Arrowstreet manages just six inter-related products, which permits the investment team to focus their intellectual capital without undue distractions. The firm has demonstrated that they are not in the business of asset gathering or rolling out unrelated new products.
- The firm manages over \$50 billion (as of 02/28/2014). This asset level is not so large as to inhibit the execution of their investment process, but does demonstrate that Arrowstreet has been successful and is a very well established business. The client base is 100% institutional, which reduces the operational complexity of working with different client types (taxable, sub-advisory, etc.).
- Arrowstreet does not market their strategies. Rather than emphasize increasing assets, resources are dedicated to maximizing the excess returns on relatively few strategies.
- Focused on maintaining their competitive edge. The Firm has declined business opportunities where the team could not be assured that holdings level information would not be shared with competitors.
- The firm has a record of closing products early, which shows their willingness to place clients' interests before their own.

Compelling Investment Process:

The emphasis of Arrowstreet's investment process is on adding value by identifying behavioral and information signals that are relevant to stock prices, but are not necessarily obvious:

- **Direct Effects.** These are stock specific factors such as valuation, momentum, and high frequency trading effects. Although very commonly used by quantitative managers, Arrowstreet does find value in these

effects, but it is limited. Due to their common usage by many quantitative managers, the value dissipates quickly in the market;

- Indirect Effects. These factors evaluate how a security might respond to changes within its country, sector and combined (referred to as country/sector basket by Arrowstreet); and
- Expanded linkages. These factors are a second type of indirect effect and seek to explain how developments in one business are likely to impact other businesses. Oftentimes these linkages are far reaching, including the effects that developments of one company is likely to have on another company in a different industry and/or in a different country.

Arrowstreet's advanced use of direct and indirect effects and the signals generated by their usage of expanded linkages makes their process especially well-suited for broad mandates, such as the recommended Global Equity product.

The quantitative process also insures discipline without excessive emotion and focuses decisions on capturing multiple sources of excess returns.

Larger universe of potential investments:

Arrowstreet's Global Equity product is a strategy that has a larger investment universe than many traditional domestic or international equity products. With over 4,600 securities to select from, Arrowstreet is able to build a differentiated "best ideas" portfolio without replicating the benchmark.

Greater flexibility and not dependent on a sub-style being in favor:

The strategy is not dependent on growth or value styles of investing to outperform. Arrowstreet will alter exposures more than most managers to take advantage of opportunities as they emerge. Investing in this strategy represents a departure from a style-box driven manager selection criteria to more of an opportunistic approach.

Different than the benchmark and SFERS' existing managers:

The Arrowstreet Global Equity product has an active share of over 90%. This means that Arrowstreet owns stocks that are part of the benchmark, but owns them in considerably different weights than the index. This is critical with regards to a manager's ability to outperform by a meaningful amount and, thereby, justify their active management fees. Strategies that are very different than the benchmark increase the amount of excess returns if the manager is right.

Arrowstreet is very different from SFERS' existing group of public equity managers.

- Arrowstreet is a global manager that finds opportunities across all countries while SFERS' other managers are regional (US or Non-US) in their investments; and
- Arrowstreet has a low correlation to SFERS' current public equity portfolio (0.24). This indicates that the Global Equity product being recommended is not duplicating existing portfolio strategies.

Positive Due Diligence Results:

Either Staff or Angeles Investment Advisors ("Angeles") have met with Arrowstreet on more than five occasions involving four people from SFERS over the past 2 years. Staff and Angeles have conducted reference checks regarding the investment professionals as well as individuals in operations and have confirmed the team's industry reputation and experience. The results of the due diligence checks have been positive and have provided Staff with a very high level of conviction in the team, process, and strategies.

Excellent Investment Performance:

Arrowstreet's Global Equity product is one of the Firm's longest standing – dating back to 2004 (benchmarked to MSCI-World) and 2006 (benchmarked to MSCI-ACWI).

Since inception, the Global Equity product has returned +7.8% (vs. +4.4% for the benchmark) on an absolute basis with an alpha of +3.2% - statistics which are in the top 10% and 15% of peers, respectively. Their Information Ratio for Global Equity has consistently been ranked in the top-decile.

RISKS & ISSUES FOR CONSIDERATION

This section evaluates the key risks of investing with Arrowstreet:

- **Organization Change:** Although Arrowstreet was formed in 1999, it is beginning the process of generational transfer. As noted earlier, Brian Clarke, one of the Firm's three co-founders, has taken on a reduced role as Executive Chairman and Anthony Ryan (joined in 2011 from Fidelity) has become Chief Executive Officer. This was the first outside hire of a key member of the senior management team and had the potential to change some aspects of the Firm's culture. In addition to Mr. Clarke, Ezra Levine (joined in 1999, but not as a founding partner) has elected to leave the Firm. This departure has been amicable.

Compensating factors: The change in Mr. Clarke's responsibilities was long in the planning and well communicated to investors and Mr. Clarke remains active at the Firm. Further, Mr. Clarke's responsibilities (and those of Mr. Ryan) are on the operational side of Arrowstreet. Arrowstreet has made a clear delineation between investments and operations, which permits the investment team, led by CIO Peter Rathjens, to focus solely on building and sustaining the Firm's investment knowledge and expertise.

- **Need to be mindful not to become over-diversified:** In a portfolio consisting of many managers, SFERS needs to be mindful to not over-diversify the overall public equity portfolio so that we will be differentiated enough to meet return objectives. Arrowstreet's strategies are highly diversified, with each owning several hundred securities. At an initial review, this would not appear to be a good complement to SFERS' already broadly diversified global equity portfolio.

Compensating factors: Although SFERS has a large set of public equity managers, Arrowstreet's Global Equity product is differentiated and complementary on at least two fronts:

1. Global "go anywhere" approach to equities. SFERS' primary approach to investing in public equities has been the very common regional (US and non-US investment managers) approach. Arrowstreet employs a global methodology, which allows the portfolio to seek and find opportunities in all markets; and
2. Low Excess Return Correlation. An ideal manager for SFERS is one that has an excess return pattern with a low correlation to that of SFERS' public equity portfolio. Through December 2013, Arrowstreet's Global Equity product has a correlation of 0.24 to SFERS' public equity portfolio.

- **Protection of their intellectual capital:** A significant risk is that other quantitative managers may replicate Arrowstreet's process. The Firm's substantial success across multiple equity product areas can be expected to catch the interest of other managers who will seek to replicate Arrowstreet's investment process. If these competitors are successful, it will dilute performance over time.

Compensating factors. Arrowstreet's investment process has been generally known to the academic world for close to a decade and there are still no signs that returns are being diluted by other market participants. Arrowstreet remains very pro-active in maintaining and enhancing their competitive advantage:

1. Arrowstreet's investment team does not speak at conferences or publish white papers on the Firm's investing methodology;
2. The Firm has shown a willingness to decline business when they feel that the client will be unable to assure that holdings information is protected;
3. The investment team is very aware that complacency (in terms of proactive research) will erode their ability to outperform over time and, as a result, are constantly examining and refining the investment process;
4. Arrowstreet has a scale advantage over many competitors. At \$50 billion in AUM, the Firm is able to maintain a robust budget for investment research, which is an advantage over smaller or less focused investment firms; and
5. The origin of Arrowstreet's research process (specifically the indirect factors) reaches back to 2004-2005. As long as Arrowstreet remains focused on evolving their research driven investment process, it will be difficult for competitors to catch up.

SUMMARY OF KEY TERMS

Investment	Arrowstreet Global Equity
Firm	Arrowstreet Capital, LP
Investment Type	Global Equity
Assets in Product / Capacity	\$10.4 billion as of December 31, 2013. Arrowstreet estimates product capacity to be over \$60 Billion before impacting performance.
Geography	Global (Developed and Emerging Markets)
Benchmark	MSCI All Country World Index (MSCI-ACWI)
Investment Objective	Outperform the Benchmark over rolling 5-year time periods with tracking error of 4-7%.
Investment Universe	Equity securities that are primarily within the Benchmark. As permitted by client guidelines, Arrowstreet will also include non-benchmark securities that are publicly traded on regulated security exchanges worldwide – such as international small cap and frontier market securities.
Capitalization Range	Primarily Large Cap
Position Limits	+/- 3% of a security's weight in the benchmark.
Country Guidelines	+/- 10% of a country's weight in benchmark.
Sector Guidelines	+/- 15% of a sector's weight in benchmark.
Cash Holdings	Cash is managed to between 0.5% and 2.0% with a maximum of 5%.
Portfolio Guidelines	Positions will range between 150 and 450 securities.
Derivatives Usage	Yes. Will employ both equity futures and currency forwards to effect the necessary transactions in client portfolios (subject to individual client guidelines). Arrowstreet does not currently employ futures (ort options on futures) for the purpose of active currency management.
Leverage	None.
Contributions / Withdrawals / Lock-up	Arrowstreet estimates that it would require 3-5 business days to fully invest or liquidate a \$200 - \$300 million account. Lock-up – None.
Fee Schedule	Separate Account – Minimum of \$100 Million. Flat Fee Structure: 80 bps – 1 st \$50 million; 65 bps – Next \$50 Million; and 45 bps – Thereafter Fee for \$500 Million Mandate: 49.5 bps (net of 1.5 bps from fee negotiations) Incentive Fee Structure: Available – subject to negotiations
Reporting	Monthly account statements and performance reports. Separate account assets will be held at SFERS' custodial bank (Currency Northern Trust). Arrowstreet's back-office and trade administration are handled by BNY-Mellon.

ATTACHMENTS

- I. Organization & People
- II. Investment Philosophy, Process, and Style
- III. Performance
- IV. Portfolio Construction & Guidelines
- V. Risk Management & Liquidity
- VI. Returns-based Style Analysis
- VII. Biographies
- VIII. Manager Evaluation

Organization: Arrowstreet is a very impressive organization. Founded in 1999, the firm is well established. The key senior executives have an average of 28 years investment experience. The firm has over 30 investment professionals among its 150+ employees. Other attributes of the firm include:

- 100% employee owned with only active shareholders having voting rights. Arrowstreet has the right to purchase back the ownership of departing owners and once a partner leaves Arrowstreet, their ownership becomes non-voting.
- Arrowstreet manages just six public equity products that operate in related markets (Global Equities, International Equities, Emerging Markets and International Small Cap).
- Arrowstreet does not market their strategies. Rather than emphasize increasing assets, resources are dedicated to maximizing the excess returns on relatively few strategies.
- The firm has a record of closing products early, which shows they put their clients' interests above their own.
- The Global Equity product has significant capacity. The Firm estimates that to sustain the current level of trading liquidity need for the Global Equity strategy, capacity is roughly \$65-\$70 billion.
- Arrowstreet is willing to accept very low base fees (on performance fee agreements). Their total compensation will be determined by their performance, which indicates confidence in their ability and also improves the alignment of interests between clients and Arrowstreet.
- The firm only accepts two or three new clients per year.

In short, Arrowstreet does many things that convey a special commitment to earning high returns for their clients.

Positives

- Arrowstreet offers a limited set of inter-related products and has a history of managing capacity in the best interests of their clients by closing products earlier than most managers. This focus allows the Firm to devote all of their resources to one area without unwanted product distractions – such as fixed-income or private markets.
- The firm limits new clients to two or three per year. Their focus is on investment management, not asset gathering or marketing.
- The firm is 100% owned by current and former employees. Non active owners do not have voting rights and will be bought out by the Firm. This keeps ownership and control in the hands of those individuals that manage Arrowstreet day-to-day.
- Personnel are paid on achievement, not asset gathering. In addition to base salary, employees are rewarded based on product performance, business performance and individual achievement.

Cautions/Negatives

- We do not have any concerns about the business or organization.

People: Arrowstreet has gradually added to their investment staff over time, indicating a measured and thoughtful approach to staffing. The firm has only lost one senior partner since its inception in 1999. Also, the Firm has lost only three mid-level or junior investment professional over their fifteen year history. Personnel turnover has been very low.

Positives:

- Chief Investment Officer and co-founder, Peter Rathjens has over 32 years of investment experience. We think Rathjens is a very skilled leader of people and the investment process.
- Chief Executive Officer Anthony Ryan brings more than 26 years of investment and operational management to Arrowstreet. Mr. Ryan joined the Firm in 2011 as Chief Operating Officer and was named CEO in 2014 as part of a long planned transition.
- Executive Chairman Bruce Clarke has over 33 years of investment experience and Partner and Head of Research John Campbell has over 21 years of experience. Rathjens, Clarke, Ryan and Campbell comprise the executive team. Their average investment experience is 28 years.
- In addition to Rathjens, Clarke, and Campbell, Arrowstreet has 13 portfolio managers and 9 researchers.
- The average experience of the key investment professionals is 15 years.

Cautions/Negatives:

- The Firm announced in 2013 that Bruce Clarke, Co-founder and Partner, was moving from President to Executive Chairman and would be replaced, in 2014, by Anthony Ryan, who joined Arrowstreet in 2011 from Fidelity. Mr. Ryan is the first non-founder to be a senior member of the executive team and represents a first major step in generational ownership transfer – from founders to second and third generation partners. Many other firms flounder at this step and can lose key investment professionals. Arrowstreet clearly communicated the transition plan and co-founders Rathjens and Campbell remain fully engaged.
- While the size of the investment and research staff appears satisfactory for a firm with \$50 billion in assets, there are concerns about the impact increased competition could have. As other quantitative firms attempt to discover and copy the sources of Arrowstreet's excess returns, the Firm may need to employ more researchers to retain their competitive advantage. However, Arrowstreet has done a very good job of protecting the details of their models from being discovered by others. Further, there has been no evidence that Arrowstreet's performance edge has been eliminated or reduced.

Investment Philosophy: Arrowstreet believes the most valuable insights for forecasting equity returns are those that are both relevant and non-obvious. This type of information is generally reflected more slowly in stock prices and can result in superior performance for the investor.

Investment Process: Arrowstreet generates alpha forecasts for stocks across all countries. Although the investment process is very integrated, the sources of excess return can be thought of as coming from:

- **Company information** – focused valuation, momentum, quality, sentiment and catalyst signals. An example would involve the revision of earnings estimates by sell-side analysts. These revisions can positively (or negatively) impact to return of a stock. As noted previously, this type (Direct Effect) of signal/factor is well understood in the markets and quickly reflected in the price a security;
- **Sector information** - particularly related to valuation and momentum. An example is the overall growth in sales or earnings within a company's sector;
- **Country information** - particularly related to valuation, momentum, and earnings. An example is the growth in country GDP as well as changes in interest rate and exchange rate policies;
- **Combined effect of country and sector information** - Arrowstreet describes the combined country/sector effect as "baskets." For example, suppose the price of oil increases or decreases significantly. The economies of emerging market countries such as Argentina and Venezuela are heavily impacted by the direction and magnitude of change in the price of oil. Arrowstreet's use of country/sector effects would evaluate the impact of the change in the price of oil on consumers in Argentina and Venezuela as well as the other sectors in those countries; and
- **Expanded linkages** - evaluating how one company is expected to be impacted by the developments in another company. For example, a long-lasting recession would have a negative effect on automobile manufacturers. Expanded linkages would evaluate the impact that a decline in automobile sales would have on auto dealers. It would also evaluate the impact on automobile insurance providers under the premise that insurance for older vehicles is less than newer vehicles. Further, it would examine the impact on providers of used auto parts, whose prospects would be likely to improve as consumers hold on to their aging vehicles longer.

Investment Style: The product has had consistently lower price-earnings, price-book, and cash flow yields, as well as a higher dividend yield, than the MSCI ACWI benchmark. The strategy buys lower priced securities, but it also has positive exposure to earnings growth.

Arrowstreet's Global Equity strategy has returned 8.4% annualized since its inception in April 2006 to December 2013 - outperforming the MSCI ACWI (+5.0%) by 3.4% per year.

Description	4/06-12/06	2007	2008	2009	2010	2011	2012	2013
Global Equity	10.4%	12.6%	-38.3%	43.8%	14.9%	-6.7%	17.7%	34.5%
MSCI ACWI	13.1%	11.7%	-42.2%	34.6%	12.7%	-7.3%	16.1%	22.8%
Excess Returns	-2.7%	0.9%	3.9 %	9.2%	2.2%	0.7%	1.6%	11.6%

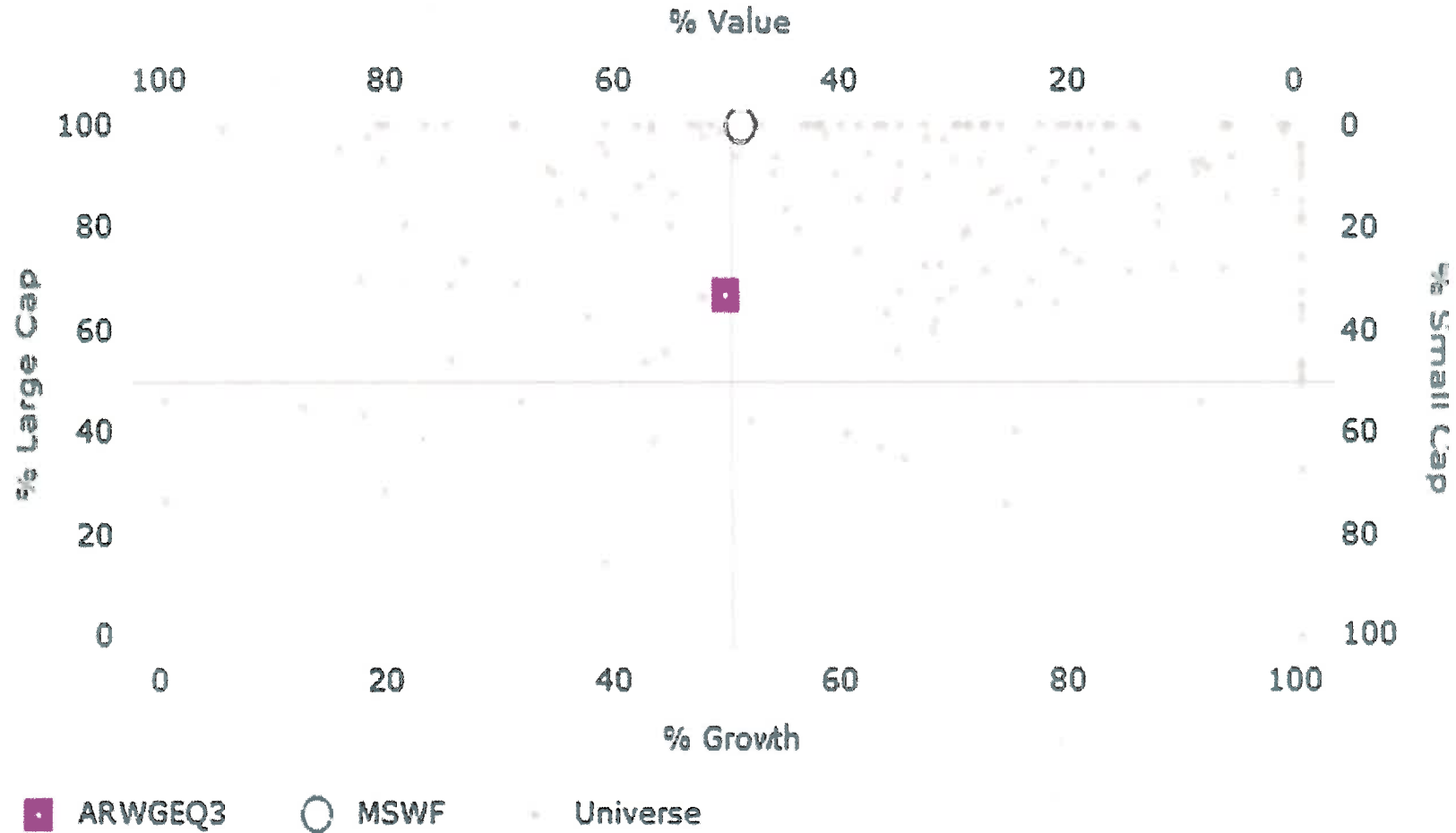
Description	1 Year	3 Years	5 Years	7 Years	4/06-12/13
Global Equity	34.5%	13.9%	19.5%	7.8%	8.4%
MSCI ACWI	22.8%	9.7%	14.9%	3.7%	5.0%
Excess Returns	11.6%	4.2%	4.6%	4.1%	3.4%

The chart on the following page shows that Arrowstreet's Global Equity product has been more geared toward large capitalization stocks, which is consistent with its benchmark universe and has an overall core-like style.

Arrowstreet - Global Equity - ACWI

Returns based style analysis in \$US (before fees) over 7 yrs and 9 mths ending December-13 (monthly calculations)

Comparison with the Global Equity (Core) universe



Style indices Large Value: MSCI World Value Large Growth: MSCI World Growth Small Value: MSCI World Small Value Small Growth: MSCI World Small Growth

Portfolio Construction: Arrowstreet employs three models in the construction of its portfolios:

- **Expected return models**

As discussed previously, these Arrowstreet's forecasts are based on valuation, momentum, earnings, and high frequency signals. In each instance, these signals are measured at different levels, including the individual stock, country, sector, the combined country and sector effect (which Arrowstreet calls "baskets") and expanded linkages.

- **Expected risk models**

This model estimates beta, the impact a country and sector are expected to have on the risk of an individual security, exposure to forecasted model factors (such as the Barra factors and Style Research factors), market capitalization, style, and other risk factors. Risk management is discussed in greater detail later in this report.

- **Transaction cost model**

The transaction cost model predicts execution costs as a function of the trade size, the volatility of a stock, the stock's recent momentum, and other stock-specific factors.

Portfolio Guidelines

- **Holdings.** The typical portfolio will hold 150 to 450 securities. Between 2009 and 2013, the number of positions ranged from 286 (December 2009) to 342 (December 2013);
- **Turnover.** Annual turnover should be expected to range from 150% to 250%;
- **Position Limits.** +/-4% around a security's weight in the benchmark;
- **Sector Limits.** +/-15% around a sector's weight in the benchmark;
- **Country Limits.** +/-10% around a country's weight in the benchmark;
- **Country-Sector Baskets Limits.** +/-5% around basket's weight in the benchmark; and
- **Cash.** Range of 0.5% to 2.0% with a maximum of 5.0%.
- **Hedging.** Arrowstreet does not hedge currencies. Instead, currency analysis is an integral part of which stocks and countries they will invest in. They view their approach to currencies as improving returns and reducing the cost of trading emerging market currencies separate from the stock and country decision.

Risk Management: Arrowstreet uses a proprietary factor-based risk model that decomposes risk into two components:

- One that represents the return associated with the stock's exposure to common risk factors, and
- One that represents risks unique to a specific stock.

The Firm's risk model integrates forecasted returns with forecasted risks and includes both country and sector exposures as risk factors. In short, risk control is multi-dimensional, as is their approach to return enhancement.

The portfolio can have relatively large country, currency, and sector exposure variances than most managers. Hence, even though the Global Equity strategy will own several hundred stocks, expected tracking error is 4-7%

Actual tracking error in Global Equity has been at the low end of expectations since inception (4.1%) and also below the median of peers (4.7%). This has been in part due to the persistence of high correlations among stocks over most of the past 3-5 years. With normalized dispersion, the tracking error for Global Equity is expected to be higher than it has been.

Liquidity: The Global Equity strategy is highly liquid: 99% of the portfolio can be traded in less than one day if necessary. Several factors improve the liquidity of the portfolio.

First, they also own roughly 250-300 stocks, so the portfolio is not heavily concentrated in only fewer stocks. As a result, they portfolio team does not need to trade an inordinate amount of the daily trading volume in the securities they own.

Second, capacity is closely monitored. As discussed earlier, Arrowstreet has a record of closing their products early and making sure assets under management are kept to a level that will enable them to execute their more dynamic and opportunistic investment process.

Lastly, Arrowstreet restricts ownership to securities in the benchmark that have a market capitalization of at least \$300 million. This improves the overall tradability of the portfolio.

Returns-based style analysis verifies that the return pattern produced by Arrowstreet historically conforms to our assessment of its investment process and style, namely, that it not dependent on a particular market segment and it is designed to do well in all types of market environments. As noted in the Performance section, Arrowstreet has outperformed on a much more consistent than most managers.

With the Global Equity product's benchmark of MSCI-ACWI and its core mandate, we expected to see a structure that is consistent with the global market capitalization.

- Developed market style factors explain the majority of Global Equity performance:
 - ✓ Value: 49.0%; and
 - ✓ Growth: 41.8%
- Emerging market style factors, although less significant, move the opposite direction
 - ✓ Value: 9.2%; and
 - ✓ Growth: 0.0%

The tilts, however, are not consistent across markets.

- US market favored Growth factors (20.1%), however
- Non-US Developed (34.0%) and Emerging Markets (9.2%)

These results are in-line with Staff's expectations for Arrowstreet. The Firm has an overall tilt towards value factors, which is consistent for many quantitative managers. Arrowstreet, however, will vary the value/growth preferences depending upon where their models indicate.

NAME/TITLE	RESPONSIBILITIES	BEGAN AT FIRM	YRS. EXP.	EDUCATION	PRIOR EXPERIENCE
SENIOR MANAGEMENT					
Bruce Clarke, CFA PARTNER, PRESIDENT	Develops and implements the firm's strategic business plan; member of the Investment Committee	1999	32	London Business School, MBA: 1984; University of British Columbia, B.Com: 1980	1994-1999: President and CEO, PanAgora 1988-1994: Dir. of Global Investments, PanAgora 1987-1988: Corporate Finance, IMI 1984-1987: Portfolio Manager, Shearson Lehman Global Asset Mgt. 1980-1982: Financial Analyst, Pemberton Securities
Peter Rathjens, Ph.D. PARTNER, CIO	Responsible for the firm's investment products; heads the firm's Investment Committee	1999	31	Princeton University, Ph.D. in Economics: 1990; Oberlin College, B.A. in Economics and Mathematics: 1981	1998-1999: CIO, PanAgora 1995-1999: Dir. of Global Investments, PanAgora 1991-1995: Director of Research, PanAgora 1990-1991: Equity Analyst, Colonial Management 1988-1990: Asst. Professor of Economics, Brandeis University 1986-1988: Instructor of Economics, Princeton University 1983-1984: Quantitative Analyst, Lehman Brothers 1981-1983: Analyst, Data Resources
Anthony Ryan, CFA PARTNER, COO	Develops and implements the firm's strategic business plan; member of the Investment Committee	2011	25	London School of Economics, MSc.: 1986; University of Rochester, B.A.: 1985	2009-2011: Chief Administrative Officer, Fidelity Investments 2006-2009: U.S. Treasury Department 2000-2006: Partner, Head of Global Business Development & Client Relations, Grantham, Mayo, van Otterloo & Co. LLC 1994-2000: State Street Global Advisors, Principal, State Street Corporation 1988-1994: Manager, Global Investments, PanAgora Asset Management 1987-1988: Manager, Equity Investments, The Boston Company
John Campbell, Ph.D. PARTNER, RESEARCH	Develops and implements the firm's research agenda; member of the Investment Committee	1999	20	Yale University, Ph.D. in Economics: 1984; Oxford University, B.A. in Economics: 1979	1994-Present: Professor of Applied Economics, Harvard University 1998-1999: Dir. of External Research, PanAgora 1992-1998: Academic Advisory Committee, PanAgora 1984-1994: Professor of Economics, Princeton University

NAME/TITLE	RESPONSIBILITIES	BEGAN AT FIRM	YRS. EXP.	EDUCATION	PRIOR EXPERIENCE
PORTFOLIO MANAGEMENT					
Marta Campillo, Ph.D. PARTNER, PORTFOLIO MANAGEMENT	Implements the firm's investment strategies; member of the Investment Committee	1999	16	Boston University, Ph.D. in Economics: 2000; Universidad Complutense, MA: 1992; Institute of Fiscal Studies, MA: 1990; Universidad de Autonoma, B.S.: 1989	1997-1999: Teaching Assistant - Dept. of Economics, Boston University 1995-1997: Research Assistant - Prof. Jeffrey Miron, Boston University 1990-1993: Research Associate-Foundation of Applied Economics Studies, FEDEA
John Capeci, Ph.D. PARTNER, PORTFOLIO MANAGEMENT	Implements the firm's investment strategies; member of the Investment Committee	1999	18	Princeton University, Ph.D. in Economics: 1990; Harvard University, A.B. in Economics: 1984	1998-1999: Director of Research, PanAgora 1994-1998: Senior Investment Manager, PanAgora 1990-1995: Assistant Professor, Brandeis University
Ezra Levine, CFA PARTNER, PORTFOLIO MANAGEMENT	Implements the firm's investment strategies; member of the Investment Committee	1999	19	Brandeis University, M.S. in Finance: 2011; Northeastern University, B.S. in Business Administration: 1992	1998-1999: Global Investment Manager, PanAgora 1995-1998: Analyst and Trader, Walden Capital Management 1993-1995: Trader, Valores Bursatiles de Mexico
George Pararas, CFA PARTNER, PORTFOLIO MANAGEMENT	Implements the firm's investment strategies; member of the Investment Committee	2002	16	Babson College, MBA in Finance: 2011; Georgetown University, B.S. in Business Administration: 1996	2000-2002: Analyst, Putnam Investments 1998-2000: Senior Investment Associate, PanAgora 1996-1998: Registered Representative, Fidelity Investments
Michael Zervas, CFA PARTNER, PORTFOLIO MANAGEMENT	Implements the firm's investment strategies; member of the Investment Committee	2004	11	Stonehill College, B.S. in Business Administration; 2001	2001-2004: Consultant, FactSet Research Systems

NAME/TITLE	RESPONSIBILITIES	BEGAN AT FIRM	YRS. EXP.	EDUCATION	PRIOR EXPERIENCE
RESEARCH					
Tuomo Vuolteenaho, Ph.D. PARTNER, RESEARCH	Develops and implements the firm's research agenda; member of the Investment Committee	2004	9	University of Chicago, Ph.D. in Finance: 2000; Helsinki School of Economics and Business Administration, M.S. in Economics: 1995	2004: Consultant, Arrowstreet Capital 2000-2004: Assistant Professor of Economics, Harvard University 1995-2000: Teaching Assistant, University of Chicago
Alex Merlis, CFA PARTNER, RESEARCH	Develops and enhances the firm's forecasting and risk models	2006	11	Boston University, M.A. in Mathematical Finance: 2006; Harvard University, A.B. in Physics and S.M. in Engineering Sciences: 1996	2003-2005: Quantitative Long/Short Analyst, Citadel Investment Group 2002-2003: Quantitative Analyst, StarMine Corp.
Sam Thompson, Ph.D. PARTNER, RESEARCH	Develops and enhances the firm's forecasting and risk models	2005	7	University of California at Berkeley, Ph.D. in Economics and M.A. in Statistics: 2000; Yale University, B.A. in Economics: 1995	2005-2006: Consultant, Arrowstreet Capital 2004-2005: Associate Professor of Economics, Harvard University 2000-2004: Assistant Professor of Economics, Harvard University
Alex Ogan PARTNER, RESEARCH	Develops and enhances the firm's forecasting and risk models	2005	7	Harvard College, A.B. in Economics: 2005	2003-2004: Project Engineer, Axis Technologies
Derek Vance, CFA PARTNER, RESEARCH	Develops and enhances the firm's forecasting and risk models	2008	5	Harvard College, A.B. in Economics: 2007	2007-2008: Analyst, Goldman Sachs

NAME/TITLE	RESPONSIBILITIES	BEGAN AT FIRM	YRS. EXP.	EDUCATION	PRIOR EXPERIENCE
BUSINESS DEVELOPMENT & CLIENT RELATIONSHIP MANAGEMENT					
Michael Stanton, CFA PARTNER, BUSINESS DEVELOPMENT	Responsible for the firm's sales and marketing efforts	2006	19	Colby College, B.A. in Government: 1992	2000-2006: Managing Director of Consultant Relations, Babson Capital Management 1994-2000: Consultant Relations Associate, Putnam Investments 1993-1994: Investor Services, Putnam Investments
Neil Garceau ASSOCIATE, BUSINESS DEVELOPMENT	Responsible for the firm's sales and marketing efforts	2010	17	Bentley University, M.S. in Finance: 1999; University of Rhode Island, B.S. in Accounting: 1992	2002-2009: Institutional Relationship Manager, The Boston Company Asset Management 1998-2002: Senior Financial Analyst, The Boston Company Asset Management 1995-1998: Senior Legal and Compliance Analyst, The Boston Company Asset Management 1993-1995: Senior Financial Auditor, Mellon Financial Corporation
Neil Tremblay MANAGER, CLIENT RELATIONSHIP MANAGEMENT	Responsible for the firm's client service efforts	2011	26	Marquette University, MBA in Finance and Economics: 1991 and B.S. in Business Administration: 1986	2003-2011: Senior Relationship Manager, State Street Global Advisors 2000-2003: Director of Sales and Marketing Western United States, State Street Global Advisors 1996-2000: State Street Retirement Investment Services, State Street Global Advisors 1994-1996: Product Specialist, Watson, Wyatt & Company 1991-1994: Institutional Trust Officer, First Colonial Bankshares 1986-1990: Financial Consultant, Merrill Lynch, Pierce, Fenner & Smith, Inc.
Barbara Shegog, CPA, CFA ASSOCIATE, CLIENT RELATIONSHIP MANAGEMENT	Responsible for the firm's client service efforts	2012	20	Boston University, MBA in Business Administration: 1997 Lafayette College, AB in Economics and Business: 1988	2010-2012: Director, Harrison Fiduciary Group 1997-2008: Senior Portfolio Manager, State Street Global Advisors 1994-1997: Assistant Portfolio Manager, Scudder Insurance Asset Management 1993-1994: Reporting Associate, Met Life Investment Management 1990-1993: Financial Analyst, Donaldson, Lufkin and Jenrette 1988-1990: Staff Accountant, KPMG Peat Marwick

Attachment VIII

Arrowstreet Capital, L.P. Global Equity
MSCI World Index \$400 - \$500 Million Target: 4-5% 2006 03/31/2014 Robert Shaw / Tony Lee

Description	03/31/2014
OVERALL RATING	A
Knowledge of the strategy	5
Business	A
People	A
Process	A
Risk/Portfolio Construction	A
Tracking Error	Above Avg
Expected Alpha	3-4%

g	Comments
	<p>Arrowstreet is a high quality organization with very experience operational and investment teams. The Global Equity product has a very strong record of performance across both up and down markets. Arrowstreet’s process that utilizes country-sector baskets, spillover effects, and expanded linkages is well ahead of the vast majority of other quantitative managers. The strategy will be an excellent fit with SFERS’ existing public equity portfolio. It is highly unusual for us to rate a manager an “A” in every category as noted above, but we do think Arrowstreet is a particularly outstanding manager.</p>
	<p>Comments</p> <ul style="list-style-type: none"> • Research focuses on insights that are difficult to arbitrage. The team focuses on relevant and less obvious signals. Ongoing research continues to be differentiated. • Arrowstreet’s process – including the use of direct and indirect characteristics; value, momentum, and high frequency trading effects; country and sector factors; the combined effect of country-sector factors; and expanded linkages, meaning how the developments in one company impact another company in a different industry and country – is compelling. • Arrowstreet’s edge in quantitative investing needs to be monitored, but thus far no other quantitative manager has come close to replicating Arrowstreet’s skills. The fact that Arrowstreet’s process utilizes numerous factors and signals suggests that competitors will catch up more slowly.