



COMMONWEALTH OF PENNSYLVANIA
PUBLIC SCHOOL EMPLOYEES' RETIREMENT SYSTEM

Public Investment Memorandum

Two Sigma Risk Premia Enhanced Fund, LP
Absolute Return Program

Robert E. Little, CPA
Senior Portfolio Manager, Non-Traditional Investment Strategies

November 21, 2016



Recommendation:

Staff, together with Aksia, recommends that PSERS invest \$200 million in the Two Sigma Risk Premia Enhanced Fund, LP (Fund). This recommendation is based on our assessment of the investment strategy and our evaluation of Two Sigma Advisers, LP's (Two Sigma) capabilities.

Firm Overview:

Two Sigma Investments, LP (TSI) was co-founded in 2001 by John Overdeck and David Siegel (currently the co-Chairmen of Two Sigma). John and David, who worked together at D.E. Shaw & Co., both have significant experience in developing and managing a quantitative, model-driven approach to investment management. Two Sigma, an affiliate of TSI, was launched in 2009 as an investment advisor focused on institutional asset management. Two Sigma aims to generate uncorrelated returns in liquid global markets across a wide range of market conditions using a disciplined, systematic approach. Two Sigma's systematic approach combines an experienced and diverse research & development team, large amounts of data, and world class computing power in an effort to create a sustainable advantage.

Market Opportunity / Investment Strategy:

Investors are compensated for taking risks. An investor's ability to identify and trade risk factor exposures (risk premia) in a systematic manner should generate positive performance over a longer time horizon. Risk premia strategies are different from traditional beta strategies that focus on asset class exposures and from alpha strategies that focus on idiosyncratic (or individual) risks. Instead, risk premia strategies focus on recognized, fundamental risks that have historically provided attractive risk-adjusted returns with low correlations to the markets and other absolute return strategies.

Two Sigma's approach to risk premia is to build a diversified portfolio of long and short positions using a diverse set of longer-term fundamental and technical models from their common research platform. Fundamental models capture quantitative and qualitative information from publicly available data to assess value, quality, yield, and other measures. Technical models capture data such as price and volume to assess behavioral biases such as trend following. Rigorous testing and bottom-up analysis is performed on large quantities of data to create models that identify and profit from trading persistent relationships. A target portfolio is created using expected returns, anticipated trading costs, and risks in a systematic way. Using proprietary technology, a dedicated execution team utilizes trading strategies to adjust the current portfolio to the optimal portfolio. Ongoing research is performed to improve performance under different market environments.

Capital will be split 70/30 between equity strategies and macro strategies. This capital allocation results in a 60/40 risk allocation between equity strategies and macro strategies. The equity portfolio is a long/short market neutral portfolio seeking to avoid exposure to general equity market risk. The macro portfolio will be a long/short directional portfolio that will trade based on the investment manager's assessment of various asset classes and financial instruments around the world.

Portfolio Fit:

The investment in the Fund will be part of the Absolute Return Program.

Investment Instruments:

The Fund will invest in equities (including single name equities and exchange traded index products), derivatives, forwards, futures, fixed income securities, and currency contracts.

Investment Team:

Geoff Duncombe will serve as the portfolio manager on the Fund. Geoff joined Two Sigma in 2008 and has worked in the investment industry since 2001. Geoff is supported by over 650 professionals that



work on the Research & Development team. This team is responsible for data gathering and cleaning, research and modeling, forecasting, portfolio construction and optimization, order execution, risk management, and portfolio analysis.

Investment Highlights:

Track Record
Two Sigma has a long track record of successfully launching and managing quantitative, model-based investment strategies. In addition, the investment manager has been disciplined in closing funds whose underlying investment strategies have reached capacity so that the funds do not grow too large and negatively impact performance.
Human Capital
Two Sigma employs over 1,100 professionals with over 650 professionals in Research & Development. Many professionals come from outside the finance industry with advanced degrees in mathematics and science. These diverse backgrounds give the firm the feel of a technology company which promotes the innovative use of technology and scientific methods in the finance industry.
Infrastructure
Two Sigma has world class computing power that would rank the firm among the top supercomputing sites in the world. This computing power is used to gather, clean, analyze, and warehouse large amounts of data from external sources.

Investment / Risk Considerations:

Modeling and Market Dynamics
The Fund uses quantitative models that rely on patterns inferred from historical data to evaluate prospective investments. Sudden unanticipated changes in underlying market conditions could impact the performance of the Fund. In addition, market dynamics change over time and a previously successful model could become less effective or outdated.
Reliance on Technology
All aspects of the investment program (data gathering, research, forecasting, portfolio construction, order execution, risk management, and all back office functions) are dependent on technology and proprietary software. The investment manager has numerous safeguards in place to detect and prevent any coding errors, technology malfunctions, or security breaches.
Reliance on Data
The investment strategies rely on gathering, cleaning, and analyzing large amounts of data from external sources. The manager will use its discretion to determine what data to gather and use in their models. There is no guarantee that the data used is the most accurate data available or is free of errors.
Market Environment
Many of the trading strategies make assumptions about the continuation of the current market environment. The strategies assume that past behavior can be used to predict the future. There are no guarantees that relationships that govern securities and their prices in the past will continue in the future.
Track Record
Two Sigma has a limited live track record with this investment strategy. While actual performance since inception in August 2015 has been in line with the projections, there is no guarantee that the actual performance will continue to match the expected performance.
Human Capital
Staffing levels have grown by over 10% each year since 2010. Given the projected staffing growth, there is a risk that Two Sigma will not maintain the culture that has generated the current set of quantitative, model-based investment strategies.
Assets Under Management



Assets under management have grown by over 10% each year since 2010. In the past, the investment manager has been disciplined in closing funds whose underlying investment strategies have reached capacity so that the funds do not grow too large and negatively impact performance. There is no guarantee that the investment manager will continue with that discipline in the future.

Transparency

Two Sigma's approach to portfolio construction is to build a diversified portfolio of long and short positions using a diverse set of longer-term fundamental and technical models. As an investor, there is limited transparency into the models, how the models are assembled to construct a portfolio, or individual portfolio holdings.

Finance Committee Disclosure:

Relationship with Aksia:	None Disclosed
Introduction Source:	Aksia
Placement Agent:	None Used
PA Political Contributions:	None Disclosed
Potential Conflicts:	We are not aware of Two Sigma having any material investment conflicts.
PSERS History with the Investment Manager:	This investment will be PSERS' first investment with the manager.
PSERS Allocation Implementation Committee Approval:	November 18, 2016

Oversight Responsibility:

Investment Office:	Charles J. Spiller Robert E. Little	Deputy CIO, Non-Traditional Investments Senior Portfolio Manager
External Consultant:	Aksia LLC	

Manager Recommendation Memo

October 26, 2016

Board of Trustees
 Pennsylvania Public School Employees' Retirement System
 5 North Fifth Street
 Harrisburg, PA 17101

Re: Two Sigma Risk Premia Enhanced Fund LP

Dear Trustees:

Aksia LLC, having been duly authorized by the PSERS Board of Trustees, has evaluated and herewith recommends a direct allocation to Two Sigma Risk Premia Enhanced Fund LP ("Two Sigma Risk Premia") in line with PSERS Investment Policy Statement, Objectives, and Guidelines.

Two Sigma Investments was founded in 2001 by John Overdeck (formerly a managing director at DE Shaw) and David Siegel (formerly a managing director at Tudor and CIO at DE Shaw), both of whom have significant experience in developing and managing quantitative, model-driven, trading systems. A third founding partner, Mark Pickard, who was primarily focused on business development, left the firm in 2005. The firm was seeded by Tudor, which still remains an investor in funds managed by the firm.

Two Sigma Risk Premia, launched on August 1st, 2015, represents the firm's strategy to capture alternative risk premia in a systematic manner across single-stock equities and macro asset classes. As is the case with other firm-wide products, the fund leverages the firm's existing suite of models and overall infrastructure, configured to accommodate the Risk Premia mandate. Per the manager, investors should expect a 70/30 capital split between equities and macro, resulting in a risk split of 60/40. The single-stock equity risk portfolio is a market neutral portfolio whereas the macro risk portfolio is largely directional in nature.

Aksia's recommendation is based upon the following analytical factors and is made within the context of PSERS' investment guidelines:

- Due diligence of the investment process, including a review of the sponsor, investment strategy, investment personnel, and risk management;
 - Most recent on-site investment due diligence visit conducted June 1, 2016.
- Due diligence of operations, including a review of the firm's organizational structure, service providers, regulatory and compliance, trade flow process, PPM reviews, and financial statement review;
 - Most recent on-site operational due diligence visit conducted January 27, 2016.
- The following table is a listing of other relevant points of contact with the manager since the last onsite visit.

Date	Nature of Contact	Aksia Points of Contact
July 19, 2016	Performance Update Call	A. Patel
August 2, 2016	Performance Update Call	A. Patel
August 11, 2016	Onsite visit to Two Sigma with PSERS	R. Desai
September 19, 2016	Performance Update Call	A. Patel

- Evaluation of the Two Sigma Risk Premia strategy within the context of the current investment environment; and
- Appropriateness of Two Sigma Risk Premia as a component of the PSERS' portfolio.

This recommendation is given solely for the benefit of PSERS and cannot be relied upon by other investors considering an investment in Two Sigma Risk Premia, since their needs, objectives, and circumstances may not be identical to those of PSERS. The scope of this recommendation is limited to the investment merits of Two Sigma Risk Premia. Aksia manager recommendation memos should be reviewed with other Aksia due diligence materials, including the full Due Diligence Report. In addition, please consult your tax, legal and/or regulatory advisors before allocating to any private investment fund.

Please feel free to contact us should you have any questions about this recommendation.

Respectfully,



Norman Kilarjian
Partner, Head of Macro and Quant Strategies



Simon Fludgate
Partner, Head of Operational Due Diligence