FAIRFAX COUNTY Retirement SYSTEMS
EMPLOYEES' POLICE Officers UNIFORMED

Risk Allocation Framework

March 6, 2018

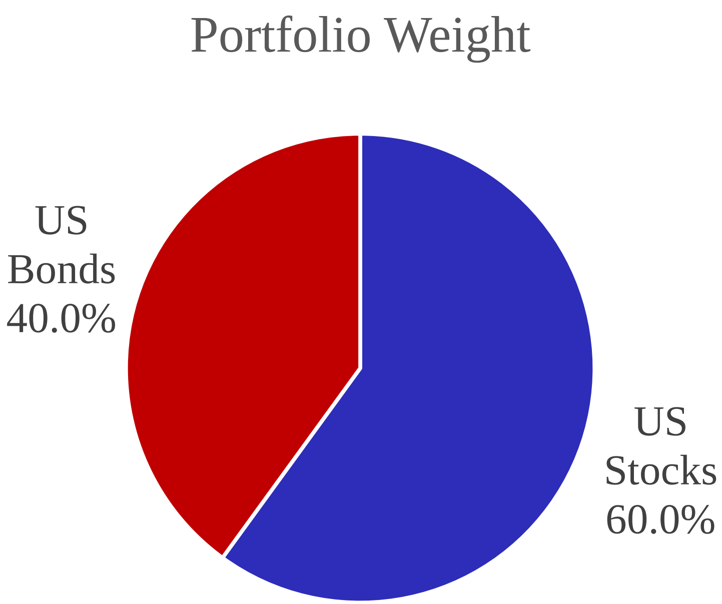
Highlights

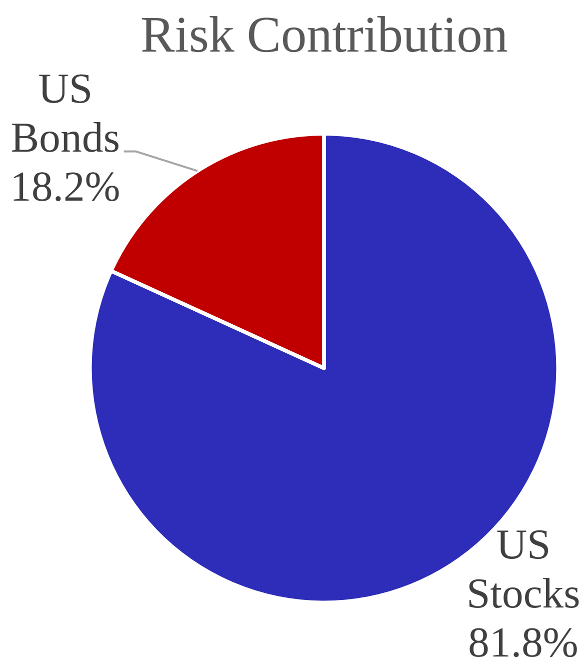
- We have three separate retirement systems which collectively total ~$7.0 billion.
- Each of our plans has a 7.25% return target.
- We are allowed to take up to 20% risk on an undiversified basis. On a diversified basis, the expected risk is ~9-10% and the expected return is ~9%.
- All three of our plans are underfunded, but the funded status for each is above the national average. Police is currently ~83%.
- Each plan has a significant allocation (30% in Police) to Risk Parity. Risk Parity as a framework underscores our entire asset allocation. As a result, we probably have better risk balance than many plans.
- We have *moved away from doing asset allocation based on asset class and instead allocate risk.*

Highlights (cont.)

- We have return and risk targets for every beta and alpha source (including the excess return of our long only managers) in our portfolios.
- We are trying to be as capital efficient as possible. As a result, we have passive exposure to certain asset classes (S&P 500, Barclays Aggregate, MSCI EAFE, Russell 2000, High Yield, Emerging Markets Debt) using futures. The leverage in Police is ~15%.
- We use risk factors to the extent we think we access beta and alternative beta more cheaply.

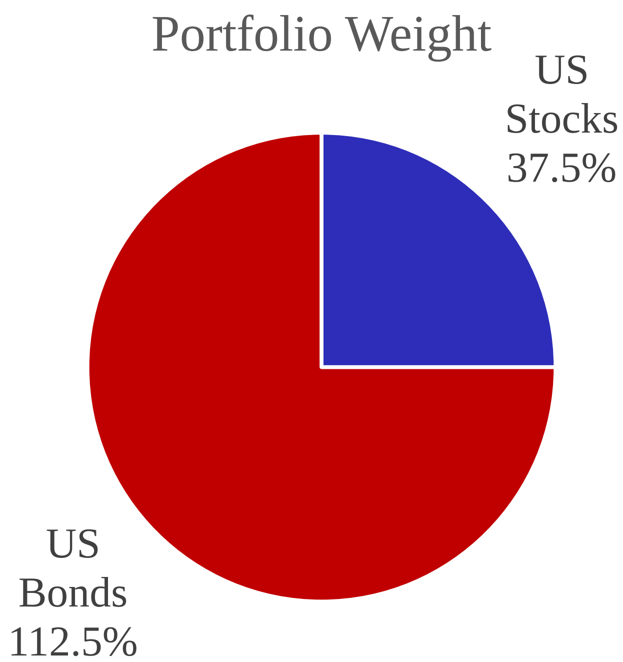
Traditional 60/40 Portfolios sacrifice diversification to achieve return objectives…

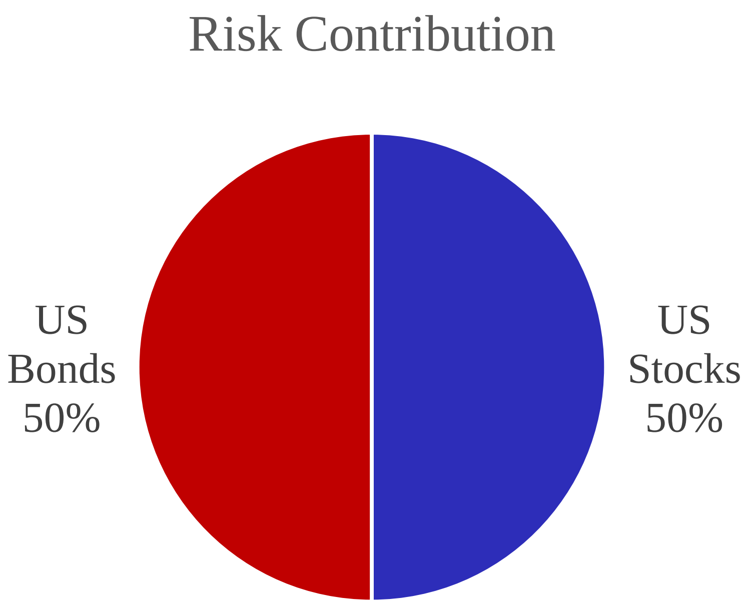




- More than 80% of a 60/40 portfolio's risk comes from equities.

Risk Balanced portfolios achieve diversification while maintaining return objectives…





- Equally risk weighting between equities and bonds requires levering fixed income.

Components of Risk Budgeting

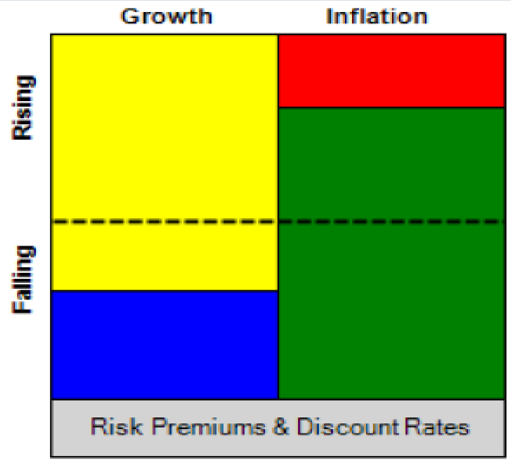
- Volatility estimate of an individual asset class or risk exposure, as well as an understanding of any embedded risks associated with that exposure such as currency risk, nominal interest rate exposure within credit, etc.
- Method of identifying the diversification benefit of a risk exposure, and the role it plays relative to the other exposures within a broader portfolio.
- Long-term estimates of expected risk premium per unit of risk taken for both systematic risks (Betas) known as a Sharpe Ratio, and non-systematic risks (Alphas) known as Information Ratio.
- Long-term estimate for the risk-free rate (Cash)

Environmental Balance

Environmental Biases Report for PORS 10312016

This report shows the portfolio's risk exposure to economic environments characterized by rising and falling growth and inflation.

Environmental Biases – Assets

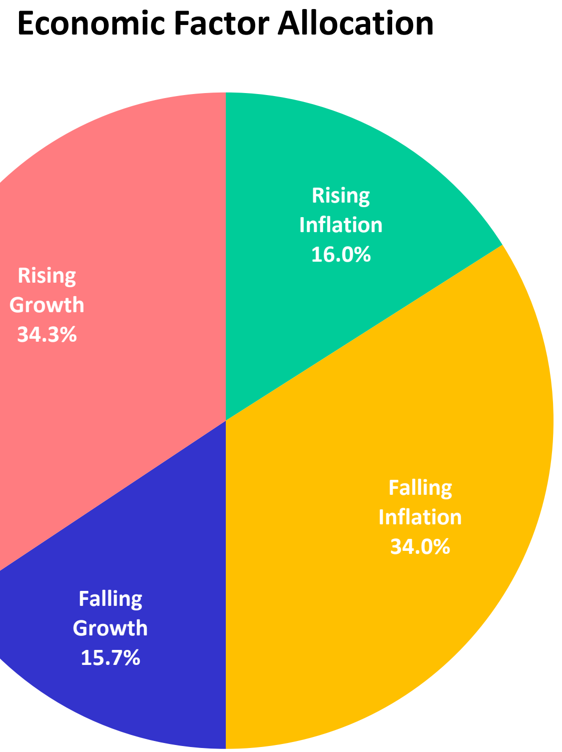


Risk Weights

Rising Growth	35%	Rising Inflation	11%
Equities	44%	I/I Bonds	7%
Real Estate	9%	All Weather	93%
High Yield (Spread)	27%		
Corporate Bonds (Spread)	1%		
All Weather	19%		
Falling Growth	**15%**	**Falling Inflation**	**39%**
High Yield (Treasury)	24%	Equities	44%
Bonds	13%	High Yield (Treasury)	17%
Mortgages	7%	Bonds	8%
I/I Bonds	10%	Mortgages	5%
Corporate Bonds (Treasury)	4%	Corporate Bonds (Treasury)	2%
All Weather	43%	All Weather	25%

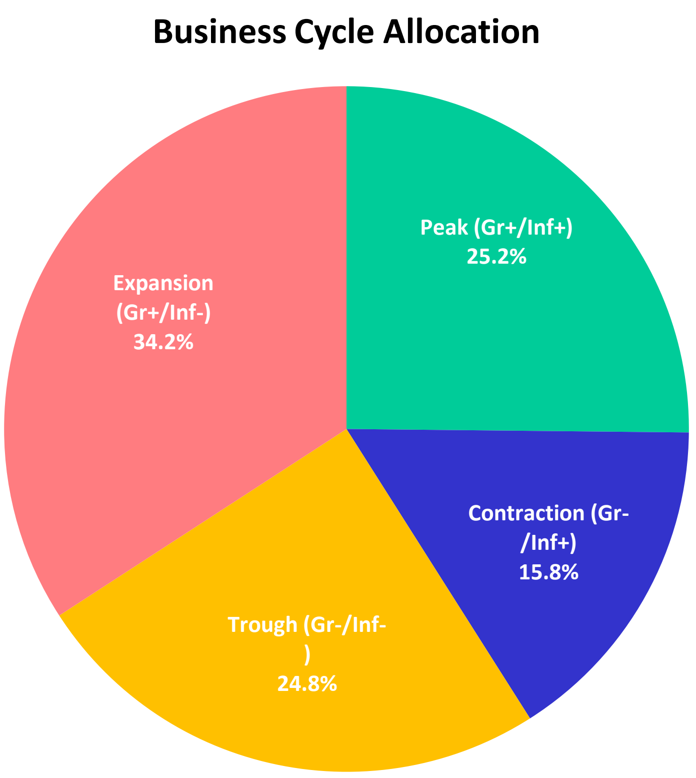
- Per Bridgewater, Police has an underweight to both Rising Inflation and Falling Growth, which is typical of most investors

Environmental Balance (cont).



- Our own risk models support the notion that Police has an underweight to both Rising Inflation and Falling Growth

Business Cycle Balance



- Said differently, Police has an underweight to the Contraction business cycle (which is Rising Inflation and Falling Growth)

Economic & Business Cycle Correlation Matrix

	Above Avg. Growth	Below Avg. Growth	Below Avg. Inflation	Above Avg. Inflation		Expansion Phase	Peak Phase	Contract. Phase	Trough Phase
Equities	+	-	+	-		Strong	Average	Weak	Average
Corp. Credit	+	-	+	-		Strong	Average	Weak	Average
Mtg. Credit	+	-	+	-		Strong	Average	Weak	Average
EM Credit	+	-	-	+		Average	Strong	Average	Weak
Real Estate	+	-	-	+		Average	Strong	Average	Weak
Commodities	+	-	-	+		Average	Strong	Average	Weak
Nom. Bonds	-	+	+	-		Average	Weak	Average	Strong
Infl. Bonds	-	+	-	+		Weak	Average	Strong	Average
Gold	-	+	-	+		Weak	Average	Strong	Average
USD vs FX	-	+	-	+		Weak	Average	Strong	Average

Macro Risk Factors Explained

BlackRock focuses on the six factors that we believe account for 90% of all returns

Economic Growth

Risk associated with global economic growth
Correlates to: Broad-market equity index returns

Real Rates

Risk of bearing exposure to real interest rate changes
Correlates to: Inflation-linked bond returns

Inflation

Risk of bearing exposure to changes in nominal prices
Correlates to: Return of long nominal bonds, short inflation-linked bonds portfolio

Credit

Risk of default or spread widening
Correlates to: Return of long corporate bonds, short nominal bonds portfolio

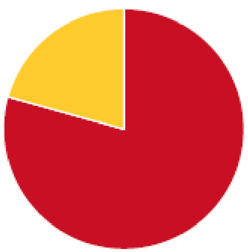
Emerging Markets

Risk that emerging sovereign government will change capital market rules
Correlates to: Equally weighted basket of EM assets

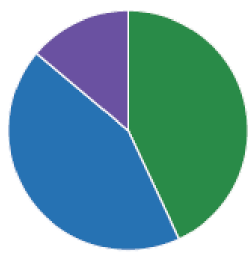
Commodity

Risk associated with commodity markets
Correlates to: Weighted GSCI Commodity index returns

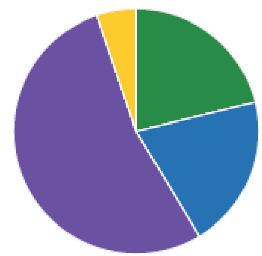
Global Equity



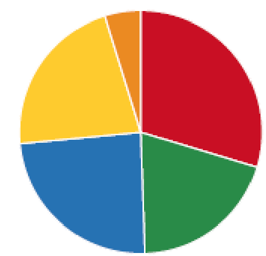
Global Fixed Income



Global High Yield



Global Real Estate



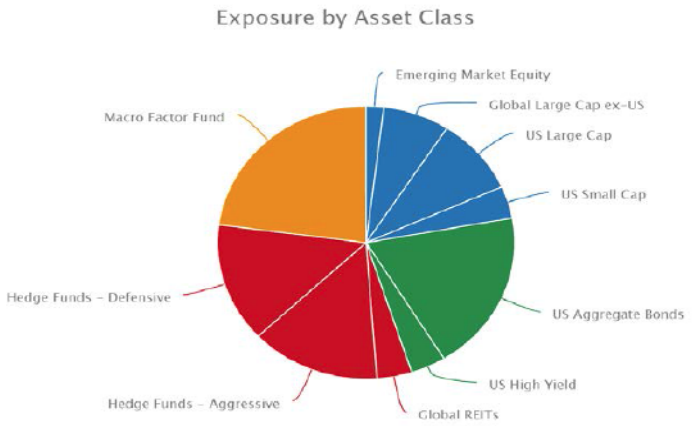
Different asset classes appear to give you diversification, but overlapping risk factor exposures can accumulate unexpectedly – especially when sized for your portfolio

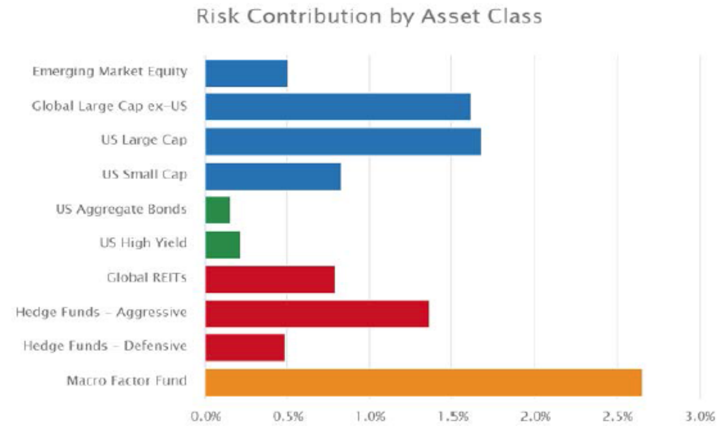
*Source: BlackRock. Based on principal component analysis of the covariance matrix of monthly returns for 13 global asset classes (Inflation Linked Debt, Developed Sovereign Debt, IG Debt, EM Sovereign Debt, HY Debt, Developed Equity, Developed Small Cap Equity, EM Equity, Private Equity, Infrastructure, Property, Commodities ex-Energy, and Energy Commodities) from 1997.01 to 2015.09.

Using a Risk Factor Lens

What factors do you own?

- Total portfolio risk is 10.3%. Risk is concentrated mostly in equity and risk parity strategies.





Traditional Asset Class Breakdowns

Equities | Fixed Income | Alternatives | Risk Parity

*Risk is defined as 1 standard deviation annualized analytic VaR, using MTC weighting (15 years of monthly data equally weighted)
Source: Aladdin Factor Workbench as of 30 Nov 2016.
This analysis is based on Fairfax's portfolio data as provided to BlackRock by Fairfax on November 30, 2016. BlackRock does not verify the accuracy of the data provided by Fairfax.

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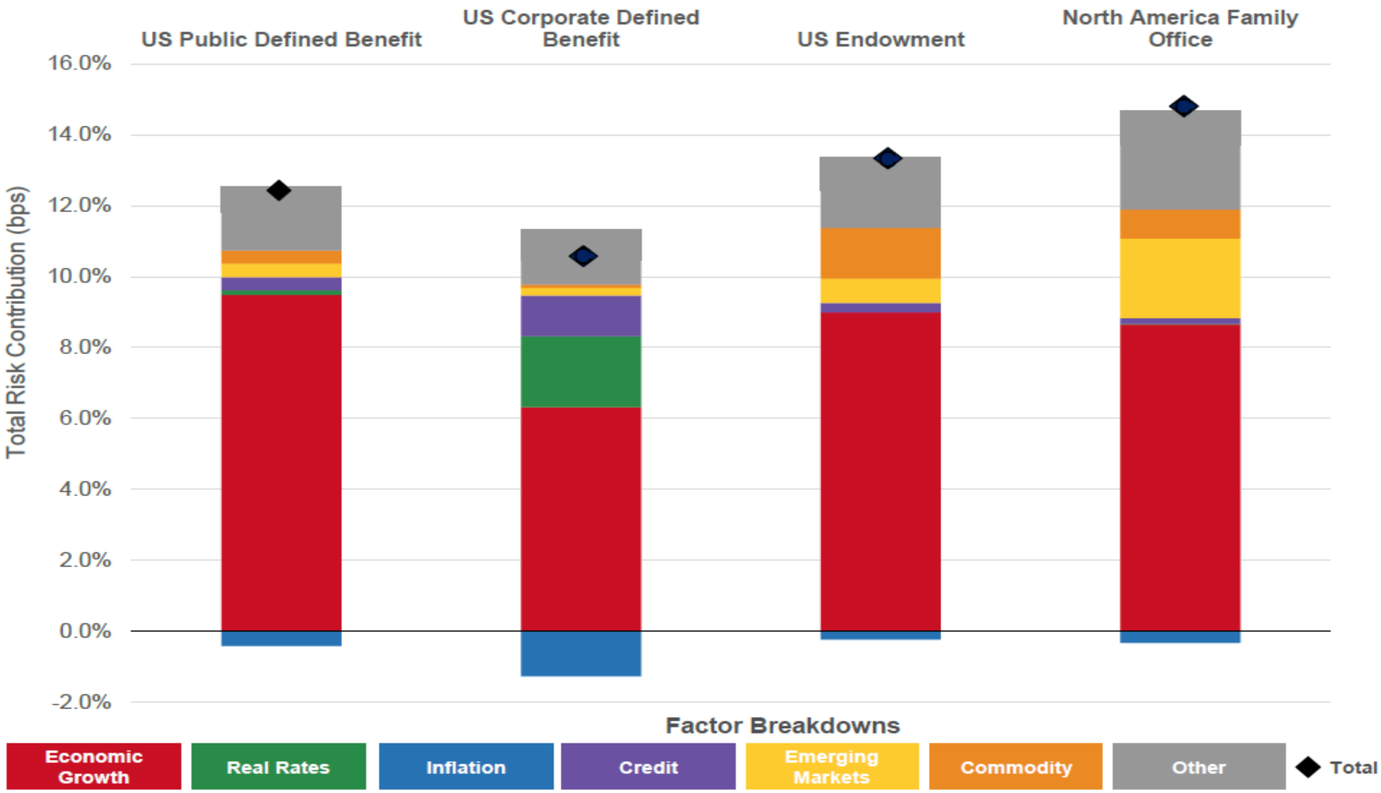
- At Fairfax County, we look at our portfolios both by asset class exposure as well as risk contribution.

Using a Risk Factor Lens (cont.)

Institutional portfolios commonly dominated by economic growth exposure



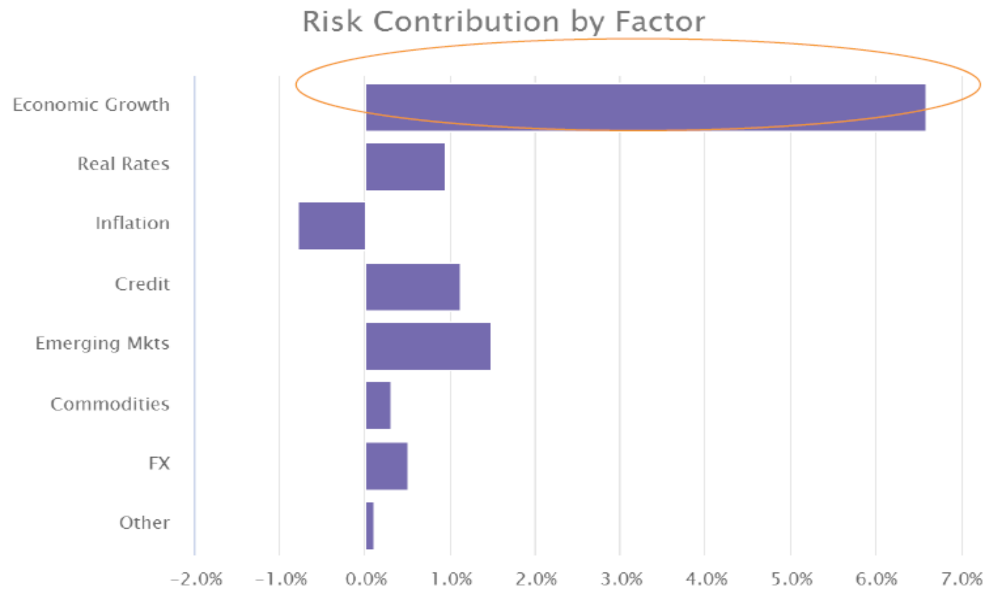
Source: BlackRock Aladdin. Exposures are as of 9/30/2015. Sample portfolios are hypothetical, provided to illustrate sample holdings of each type of institution and are shown for illustrative purposes only. US Public Defined Benefit portfolio and US Corporate Defined Benefit portfolio were developed based on sample defined benefit allocations from Pensions & Investments (*http://researchcenter.pionline.com/rankings/plan-sponsor/datatable*). US Endowment portfolio was developed based on a sample endowment allocation from the 2014 NACUBO-Commonfund Study (*http://www.nacubo.org/About_NACUBO/Press_Room/2014_NACUBO-Commonfund_Study_of_Endowments_(Final_Data).html*). North America Family Office portfolio was based on a sample family office allocation from UBS/Campden Research for North American family office (*http://www.globalfamilyofficereport.com/investments/*). No representation is made that any institutional portfolio will have characteristics similar to those shown here.. Please see appendix for AFW methodology and assumptions.

- Economic Growth contributes almost 10% to the ~12% total risk of most US public pensions

Using a Risk Factor Lens (cont.)

What factors do you own? *The view from a factor lens*

- Economic growth is the largest macro factor risk.
- Economic growth contributes over 64% to total portfolio risk.



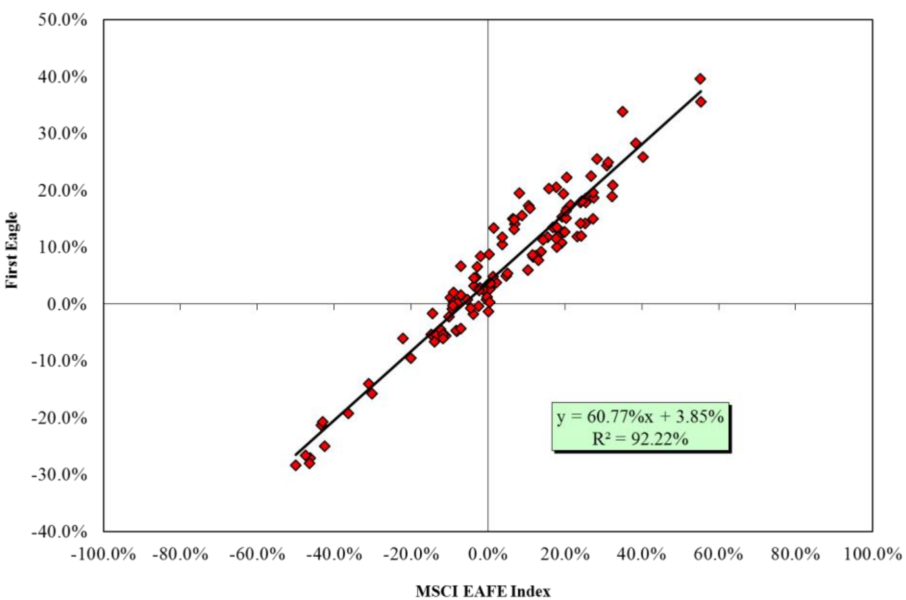
Source: Aladdin Factor Workbench as of 30 Nov 2016.
Exposure is the portfolio's beta to each factor. Risk contribution is the risk decomposition of the portfolio by factor, taking into account the correlations between the factors and benefits of diversification.
This analysis is based on Fairfax's portfolio data as provided to BlackRock by Fairfax on November 30, 2016. BlackRock does not verify the accuracy of the data provided by Fairfax.

- For Fairfax County Police Officers, Economic Growth contributes less: ~6.6% of our total 10.3% risk.

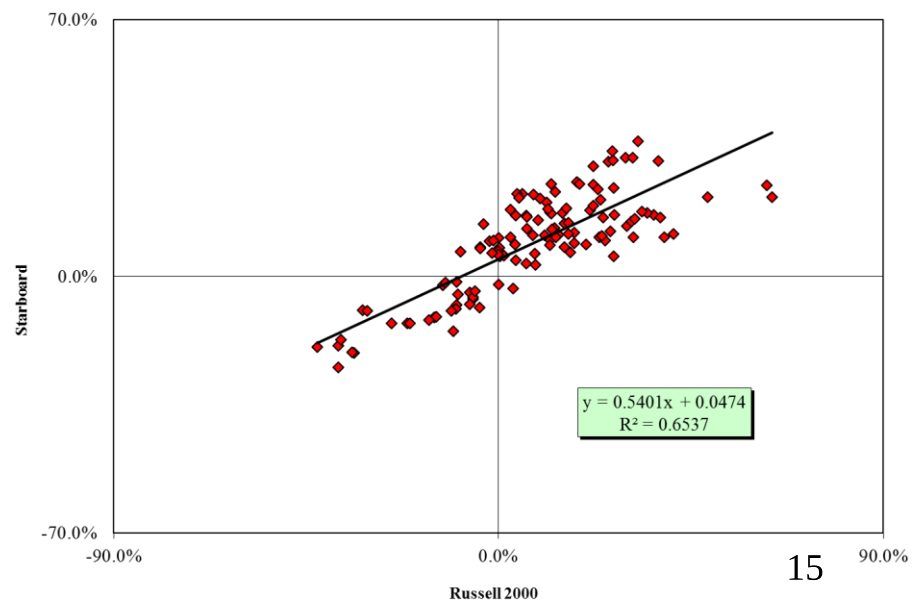
Adding Back Beta Exposure

- Beta adjust certain managers to account for the fact that each consistently has lower Beta to its respective index than what our model assumes.
- For Manager A, add 1.56% in futures (4% target size x 0.39) on the MSCI EAFE to account for their historical beta of 0.61.
- For Manager B, add 1.1% in futures (2.5% target size x 0.44) on the Russell 2000 to account for their historical beta of 0.54.

Manager A Rolling 12 Month Relative Returns



Manager B Rolling 12 Month Relative Returns



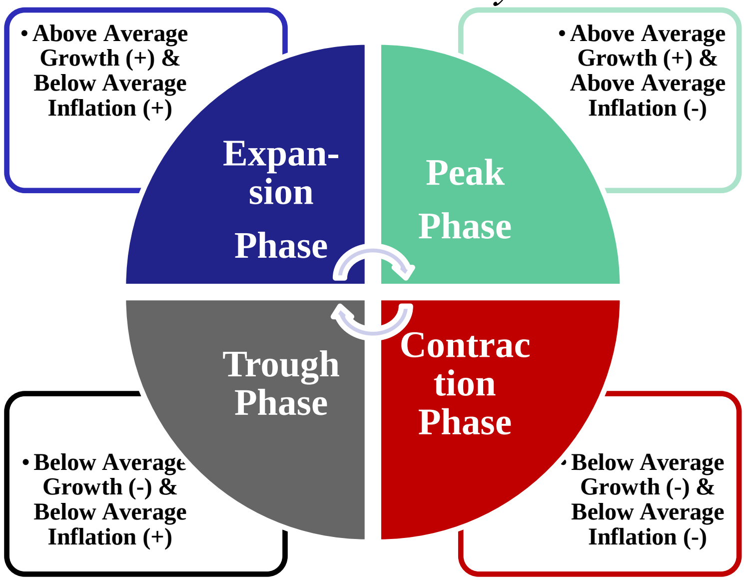
Summary

- All three Fairfax County Retirement Systems try to be balanced to economic cycles (rising/falling inflation and growth) as well as balanced to all of the business cycles (peak, trough, expansion, contraction).

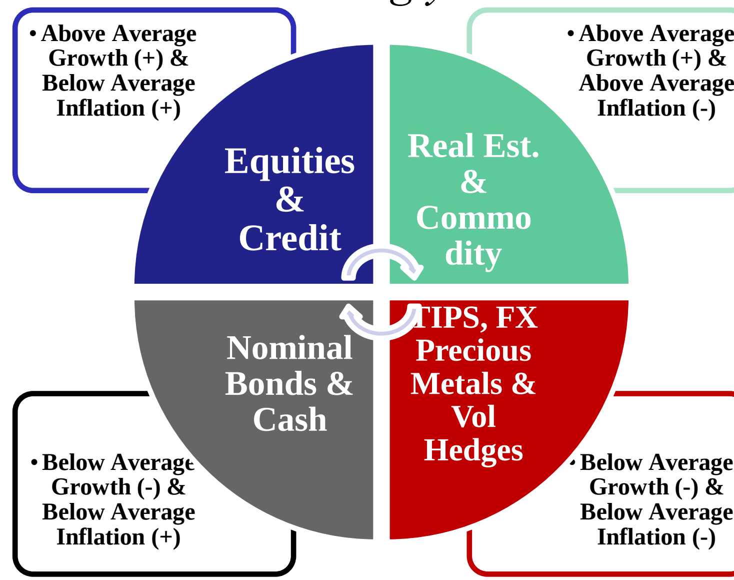
Appendix

The Business Cycle is a function of the interaction of Growth & Inflation…

As Growth & Inflation Ebb & Flow through the Business Cycle…



Asset Class Risk Exposures respond accordingly…



- Starting with an **Expansion**, which is typically characterized by lower interest rates and low levels of relative Inflation spurring economic Growth
- As the Expansion begins to **Peak**, Inflation begins to pick up and the Central Bank begins to raise interest rates.
- The resulting slowdown in economic Growth from higher interest rates results in a **Contraction** to accompany higher prices.
- As Inflation tails off, the Cycle reaches a **Trough**, the Central Bank begins to lower interest rates to restart economic Growth from depressed levels.