PCA PENSION CONSULTING ALLIANCE

Rhode Island SIC

2016Asset Liability Review

Crisis Risk Offset

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Why Consider This New Functional Class?

Unique circumstances have created a difficult investment challenge for ERSRI

- The fund has a large External Net Negative Cash Flow (approximately -5% per year)
- The fund is underfunded (~ 60% funded ratio)

- ERSRI must assume risk to achieve the actuarial return objective
- Return Volatility reduces compounded returns

- Underfunded Plan + Large external Net Negative Cash Flow + volatile returns create an investment challenge

New Class: Crisis Risk Offset

- **Rationale**:
  - Core fixed income and most hedge fund strategies are diversifying assets. However, they not responsive enough to Growth crises
    - Low volatility assets
    - No return pop in a market crisis
  - Core fixed income generates low returns in normal market conditions (i.e., low interest rates)
    - It's expensive to hold Fixed Income under normal market conditions
    - Given current market conditions asset liability model allocates the minimum weighting to core Fixed Income
  - Investors need a class to diversify (reduce) overall portfolio risk, particularly offsetting significant drawdown risk in the equity portfolio
    - Class designed to generate positive performance in a equity market crisis (extended period of losses -20% or more)

New Class: Crisis Risk Offset

Crisis Risk Offset Class:

- Purpose:
  - Offset economic growth risk | Provide significant positive return and liquidity during growth crises

- Requirements:
  - Invest only in **liquid** assets/strategies (for rebalancing)
  - **Negative conditional correlation to equities** / credit during drawdowns
  - **Scalable**
  - **Equity-like volatility** (i.e., positive return impact needs to be material)
  - **Allocation to the strategy needs to be material** (i.e., > 10%) to impact total fund return
  - **Positive expected long-term return** (at or above core fixed income)
  - **Cost effective** (rely primarily on systematic exposures and less on active manager skill)

New Class: Crisis Risk Offset

Components:

- 40% Long Duration (Long U.S. Treasury Securities)
- 40% Systematic Trend Following (STF)
- 20% Alternative Risk Capture (ARC)

Why these three strategies?

- Each strategy performs a specific role in the functional class
- They complement each other -- behave differently in different stages of a market crisis
  - Since 1970 only 2 calendar years where all 3 components produced negative returns
- No strategy is dependent on equity growth risk to generate return
- A risk mitigation class could be constructed with only long duration U.S. Treasury and trend following strategies

Rationales behind the Sub-Elements Chosen

- Long Duration
  - Very high quality investment – benefits from flight to quality
  - When interest rates decline, instruments with long duration increase in value
  - Long Treasuries perform well in the intimal stage of an unexpected equity market crisis

- Systematic Trend Following
  - Many financial markets trend (over 100 years of evidence)
  - Trend following strategies work in multiple financial markets (up and down markets)
  - Trend following strategies perform well in later stages of an equity market crisis (once the tread is established)

- Alternative Risk Capture
  - Accessing alternative risk premia
  - Not exposed to equity market risk premia (market neutral)
  - Thus, uncorrelated to market risk premia crises (growth crises)
  - Provide return during non-crisis periods, do no harm during crisis
  - Smooths out returns of the functional class over the whole market cycle
  - Least diversifying strategy during crisis

Crisis Offset Class: Focus on Alternative Risk Capture

Alternative risk premia exist in various markets

- Commodities
- Currency
- Equity
- Credit
- Interest rates

Return Drivers

- Carry – high yielding assets outperform low yielding assets
- Momentum – asset that performed well (poorly) recently will continue to perform well (poorly) in the future
- Value – low priced assets outperform high priced assets – as they return to intrinsic value
- Volatility – implied volatility premium vs. realized volatility
- Other

Crisis Offset Class: Focus on Alternative Risk Capture

- Covers many risk premia and strategies that hedge funds pursue
  - However, they are not hedge funds structures
  - Nor are they replicating hedge fund performance (those are separate products)
- Use Liquid, exchange-traded instruments
- Beta (equity market risk) hedged out of the portfolio
- Since there is no (little) Beta exposure -- leverage used to boost returns
- Systematic management process – rules based
  - Some human override in stressed market conditions
- Product has relatively short live track record.
- Many product providers have been managing these premia in different products
  - Challenge today is to bring them all into one product

Crisis Offset Class: Focus on Alternative Risk Capture

Portfolio management
- Low correlation among return drivers reduces portfolio risk

Risk management factors
- Leverage (margin)
- Liquidity
- Volatility
- Drawdown

Product expected return and volatility
- Customized to the role the strategy plays in the portfolio

Fees
- ~ 100+ bp (flat fees)

Crisis Risk Offset: Functional Class Risks

Functional Class level

- The primary risk of the functional risk class is that it does not perform well in a market crisis period and produces anemic or negative returns similar to growth risk related assets
    - CRO sub-assets have historically performed well in prior market crises. However, each market crisis trigger is unique and what worked in the past may not work in the future.
- The functional class could produce mediocre returns in periods where there is no market crisis.
- Mitigating factor: the functional class is composed of three independent sub-assets. Therefore, the success of the class is not dependent on one factor or asset. The three components have historically exhibited diversifying performance profiles.

Crisis Offset Class Risk: Long Duration Risk

Primary risk – interest rate risk (chart following page)

- Long U.S. Treasury Securities average duration 21 years
  - 100 bp rise interest rates = ~ 21% loss in principal

  - Core Fixed Income duration ~ 5.2 years
  - Long duration U.S. Treasuries are 3 X more sensitive to movements in interest rates that the core bond market

Other issues:

Interest rates are near historic lows. Is there any upside return left in the long-duration U.S. Treasury?

Crisis Offset Class: Rising Interest Rates

Selected portfolios: Total Portfolio Fixed Income Assets – sensitivity to interest rates

	Current	60/40	4 ex-CRO	6 ex-CRO	6 ex-CRO adj.	2 w-CRO	5 w-CRO v2	9 w-CRO
High Yield	0.9%	0.0%	1.5%	1.5%	1.5%	1.8%	2.0%	1.9%
Bank Loans	3.5%	0.0%	2.9%	2.7%	2.7%	1.7%	1.6%	1.1%
Long US Treasury	0.0%	0.0%	0.0%	0.0%	0.0%	8.0%	4.0%	6.0%
Core Fixed Income	15.0%	40.0%	17.0%	15.0%	15.0%	11.0%	10.0%	10.0%
Total Nominal Interest Rate	19.4%	40.0%	21.4%	19.2%	19.2%	22.5%	17.6%	19.0%
Duration (Years)	4.30	5.20	4.48	4.45	4.45	10.37	8.23	9.80
$$ amt Fixed Assets	1,436	2,960	1,584	1,421	1,421	1,665	1,302	1,406
Value after 100 rate rise	1,374	2,806	1,513	1,358	1,358	1,492	1,195	1,268
$ Loss	-62	-154	-71	-63	-63	-173	-107	-138

Crisis Risk Offset: Long Duration Risk

Years Long U.S. Treasury Securities Produced Negative Returns (data following page)

- Since 1970(46 years) there have been 18 years where long U.S. Treasuries have produced negative return
- In only 2 of the 18 years did all three strategies produce negative returns
  - In both years equity (growth) markets produced large positive returns
- Long U.S. Treasuries are volatile (expected volatility 18% per year)
  - In the context of a CRO portfolio – this s a positive attribute
  - The CRO portfolio must offset large negative equity portfolio returns

Crisis Risk Offset: Long Duration Risk

Years Long U.S. Treasury Securities Produced Negative Returns

	Long Duration	STF	ARC	CRO v1	CRO v2	US Equity	Non-US Equity	IG Fixed Income	60/40
1973	-4.45	82.62	6.73	32.61	39.08	-23.57	-18.44	-0.12	-12.65
1974	-9.36	29.99	-13.18	5.61	10.31	-36.80	-26.18	-1.22	-19.38
1975	-2.08	-13.82	2.25	-5.91	-7.95	34.78	31.30	5.07	21.85
1977	-5.44	16.49	14.31	7.28	5.53	-21.72	14.17	0.26	-2.16
1978	-13.27	0.99	-9.50	-6.82	-6.14	-4.22	28.56	-0.58	7.07
1979	-16.11	25.06	11.31	5.84	4.48	20.06	1.30	-0.31	6.28
1980	-26.83	-4.36	4.09	-11.66	-15.59	29.50	18.99	0.10	14.58
1981	-10.44	25.36	7.07	7.38	7.46	-12.03	-5.69	1.94	-4.54
1983	-8.41	-11.68	13.98	-5.24	-10.04	18.51	19.18	3.03	12.52
1987	-18.97	6.70	0.33	-4.84	-6.14	-4.86	19.49	0.12	4.44
1990	-0.81	7.00	-8.27	0.82	3.09	-12.74	-26.76	3.15	-10.59
1994	-22.09	1.60	-5.25	-9.25	-10.25	-6.87	1.73	-2.91	-2.70
1996	-4.83	5.90	30.03	6.44	0.54	17.49	1.78	1.00	6.18
1999	-21.06	-10.25	-16.26	-15.78	-15.66	16.42	25.02	-1.22	11.94
2003	-0.57	11.75	24.73	9.42	5.59	32.99	41.09	3.79	23.74
2005	-4.88	-1.71	26.19	2.60	-3.29	8.78	19.64	0.00	8.53
2006	-5.84	8.01	2.05	1.28	1.08	18.09	28.53	2.75	15.08
2009	-22.14	-19.38	-14.40	-19.49	-20.76	30.32	42.25	7.17	24.64
2013	-24.81	-2.78	18.79	-7.28	-13.80	35.37	18.90	-4.95	14.30
2015	-22.62	1.01	0.21	-8.60	-10.80	3.33	0.23	-2.82	-0.06

Composite Descriptions:

CRO v1 =
- 40% Long Duration
- 40% STF
- 20% ARC

CRO v2 =
- 50% Long Duration
- 50% STF

60/40 =
- 30% US Equity
- 30% Non-US Equity
- 40% IG Fixed Income

Crisis Risk Offset: Systematic Trend Following Risk

Systematic Trend Following Strategies

- Trends take time to develop
- In trendless periods the portfolio may not generate positive returns
- Trends that start and reverse in the short term provide a headwind to this product
  - Product has incurred cost to position portfolio to capture the trend, yet it does not occur
- Will trend following return premia be arbitraged away in the long-term?

Mitigating factor: product focused on multiple markets, offering opportunity to benefit from trends (up or down) in any market.

Crisis Risk Offset: Alternative Risk Capture Risk

Liquid Alternative Risk Capture

- Alternative premia exist
- However, they may at some point be arbitraged away or go through periods were they are not rewarded
- Operational risk – some complex financial structures required to capture a premia
- Managing multiple risk premia across multiple markets -- Risk management is complex
- Most product track records are back-tested

CRO Functional Class: Historical Data Series

	Long Duration	STF	ARC	CRO v1	CRO v2	US Equity	Non-US Equity	IG Fixed Income	60/40
1970	19.48	15.30	3.12	14.53	17.39	-2.63	-14.88	7.82	-2.12
1971	11.97	6.05	2.66	7.74	9.01	9.02	25.59	3.81	11.91
1972	-0.05	9.62	1.71	4.17	4.78	14.29	31.77	1.91	14.58
1973	-4.45	82.62	6.73	32.61	39.08	-23.57	-18.44	-0.12	-12.65
1974	-9.36	29.99	-13.18	5.61	10.31	-36.80	-26.18	-1.22	-19.38
1975	-2.08	-13.82	2.25	-5.91	-7.95	34.78	31.30	5.07	21.85
1976	21.26	9.92	24.74	17.42	15.59	19.84	-1.08	6.78	8.34
1977	-5.44	16.49	14.31	7.28	5.53	-21.72	14.17	0.26	-2.16
1978	-13.27	0.99	-9.50	-6.82	-6.14	-4.22	28.56	-0.58	7.07
1979	-16.11	25.06	11.31	5.84	4.48	20.06	1.30	-0.31	6.28
1980	-26.83	-4.36	4.09	-11.66	-15.59	29.50	18.99	0.10	14.58
1981	-10.44	25.36	7.07	7.38	7.46	-12.03	-5.69	1.94	-4.54
1982	36.03	15.69	11.86	23.06	25.86	16.24	-5.54	15.62	9.46
1983	-8.41	-11.68	13.98	-5.24	-10.04	18.51	19.18	3.03	12.52
1984	9.01	12.36	11.04	10.76	10.69	-3.27	2.95	6.55	2.52
1985	31.97	3.78	23.02	18.90	17.87	29.11	50.34	10.17	27.90
1986	32.22	1.12	7.84	14.91	16.67	11.73	63.18	6.60	25.11
1987	-18.97	6.70	0.33	-4.84	-6.14	-4.86	19.49	0.12	4.44
1988	5.12	-6.55	30.48	5.52	-0.72	12.99	22.37	2.78	11.72
1989	17.49	0.72	-1.53	6.98	9.10	25.90	6.97	6.23	12.35
1990	-0.81	7.00	-8.27	0.82	3.09	-12.74	-26.76	3.15	-10.59
1991	18.47	-9.88	2.24	3.88	4.30	30.79	8.83	7.22	14.78
1992	12.90	-9.92	4.08	2.01	1.49	3.83	-15.34	2.60	-2.41
1993	22.03	7.85	20.97	16.14	14.94	5.17	29.16	4.08	11.93
1994	-22.09	1.60	-5.25	-9.25	-10.25	-6.87	1.73	-2.91	-2.70
1995	31.53	2.70	6.89	15.07	17.12	34.34	4.94	8.27	15.09
1996	-4.83	5.90	30.03	6.44	0.54	17.49	1.78	1.00	6.18
1997	10.61	1.51	7.79	6.41	6.06	28.66	-2.72	3.76	9.29
1998	19.13	15.16	-11.56	11.40	17.14	20.05	9.00	2.48	9.71
1999	-21.06	-10.25	-16.26	-15.78	-15.66	16.42	25.02	-1.22	11.94
2000	15.07	23.54	5.75	16.60	19.31	-4.39	-8.64	9.87	0.04
2001	2.15	1.19	8.13	2.96	1.67	-8.26	-12.56	6.55	-3.63
2002	24.27	8.15	13.45	15.66	16.21	-18.04	-8.32	8.67	-4.44
2003	-0.57	11.75	24.73	9.42	5.59	32.99	41.09	3.79	23.74
2004	4.95	4.28	17.73	7.24	4.61	14.43	23.44	2.75	12.46
2005	-4.88	-1.71	26.19	2.60	-3.29	8.78	19.64	0.00	8.53
2006	-5.84	8.01	2.05	1.28	1.08	18.09	28.53	2.75	15.08
2007	4.67	-0.47	1.71	2.02	2.10	7.83	20.09	4.61	10.22
2008	34.35	56.38	-13.56	33.58	45.37	-33.32	-35.15	-0.41	-20.71
2009	-22.14	-19.38	-14.40	-19.49	-20.76	30.32	42.25	7.17	24.64
2010	11.15	4.42	-0.96	6.04	7.79	19.26	15.20	5.42	12.50
2011	30.70	17.98	8.14	21.10	24.34	3.84	-6.88	5.71	1.37
2012	6.93	-15.45	-4.90	-4.39	-4.26	18.76	20.32	3.43	13.10
2013	-24.81	-2.78	18.79	-7.28	-13.80	35.37	18.90	-4.95	14.30
2014	18.62	29.47	4.52	20.14	24.04	15.02	1.88	3.46	6.45
2015	-22.62	1.01	0.21	-8.60	-10.80	3.33	0.23	-2.82	-0.06

Composite Weigtings:

CRO v1 =
- 40% Long Duration
- 40% STF
- 20% ARC

CRO v2 =
- 50% Long Duration
- 50% STF

60/40 =
- 30% US Equity
- 30% Non-US Equity
- 40% IG Fixed Income

Crisis Risk Offset: Returns Various Market Environments

Returns various market environments:

Historical Event	Date Range	Long Duration	STF	ARC	CRO v1	CRO v2	US Equity	Non-US Equity	IG Fixed Income	60/40
September 11	9/10/2001 - 9/18/2001	-1.5%	7.8%	---	---	3.1%	-4.9%	-6.9%	0.2%	-3.4%
SARS scare	12/2002 – 02/2003	6.9%	26.4%	6.5%	14.4%	16.4%	-9.7%	-8.5%	3.6%	-4.2%
Brexit	6/24/2016 - 6/27/2016	5.1%	3.7%	1.8%	3.9%	4.4%	-5.3%	-8.5%	1.1%	-3.7%
Bull Market 1	8/2003 – 10/2007	6.4%	6.0%	16.6%	8.5%	6.5%	13.1%	27.3%	4.6%	13.8%
Bull Market 2	3/2009 – 4/2011	2.8%	3.9%	5.7%	4.1%	3.7%	35.8%	40.3%	7.2%	25.4%
Bear Market 1	10/2008 – /2009	12.4%	15.8%	10.2%	13.7%	14.6%	-41.4%	-47.2%	4.5%	-27.7%
Market Volatility	5/2011 – 9/2011	26.5%	-6.0%	2.6%	8.1%	9.4%	-16.3%	-23.1%	4.9%	-10.4%

Composite Weightings:

CRO v1 =
- 40% Long Duration
- 40% STF
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60/40 =
- 30% US Equity
- 30% Non-US Equity
- 40% IG Fixed Income

CRO v2 =
- 50% Long Duration
- 50% STF

CRO Sub-components: Recent Performance

	Long Duration	STF	ARC	CRO v1	CRO v2	Global Equity	Fixed Income	60/40
Jan-16	5.0%	3.8%	2.8%	4.1%	4.4%	-6.1%	1.4%	-3.1%
Feb-16	3.0%	2.4%	0.6%	2.3%	2.7%	-0.6%	0.7%	-0.1%
Mar-16	0.0%	-2.9%	-0.7%	-1.3%	-1.5%	7.5%	0.9%	4.9%
Apr-16	-0.5%	-3.7%	0.5%	-1.6%	-2.1%	1.5%	0.4%	1.1%
May-16	0.8%	-2.7%	-1.4%	-1.0%	-1.0%	0.2%	0.0%	0.1%
Jun-16	6.1%	5.4%	2.5%	5.1%	5.8%	-0.6%	1.8%	0.4%
Jul-16	2.2%	1.7%	0.1%	1.6%	2.0%	4.3%	0.6%	2.9%
YTD	3.6%	17.7%	4.3%	9.3%	10.5%	5.9%	6.0%	6.1%

Composite Weightings:

CRO v1 =
- 40% Long Duration
- 40% STF
- 20% ARC

CRO v2 =
- 50% Long Duration
- 50% STF

60/40 =
- 30% US Equity
- 30% Non-US Equity
- 40% IG Fixed Income

Composite Descriptions:

Long Duration = Barclays Capital Long US Treasuries Index

STF = SG Trend Index

ARC = Average of live manager returns and Credit Suisse Neuberger Berman Core Risk Premia Index

Global Equity = MSCI ACWI Index

Fixed Income = Barclays Capital Aggregate Bond Index

Summary Scenario Comparisons: Compound Return

Comment	Time Period	Long Duration	MLM Index	AQR: Century of Trend	S&P 500 Index	BC Agg	CRO: 50/50	Trad. 60/40	60/40 + 15% CRO
Full Period	1961-01 to 2015-12	1.74%	6.33%	13.20%	4.77%	1.76%	4.17%	3.82%	3.95%
Extended Rising Rates Period	1961-02 to 1980-12	-2.21%	10.93%	16.65%	2.20%	-1.26%	4.42%	1.03%	1.61%
Extended Falling Rates Period	1980-12 to 2015-12	4.03%	3.61%	11.07%	6.18%	3.48%	3.92%	5.38%	5.23%
Deflation	2008-06 to 2008-12	16.55%	5.96%	17.56%	-28.94%	3.60%	11.37%	-16.93%	-13.00%
Disinflation	1969-11 to 1972-06	4.32%	10.09%	12.42%	3.52%	5.11%	7.33%	4.34%	4.84%
Disinflation	1974-11 to 1976-12	4.18%	2.23%	11.89%	20.42%	6.94%	3.50%	15.08%	13.35%
Disinflation	1980-02 to 1983-07	3.01%	4.23%	19.96%	4.72%	3.31%	3.94%	4.44%	4.47%
Rising Rates & Falling Equities	1968-06 to 1970-06	-6.80%	9.49%	27.51%	-16.43%	-6.91%	1.13%	-12.55%	-10.56%
Rising Rates & Falling Equities	1973-01 to 1974-09	-6.33%	53.15%	44.84%	-31.64%	-8.24%	21.21%	-22.75%	-17.15%
Gradual Rising Rates	2003-05 to 2006-07	-1.96%	0.06%	4.33%	8.42%	-0.18%	-0.89%	5.00%	4.12%
Gradual Rising Rates	1961-04 to 1966-11	-1.21%	9.63%	5.99%	3.47%	-0.78%	4.16%	1.90%	2.28%
Gradual Rising Rates	1971-10 to 1974-08	-4.31%	31.70%	34.13%	-11.04%	-4.76%	13.10%	-8.39%	-5.32%
Rate Spike	1980-05 to 1981-10	-16.55%	10.97%	27.23%	-0.66%	-12.27%	-3.49%	-5.20%	-4.83%
Rate Spike	1983-04 to 1984-08	-6.78%	-0.34%	5.11%	-3.33%	-4.19%	-3.46%	-3.54%	-3.49%
Rate Spike	1993-09 to 1995-04	-5.01%	6.67%	8.12%	5.57%	-2.11%	0.74%	2.48%	2.25%
Rate Spike	1998-11 to 2000-07	-4.55%	-0.95%	3.51%	8.60%	-2.36%	-2.68%	4.30%	3.30%
Recent Bear Market	2000-08 to 2002-09	9.10%	0.16%	11.28%	-26.48%	6.84%	4.60%	-14.12%	-11.42%
Recent Bear Market	2007-10 to 2009-02	12.19%	9.10%	15.11%	-40.47%	2.84%	10.86%	-25.38%	-20.64%
Recent Trend Underperformance	2010-05 to 2014-07	4.11%	-0.35%	3.80%	16.71%	3.77%	1.92%	11.61%	10.17%
Recent Trend Outperformance	2014-07 to 2015-12	3.84%	8.18%	4.10%	5.94%	1.82%	6.06%	4.45%	4.73%

Composite Descriptions:

CRO 50/50: 50% Long Duration, 50% MLM Index

Traditional 60/40: 60% S&P 500 Index, 40% BC Aggregate Bond Index

Summary Scenario Comparisons: S&P 500 Correlation

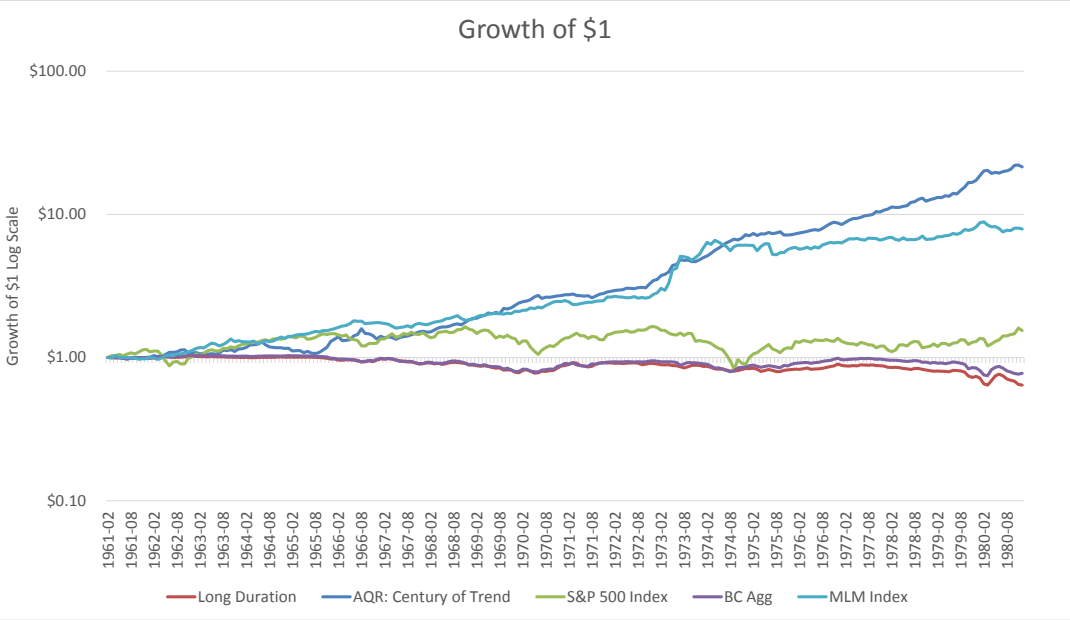
Comment	Time Period	Long Duration	MLM Index	AQR: Century of Trend	S&P 500 Index	BC Agg	CRO: 50/50	Trad. 60/40	60/40 + 15% CRO
Full Period	1961-01 to 2015-12	0.15	-0.10	-0.11	1.00	0.26	0.00	0.98	0.96
Extended Rising Rates Period	1961-02 to 1980-12	0.28	-0.01	-0.15	1.00	0.32	0.11	0.97	0.96
Extended Falling Rates Period	1980-12 to 2015-12	0.08	-0.22	-0.08	1.00	0.21	-0.08	0.98	0.97
Deflation	2008-06 to 2008-12	0.53	-0.84	-0.84	1.00	0.62	-0.27	0.99	0.97
Disinflation	1969-11 to 1972-06	0.54	0.00	-0.44	1.00	0.56	0.44	0.98	0.98
Disinflation	1974-11 to 1976-12	0.17	0.33	-0.20	1.00	0.46	0.34	0.98	0.97
Disinflation	1980-02 to 1983-07	0.36	-0.28	-0.15	1.00	0.42	0.11	0.95	0.92
Rising Rates & Falling Equities	1968-06 to 1970-06	0.49	-0.11	-0.22	1.00	0.38	0.23	0.98	0.96
Rising Rates & Falling Equities	1973-01 to 1974-09	0.21	0.18	0.10	1.00	-0.16	0.22	0.96	0.94
Gradual Rising Rates	2003-05 to 2006-07	-0.03	0.23	0.39	1.00	-0.11	0.13	0.94	0.90
Gradual Rising Rates	1961-04 to 1966-11	0.22	-0.02	-0.20	1.00	0.24	0.04	0.99	0.99
Gradual Rising Rates	1971-10 to 1974-08	0.31	0.10	0.00	1.00	0.29	0.16	0.98	0.97
Rate Spike	1980-05 to 1981-10	-0.13	-0.50	-0.22	1.00	0.21	-0.45	0.95	0.92
Rate Spike	1983-04 to 1984-08	0.49	-0.15	-0.43	1.00	0.40	0.23	0.96	0.95
Rate Spike	1993-09 to 1995-04	0.55	-0.46	0.03	1.00	0.79	0.16	0.99	0.98
Rate Spike	1998-11 to 2000-07	0.17	-0.36	-0.18	1.00	0.34	-0.15	0.99	0.98
Recent Bear Market	2000-08 to 2002-09	-0.51	-0.51	-0.69	1.00	-0.47	-0.62	0.99	0.98
Recent Bear Market	2007-10 to 2009-02	0.27	-0.67	-0.59	1.00	0.36	-0.23	0.99	0.97
Recent Trend Underperformance	2010-05 to 2014-07	-0.47	-0.16	-0.30	1.00	-0.29	-0.48	0.99	0.98
Recent Trend Outperformance	2014-07 to 2015-12	-0.07	-0.16	-0.21	1.00	-0.04	-0.17	0.99	0.97

Composite Descriptions:

CRO 50/50: 50% Long Duration, 50% MLM Index

Traditional 60/40: 60% S&P 500 Index, 40% BC Aggregate Bond Index

Rising Rates Feb 1961 – Dec 1980*



Economic Data	Reading Change	Percent Change
CPI % Δ YOY	1.4% to 12.5%	792.9%
Unemployment	6.9% to 7.2%	4.3%
10-Year Tsy Yld	3.8% to 12.8%	236.8%
Fed Funds Rate	2.5% to 18.9%	656.0%
USE Valuations	19.2 to 9.4	-51.0%
PPI % Δ YOY	0.6% to 12.5%	1983.3%
Oil Price	3 to 37	1133.3%
Eur/USD	n/a	n/a
US GDP %Δ YOY	0.5% to 12%	2300.0%

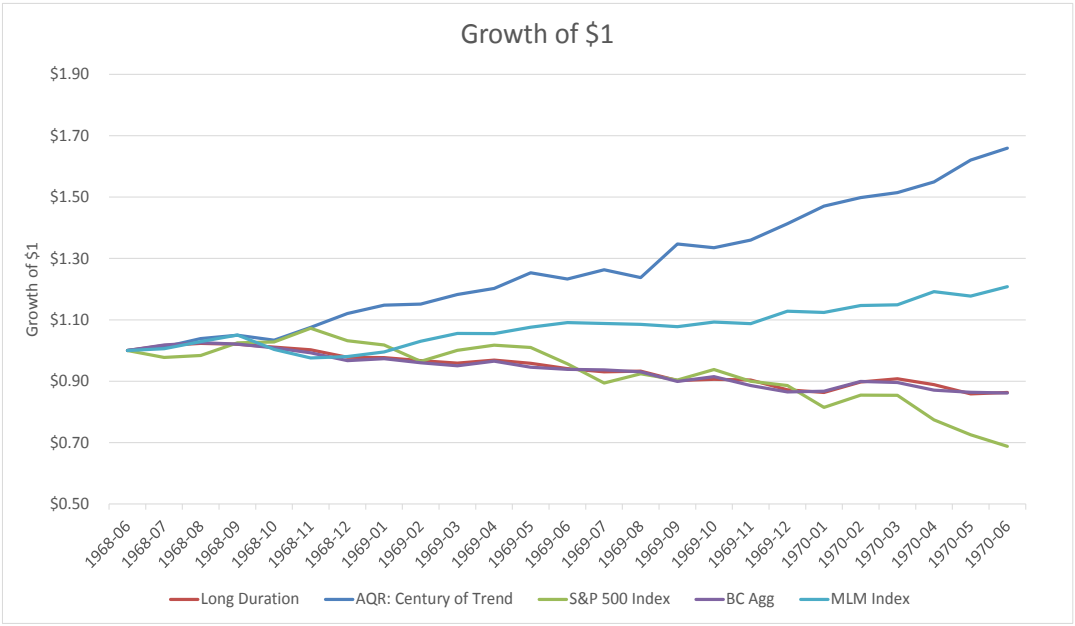
	AQR: Century of Trend	Long Duration	S&P 500 Index	BC Agg
Long Duration	(0.27)			
S&P 500 Index	(0.15)	0.28		
BC Agg	(0.39)	0.76	0.32	
MLM Index	0.39	(0.07)	(0.01)	(0.09)

Data Series	Leverage	Ann. Ret	StDev	Ret/Risk	Skew	Kurtosis	Max DD	Downside StDev	Growth of $1
Long Duration	1.00	-2.2%	5.9%	-0.38	0.03	6.82	-37.2%	4.3%	$0.64
MLM Index	1.00	10.9%	12.5%	0.87	1.56	12.23	-20.6%	7.6%	$7.90
AQR: Century of Trend	1.00	16.6%	10.0%	1.67	0.10	1.07	-17.7%	6.0%	$21.47
S&P 500	1.00	2.2%	14.5%	0.15	-0.05	1.10	-49.6%	9.6%	$1.54
BC Agg	1.00	-1.3%	5.9%	-0.21	0.54	7.41	-27.7%	4.2%	$0.78

- AQR produced highest return to risk and lowest drawdown
- AQR & MLM exhibited modest positive correlation during the period

*Returns are in excess of cash

(1) Rising Rates + Falling Equities July 1968 – June 1970*



Economic Data	Reading Change	Percent Change
CPI % Δ YOY	4.2% to 6%	42.9%
Unemployment	3.7% to 4.9%	32.4%
10-Year Tsy Yld	5.7% to 7.8%	36.8%
Fed Funds Rate	6.1% to 7.6%	24.6%
USE Valuations	22 to 13.8	-37.3%
PPI % Δ YOY	2.1% to 3.4%	61.9%
Oil Price	3.1 to 3.4	9.7%
Eur/USD	n/a	n/a
US GDP % Δ YOY	9.9% to 5.5%	-44.4%

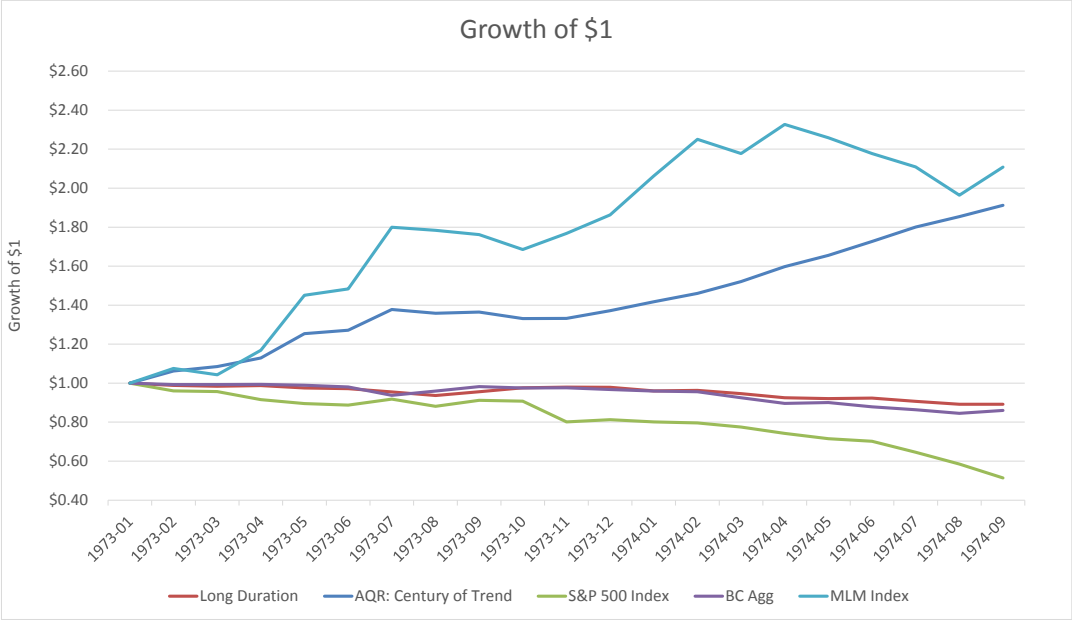
	AQR: Century of Trend	Long Duration	S&P 500 Index	BC Agg
Long Duration	(0.44)			
S&P 500 Index	(0.22)	0.49		
BC Agg	(0.37)	0.79	0.38	
MLM Index	(0.00)	0.06	(0.11)	0.07

Data Series	Leverage	Ann. Ret	StDev	Ret/Risk	Skew	Kurtosis	Max DD	Downside StDev	Growth of $1
Long Duration	1.00	-6.8%	6.0%	-1.14	0.35	0.86	-16.1%	4.0%	$0.86
MLM Index	1.00	9.5%	6.9%	1.37	-0.73	0.80	-7.1%	5.1%	$1.21
AQR: Century of Trend	1.00	27.5%	8.3%	3.31	0.46	1.53	-2.0%	1.6%	$1.66
S&P 500	1.00	-16.4%	14.7%	-1.11	-0.08	-1.08	-35.9%	9.5%	$0.69
BC Agg	1.00	-6.9%	6.0%	-1.16	0.51	0.22	-16.0%	3.6%	$0.86

- MLM and AQR exhibit no correlation to each other
- AQR produced 3 times the return as MLM with 20% more risk

*Returns are in excess of cash

(2) Rising Rates + Falling Equities Feb 1973 – Sept 1974*



Economic Data	Reading Change	Percent Change
CPI % Δ YOY	3.6% to 11.9%	230.6%
Unemployment	4.9% to 5.9%	20.4%
10-Year Tsy Yld	6.5% to 8%	23.1%
Fed Funds Rate	5.9% to 11.3%	91.5%
USE Valuations	18.7 to 8.7	-53.5%
PPI % Δ YOY	7.2% to 19.7%	173.6%
Oil Price	3.6 to 10.1	180.6%
Eur/USD	n/a	n/a
US GDP %Δ YOY	11.9% to 8.4%	-29.4%

	AQR: Century of Trend	Long Duration	S&P 500 Index	BC Agg
Long Duration	(0.50)			
S&P 500 Index	0.10	0.21		
BC Agg	(0.49)	0.46	(0.16)	
MLM Index	0.68	(0.21)	0.18	(0.14)

Data Series	Leverage	Ann. Ret	StDev	Ret/Risk	Skew	Kurtosis	Max DD	Downside StDev	Growth of $1
Long Duration	1.00	-6.3%	4.4%	-1.45	0.73	0.01	-10.8%	2.6%	$0.89
MLM Index	1.00	53.1%	29.5%	1.80	0.94	0.46	-15.6%	6.0%	$2.11
AQR: Century of Trend	1.00	44.8%	10.6%	4.23	0.50	1.43	-3.4%	2.7%	$1.91
S&P 500	1.00	-31.6%	15.2%	-2.09	-0.65	0.14	-48.6%	13.3%	$0.51
BC Agg	1.00	-8.2%	6.2%	-1.33	-0.11	0.02	-15.5%	4.6%	$0.86

- Both trend-following series produced outsized gains relative to equities and fixed income

*Returns are in excess of cash

Modeling a Crisis Protection Class

Crisis Risk Offset	10-Year Expected Risk & Return		
	Arithmetic Return	Standard Deviation	Compound Return
Treasury Duration	4.5%	18.0%	3.1%
Systematic Trend Following	7.9%	18.0%	6.6%
alternative risk capture	6.1%	12.0%	5.5%
Total	**6.2%**	**10.8%**	**5.7%**

Appendix

Managers that Implement Sub-Elements

- Long Duration
  - Any fixed income manager, internal staff that trade Treasury futures
  - Extremely low cost (<10 basis points)

- Systematic Trend following
  - Also known as systematic managed futures, systematic CTAs
  - Graham, AQR, Fulcrum, Salient, Systematica, Mount Lucas, CFM, etc.
  - Simple trend following is relatively cheap (50-100 basis points)

- Alternative Risk Capture
  - Most expensive (100+ basis points)
  - Requires a specialized implementer (long-short across many markets), sophisticated trading desk, significant leverage, top shelf risk management
  - Limited number of providers with a track record: AQR, Kepos, GSAM

- Functional class total cost ~ 65 -75 bp

Appendix: Potential Underlying Strategies

Strategy	Description / Definition
Long Duration	Treasury securities (bonds) have duration, a measure of their sensitivity to interest rate changes. Since Treasury bonds are considered to be essentially default-risk free, pricing of Treasury bonds benefits from something called price certainty, given a level of yields across the yield curve. That is, all you need to price Treasury bonds is the level of interest rates. This means that Treasuries will rise, if interest rates decline, something that they have tended to do in most growth crises.
Systematic Trend Following	Trend following (trend capture) investing involves going long markets that have been rising and going short markets that have been falling, betting that those trends continue. This strategy is particularly suited to futures markets, where establishing a position long or short is effective zero cost. Opening futures position doesn't cost anything, but movement of futures prices results in either gains or losses to the position, which result in a transfer of funds (margin) to or from the position holder. This strategy is often called systematic global macro in its hedge fund form (as opposed to discretionary global macro).
alternative risk capture	alternative risk capture or liquid alternative risk premia investing involves going long and short securities and markets, in a market neutral fashion, to isolate returns historically attributable to the various factors of value, carry, momentum (cross-sectional), and low-volatility. These factors have historically been rewarded. The reasons ascribed to these structural "excess " returns vary. Academics and practitioners provide both behavioral- and risk-based explanations, but their historical existence is not in dispute.

Appendix: Component Modeling Detail

- **Trend Capture** (or Trend Following) investing involves going long markets that have been rising and going short markets that have been falling, betting that those trends continue. The construction of the data set is an equal weighted combination of 1-month, 3-month, and 12-month time series momentum strategies for 59 markets across 4 major asset classes – 24 commodities, 11 equity indices, 15 bond markets, and 9 currency pairs. Leverage can be added (subtracted) to increase (decrease) the strategy volatility and return.

- The **Treasury Duration** excess return is the excess return on the 10 year "constant maturity" security for the year is calculated as, the coupon [average of year end rates (e.g. (Dec 1969 rate + Dec 1970 rate)/2)], minus duration times the change in rates, minus the return on cash (T-bills) for the year. The excess return is the return of the strategy in excess of cash. Leverage can be added (subtracted) to increase (decrease) the strategy volatility and return. The Treasuries data in the GRO/CRO class is scaled to match the volatility of longer-maturity Treasuries.

- **Alternative Risk Premium** investing involves going long and short securities and markets, in a market neutral fashion, to isolate returns historically attributable to the various factors of value, carry, momentum (cross-sectional), and low-volatility. The excess return is the return of the strategy in excess of cash. Leverage can be added (subtracted) to increase (decrease) the strategy volatility and return.

- Trend Capture and Alternative Risk Premium strategies might be considered active management. However, the strategies modeled here are highly systematic in nature, utilizing rules-based approaches to structuring portfolios and capturing the associated risk premiums.

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