

Non-Life Insurance Underwriting Risk and Investment Risk

May 2019



Today's Presenters

Eric Nilles, CFA, CAIA, Divisional Vice President - Investments, Heath Care Service Corporation (HCSC), joined the firm in 2009. HCSC is the parent company of Blue Cross/Blue Shield of Illinois, Texas, New Mexico, Oklahoma and Montana. Eric's current responsibilities include developing and executing investment strategy for HCSC's \$16.2 billion investment portfolio. Eric is also responsible for internally managed investment strategies, external manager selection/evaluation, and investment analytics/risk management. Previous experience at Chinatrust Capital, ABN AMRO Investment Management, and the Allstate Insurance Company spanned a range of investment strategies, asset classes and risk tolerances. Eric earned his MBA from Northwestern University (Kellogg).

Stephen Smith, CFA, FSA, Managing Director, joined Neuberger Berman in 2016. Steve is the Global Head of Insurance Analytics, responsible for strategic and quantitative analysis for insurance clients, especially strategic asset allocation, capital management, and asset-liability management. Previously, Steve held positions in Insurance Strategy at Goldman Sachs and in Asset-Liability Management, Annuity Modeling, and Corporate Tax at MassMutual. Steve earned his BS in Mathematics and Statistics from the University of South Carolina.

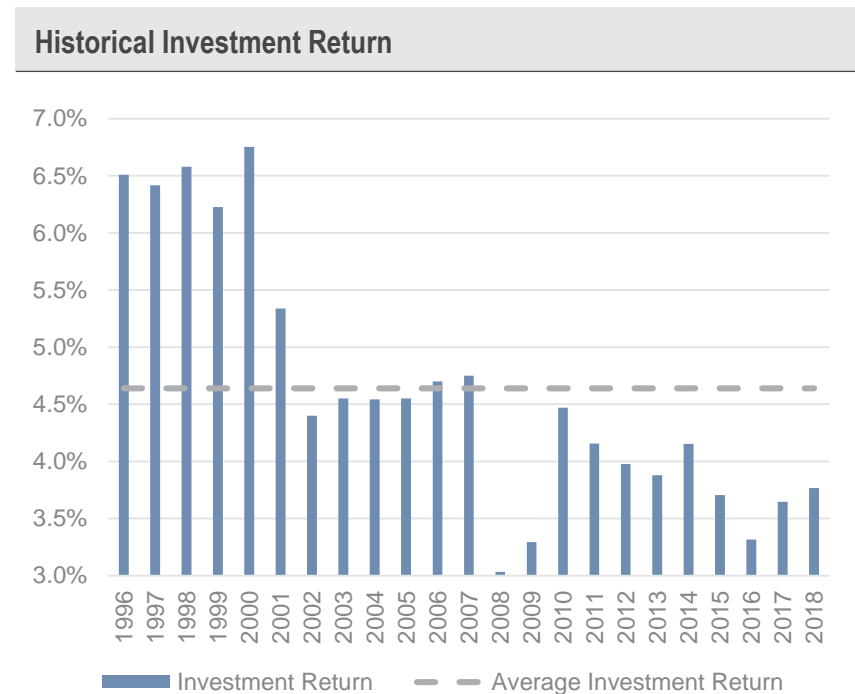
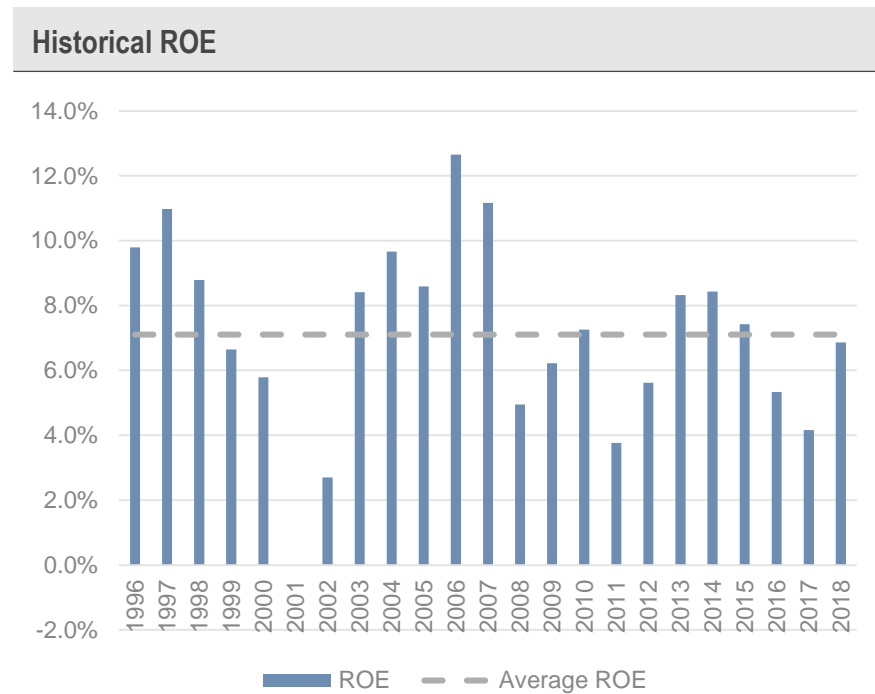
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P&C INDUSTRY ROE DATA ANALYSIS

Aggregated P&C Industry Historical Analytics: 1996-2018

ROE has been lower in recent years than historical average



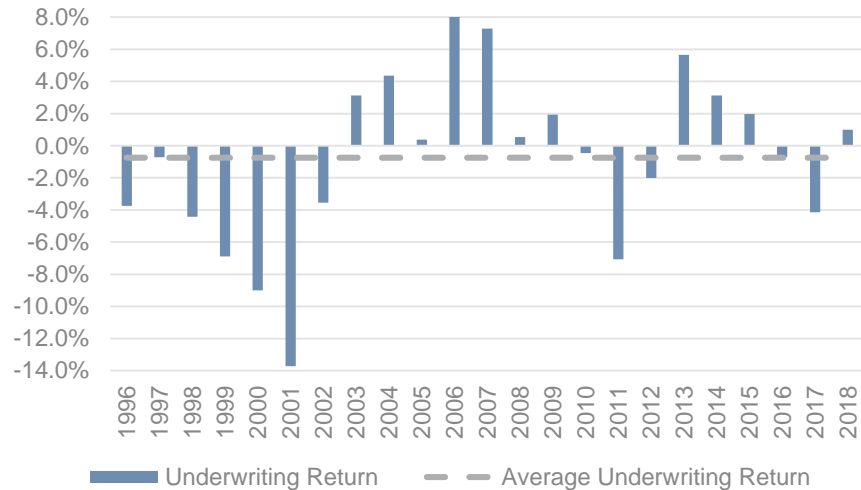
Definitions & Observations

- ROE: net income divided by capital & surplus
- Investment return: net investment income divided by total cash & investments
- ROE and investment return have been lower in recent years than historical average
- In 2008, investment returns were particularly low and so was ROE
- All data is based on statutory filings—ROE is thus being expressed as a stat metric rather than GAAP

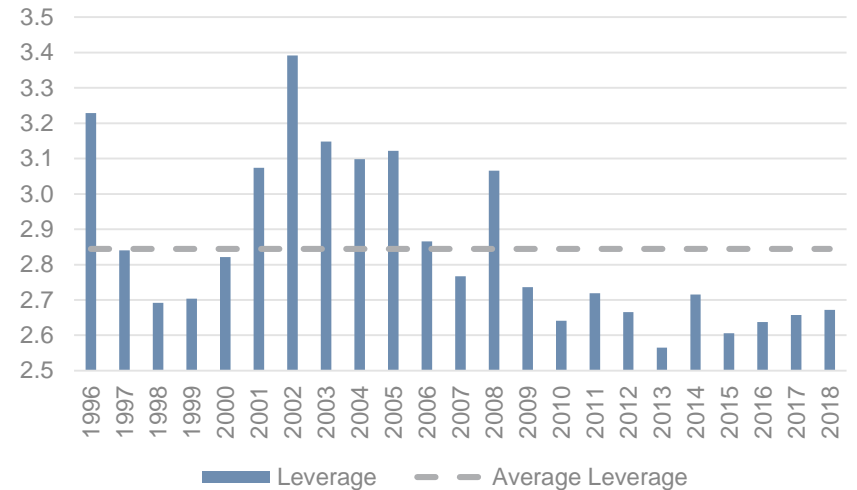
Aggregated P&C Industry Historical Analytics: 1996-2018

Leverage has been lower in recent years than historical average

Historical Underwriting Return



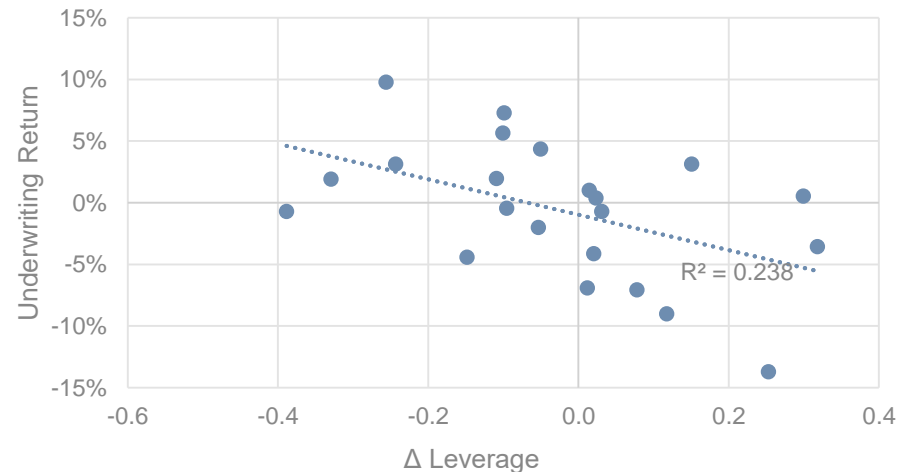
Historical Leverage



Definitions & Observations

- Underwriting return is defined as (1 – combined ratio)
- Leverage is defined as total assets divided by capital & surplus
- Underwriting return fluctuates historically and the average is -0.75%
- Leverage has generally been decreasing in the past 20 years
- Change in leverage is negatively correlated with underwriting return, suggesting that insurers do not reverse the capital structure impact of positive (negative) underwriting results growing (shrinking) surplus

Historical Underwriting Return vs Leverage Change

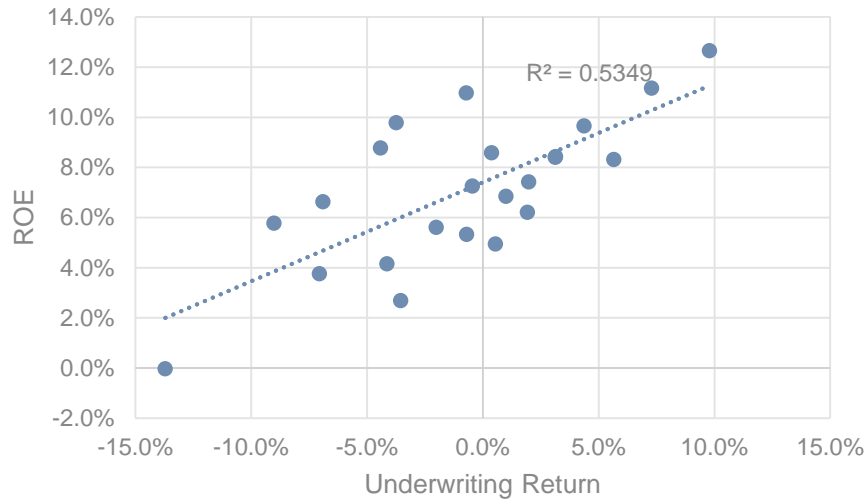


Source: SNL Financial, Neuberger Berman

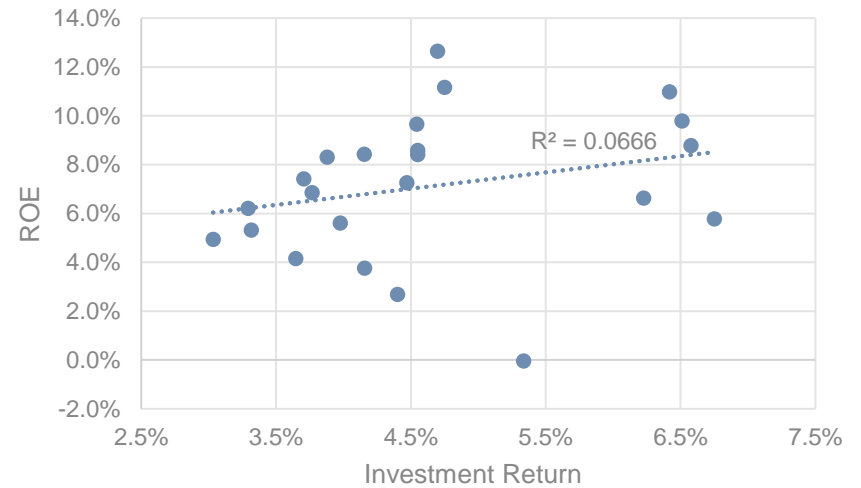
Aggregated P&C Industry Historical Analytics: 1996-2018

ROE is positively correlated with underwriting return and investment return but not with leverage

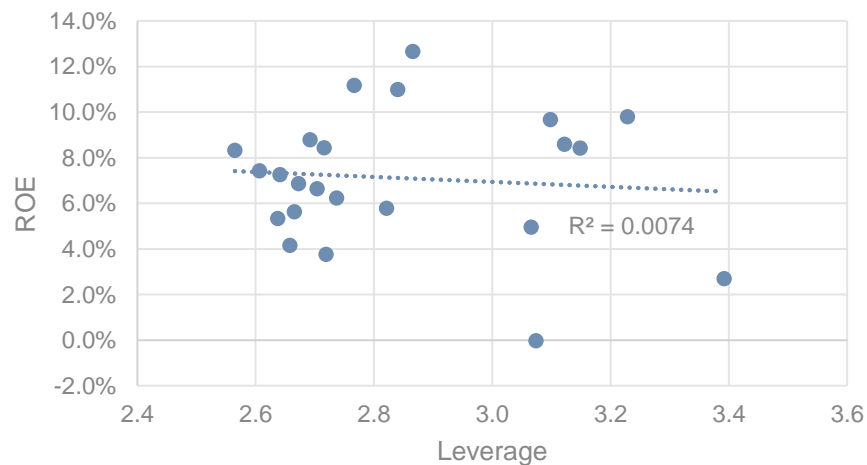
ROE vs Underwriting Return



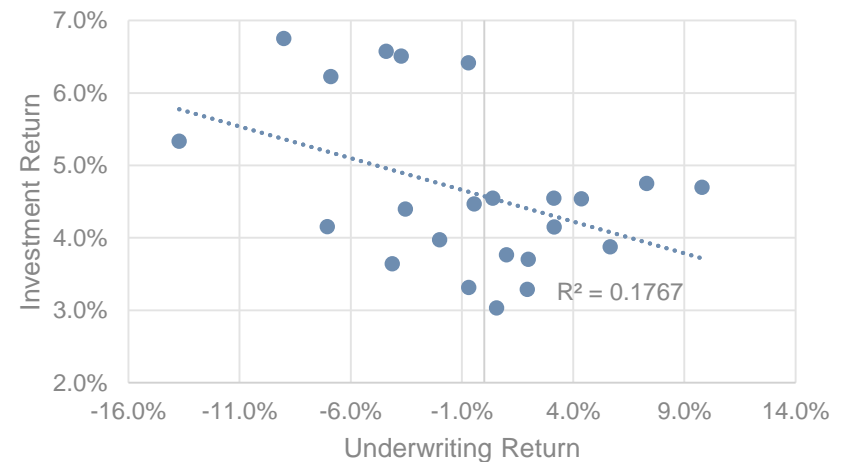
ROE vs Investment Return



ROE vs Leverage



Underwriting Return vs Investment Return



Source: SNL Financial, Neuberger Berman

Aggregated P&C Industry Historical Analytics: 1996-2018

ROE is well explained by underwriting return and investment return

Multivariate Linear Regression:

$$ROE = \beta_1 * Underwriting + \beta_2 * Investment + \beta_3 * Leverage$$

R²: 0.99

	Coefficient	Std Err	t-value	p-value
Underwriting Return	0.56	0.04	15.9	0.00
Investment Return	1.88	0.17	11.0	0.00
Leverage	-0.00	0.03	-1.5	0.15

Observations

- Underwriting return and investment return coefficients are both significantly positive, indicating that higher underwriting return and investment return contributes to higher ROE
- Coefficient of leverage is slightly negative and not significant, indicating that leverage has less impact on ROE than underwriting and investment return

P&C Industry Business Segments in 2018

P&C industry average ROE is 6.9% and average leverage is 2.7

	# Companies	Total Asset (\$bn)	ROE	Underwriting Return	Investment Return	Leverage
Private Auto	238	727	7.2%	2%	3.8%	2.1
Workers Comp	151	107	8.1%	3%	3.2%	2.9
Home / Farmowners Multi-Peril	186	68	6.2%	3%	2.8%	2.2
Other Liability	128	48	8.3%	7%	3.5%	2.8
Non Proportional Reinsurance	9	47	4.6%	6%	4.2%	1.4
Medical Malpractice	133	36	6.0%	-4%	3.6%	2.2
Fin. / Mtg. Guaranty Combined	23	27	7.7%	23%	2.2%	2.5
Cmcl Multi-Peril Combined	57	25	4.4%	-5%	3.0%	2.7
Fidelity / Surety Combined	55	12	13.9%	29%	3.4%	1.8
Fire and Allied Lines Combined	57	11	3.6%	-7%	4.2%	2.5
Commercial Auto Est.	60	9	5.8%	1%	3.1%	3.1
Other Commercial	33	7	12.7%	15%	2.8%	3.1
Marine Lines Combined	19	3	3.8%	3%	3.2%	1.9
A&H Lines Combined	11	3	2.4%	2%	1.7%	2.3
Multi Segments ¹	386	866	6.5%	-1%	4.0%	3.3
P&C Industry	1,546	1996	6.9%	1%	3.8%	2.7

1. For each company, if one business segment assets is bigger than 50% of the total assets, the company is categorized under that business segment; otherwise, company is put under multi-segments category
Source: SNL Financial

Business Segments: ROE in 2018

ROE is driven by both underwriting and investment results

ROE vs Underwriting Return and Investment Return

		Underwriting Return					
		(21%)–(13%)	(13%)–(6%)	(-6%)–2%	2%–9%	9%–17%	17%–24%
Investment Return	0.9%–1.5%	-3%	-3%	-1%	5%	6%	13%
	1.5%–2.0%	-3%	-5%	2%	6%	10%	12%
	2.0%–2.5%	-6%	0%	3%	7%	10%	8%
	2.5%–3.1%	-8%	-1%	5%	7%	10%	11%
	3.1%–3.6%	-6%	1%	5%	9%	12%	13%
	3.6%–4.1%	-3%	1%	6%	10%	12%	17%

Methodology & Observations

- P&C companies are grouped by their investment return and underwriting return
- Average ROE is calculated for each group
- ROE is higher for groups with higher underwriting return
- ROE is higher for groups with higher investment return when underwriting return is reasonably good; otherwise, ROE results are driven by underwriting return

Source: SNL Financial, Neuberger Berman

Business Segments: ROE in 2018

When underwriting results are bad, high leverage leads to worse ROE

ROE vs Underwriting Return and Leverage

		Underwriting Return					
		(21%) – (13%)	(13%) – (6%)	(-6%) – -2%	2% – 9%	9% – 17%	17% – 24%
Leverage	1.3 – 1.7	-1%	3%	3%	6%	8%	9%
	1.7 – 2.1	-2%	0%	4%	7%	10%	11%
	2.1 – 2.6	-4%	0%	4%	7%	10%	12%
	2.6 – 3.0	-10%	-1%	4%	7%	12%	15%
	3.0 – 3.4	-3%	-2%	6%	9%	8%	14%
	3.4 – 3.9	-13%	-4%	5%	8%	14%	15%

Methodology & Observations

- P&C companies are grouped by their leverage and underwriting return
- Average ROE is calculated for each group
- ROE is higher for groups with higher underwriting return
- Higher leverage improves ROE when underwriting return is positive but hurts ROE when underwriting return is negative

Source: SNL Financial, Neuberger Berman

Business Segments: ROE in 2018

No linear pattern between leverage and ROE given certain level of investment return

ROE vs Investment Return and Leverage

		Investment Return					
		0.9%–1.5%	1.5%–2.0%	2.0%–2.5%	2.5%–3.1%	3.1%–3.6%	3.6%–4.1%
Leverage	1.3–1.7	4%	4%	7%	6%	5%	5%
	1.7–2.1	3%	5%	4%	6%	7%	8%
	2.1–2.6	4%	4%	6%	5%	6%	6%
	2.6–3.0	3%	2%	5%	5%	6%	9%
	3.0–3.4	-2%	5%	5%	6%	8%	7%
	3.4–3.9	2%	7%	1%	5%	3%	5%

Methodology & Observations

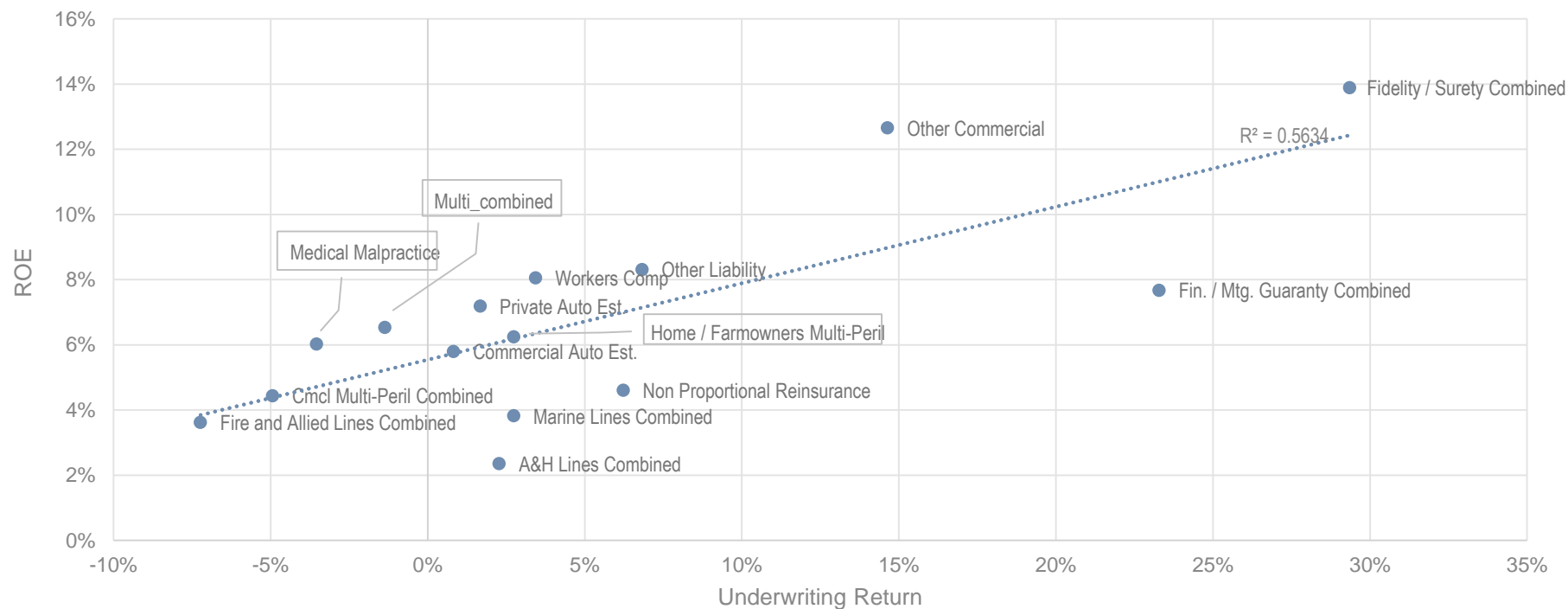
- P&C companies are grouped by their leverage and investment return
- Average ROE is calculated for each group
- ROE is higher for groups with higher investment return
- There is no linear pattern between leverage and ROE

Source: SNL Financial, Neuberger Berman

Business Segments: ROE and Underwriting Return in 2018

ROE is positively correlated with underwriting return

Business Segments: ROE vs Underwriting Return in 2018



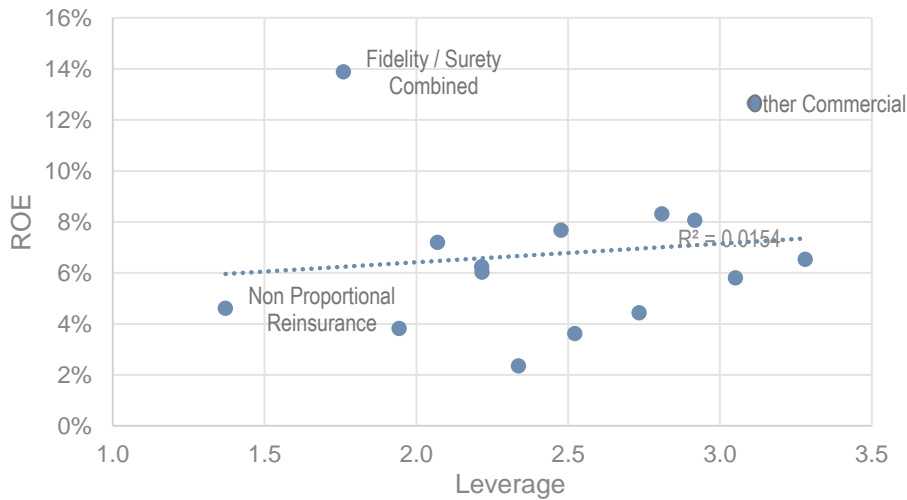
Methodology & Observations

- Each dot represents the ROE and underwriting return of companies within one business segment
- Segments include: Private Auto, Workers Comp, Home / Farmowners Multi-Peril, Fire and Allied Lines, Marine Lines, Medical Malpractice, Fin./Mtg. Guaranty, Commercial Auto, A&H lines, CmcI Multi-Peri, etc.
- It shows that business segment with lower combined ratio has higher ROE

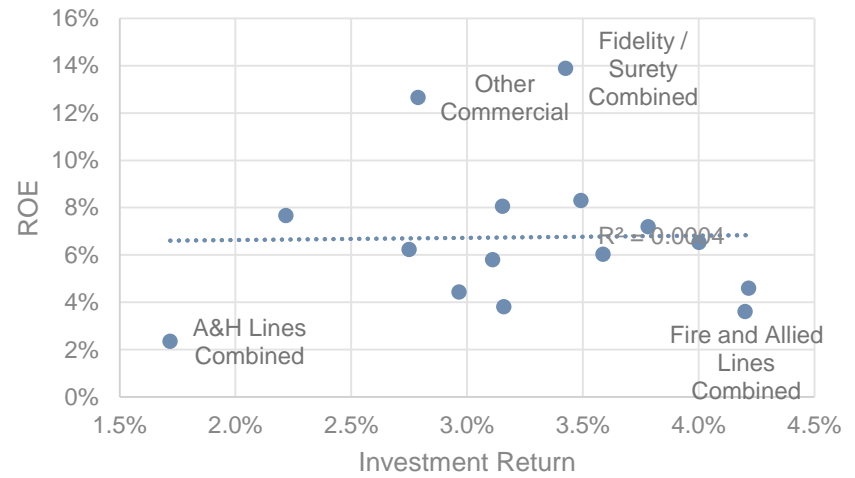
Business Segments: ROE and Investment Return in 2018

Investments return and leverage do not seem to have impacts on ROE cross-sectionally

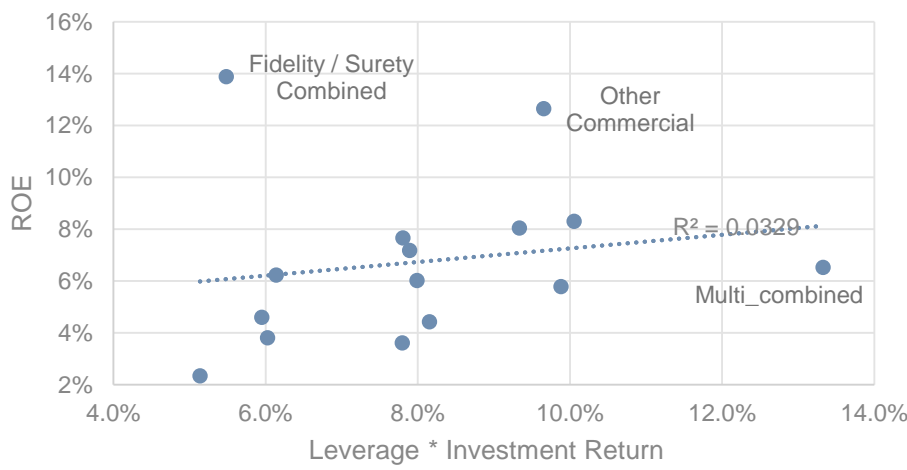
Business Segments: ROE vs Leverage in 2018



Business Segments: ROE vs Investment Return in 2018



Business Segments: ROE vs Leverage * Return in 2018



Observations

- Differences in investment strategies across business segments are not large enough for investments to explain variation in ROE across segments in 2018
- The effects of investment returns and leverage are overpowered by underwriting returns

Source: SNL Financial, Neuberger Berman

Business Segments: ROE and Investment Return in 2018

ROE is well explained by underwriting return cross-sectionally

Multivariate Linear Regression:

$$ROE = \beta_1 * Underwriting + \beta_2 * Investment + \beta_3 * Leverage$$

R²: 0.95

	Coefficient	Std Err	t-value	p-value
Underwriting Return	0.26	0.05	5.59	0.00
Investment Return	0.76	0.46	1.66	0.12
Leverage	0.01	0.01	2.05	0.06

Observations

- Underwriting return is significantly positive, indicating that higher underwriting return contributes to higher ROE
- Coefficients of investment return and leverage are not significant at 5%, indicating that investment return and leverage have less impact on ROE than underwriting return
- Unlike historical data, within a given year underwriting returns vary more across business segments than do investment returns

TWO-SIDED BALANCE SHEET OPTIMIZATION: P&C INDUSTRY AND PRIVATE AUTO SEGMENT

SAA Methodology & Key Results

- NB runs portfolio optimization for P&C Industry and Private Auto Segment

Methodology

- NB constructs a simplified balance sheet model to study the impacts of investment return, underwriting return and leverage on ROE
- On the investment side, two representative asset classes are modeled: equities (proxied by S&P 500) and fixed income (proxied by Barclay Agg index)
- Underwriting is modeled like an asset class (more details on next page) for optimization purpose
- Optimization process
 - For a fixed leverage size, NB constructs the investment portfolios to minimize ROE volatility across a range of ROE targets using optimization; allocation to equities is capped at 30%
 - NB runs optimization for a range of leverage sizes (from 1 to 3.5 with step size 0.06) and obtains a series of efficient frontiers
 - For each ROE target, a minimal portfolio selected from the series of efficient frontiers
 - The ultimate efficient frontier is constructed using the ROE targets and minimized volatility for each target

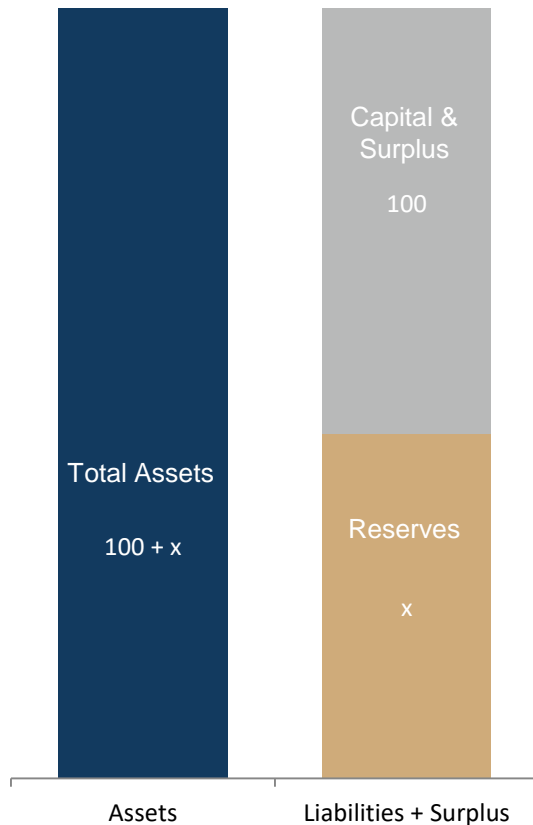
Key Results

- NB constructs the efficient frontier for both the P&C Industry and Private Auto Segment
- ROE increase with higher leverage and equity allocation and so are its volatility in both cases
- Larger leverage is preferred over higher equity ratio when the underwriting volatility is small
- On each efficient frontier, NB highlights four model portfolios, which have ROE of 6%, 8%, 10% and 12%
- ROE volatility increases faster than ROE; the ROE / volatility ratio drops as ROE increases

Estimated returns and estimated volatility (risk) shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. Past performance is no guarantee of future results. See Additional Disclosures at the end of this presentation, which are an important part of this presentation.

SAA Methodology Details

Hypothetical Statutory Balance Sheet



Definitions

- $\text{Leverage} = \text{Total Assets} / \text{Capital \& Surplus}$
- $\text{Net Income} = \text{Total Assets} * \text{Investment Return} + \text{Reserves} * \text{Underwriting Return}$
 - Implicit in this definition of net income is a simplifying assumption that reserves are equal to premiums written in the current year—in other words, no liabilities have a tail longer than 1 year
- $\text{ROE} = \text{Net Income} / \text{Capital \& Surplus}$

Underwriting modeling

- Modeled return: exponential moving average (EWMA) of historical (1 – combined ratio)
- Volatility:
 - volatility for each company's historical underwriting return; data horizon 1996 - 2018
 - average over all companies
- Correlations with assets: calculated using the historical combined ratio of the segment; data horizon: 1996-2018

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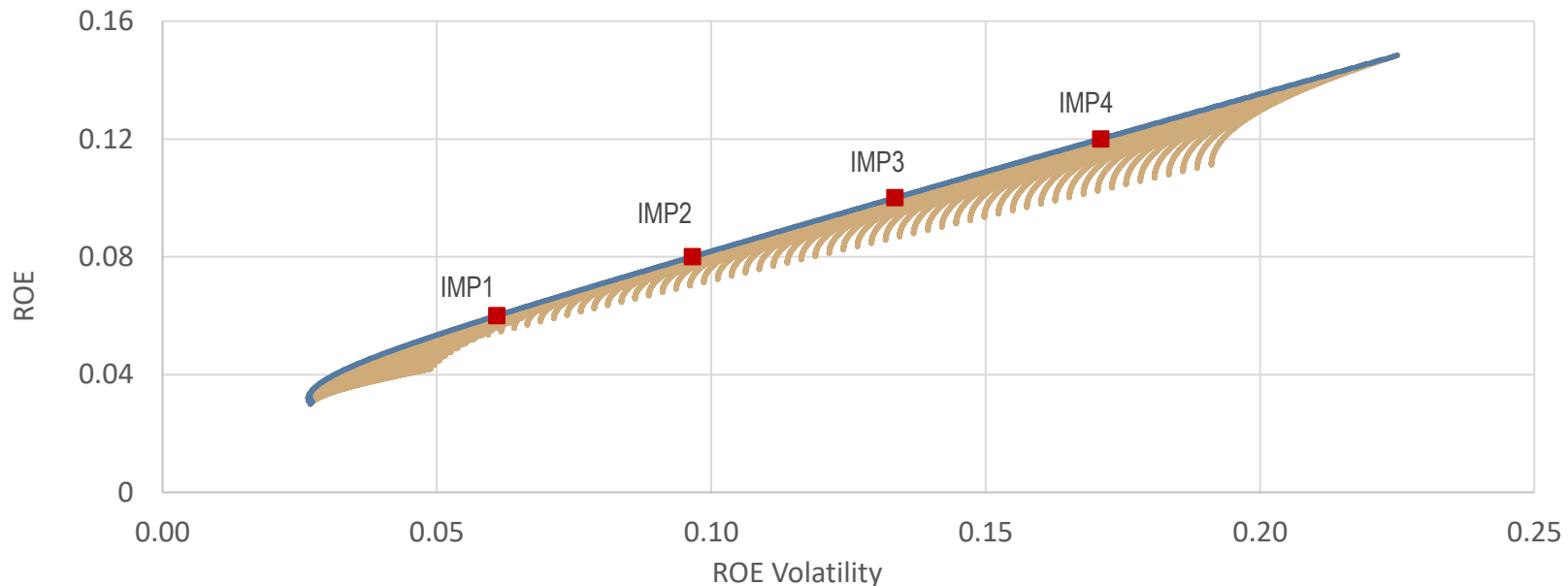
Efficient Frontiers: P&C Industry

ROE vs ROE Volatility

	IMP1	IMP2	IMP3	IMP4
Equity	16%	24%	27%	29%
Bond	84%	76%	73%	71%
Leverage	1.63	2.00	2.40	2.83
ROE	6.0%	8.0%	10.0%	12.0%
ROE Volatility	6.1%	9.7%	13.3%	17.1%
ROE/Vol	98%	83%	75%	70%

Underwriting Business	P&C Industry
Modeled Return¹ (%)	0.12
Return Vol¹ (%)	8.76

Efficient Frontiers



1. 23 years historical data are used. Exponential weighted moving average method is applied and half life is 5 years. Estimated returns and estimated volatility (risk) shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. Past performance is no guarantee of future results. See Additional Disclosures at the end of this presentation, which are an important part of this presentation.

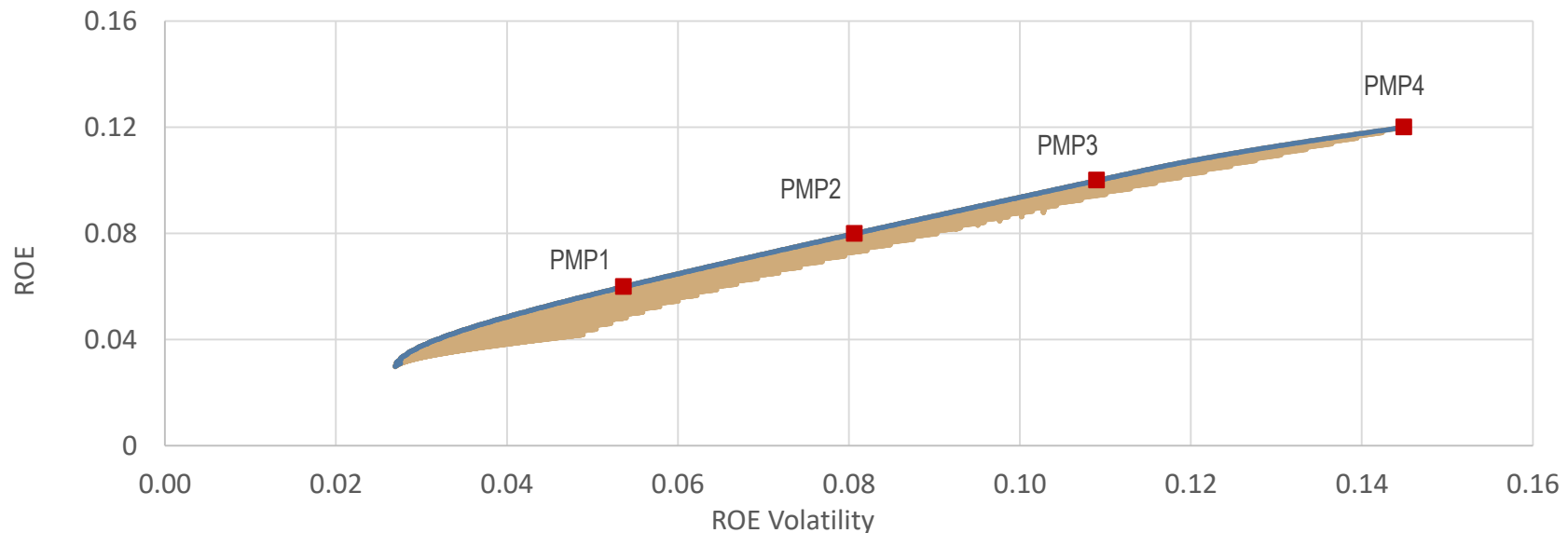
Efficient Frontiers: Private Auto Segment

ROE vs ROE Volatility

	PMP1	PMP2	PMP3	PMP4
Equity	13%	16%	18%	30%
Bond	87%	84%	82%	70%
Leverage	2.00	2.67	3.33	3.47
ROE	6.0%	8.0%	10.0%	12.0%
ROE Volatility	5.4%	8.1%	10.9%	14.5%
ROE/Vol	112%	99%	92%	83%

Underwriting Business	Private Auto
Modeled Return¹ (%)	-1.02
Return Vol¹ (%)	4.97

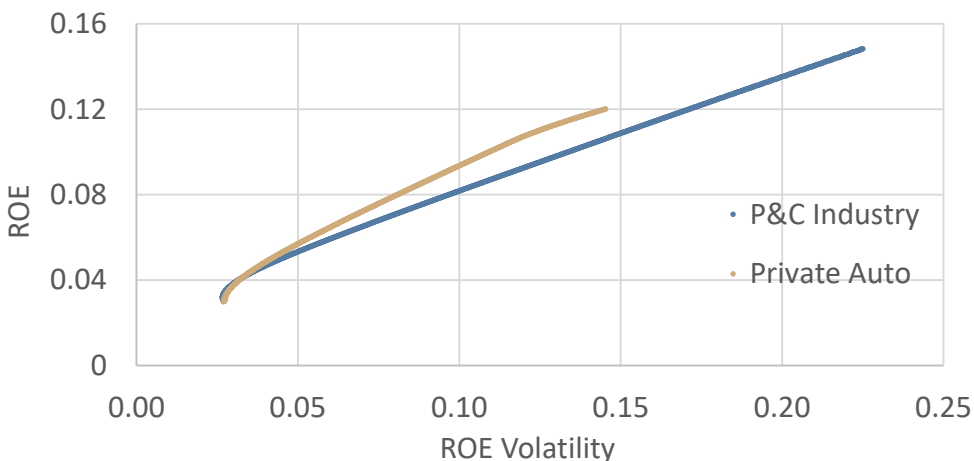
Efficient Frontiers



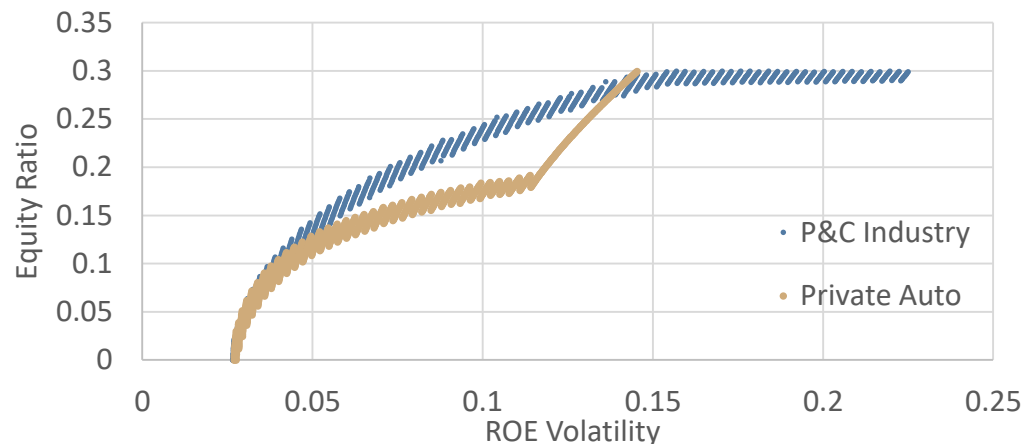
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Efficient Frontiers: P&C Industry vs. Private Auto Segment

Efficient Frontiers

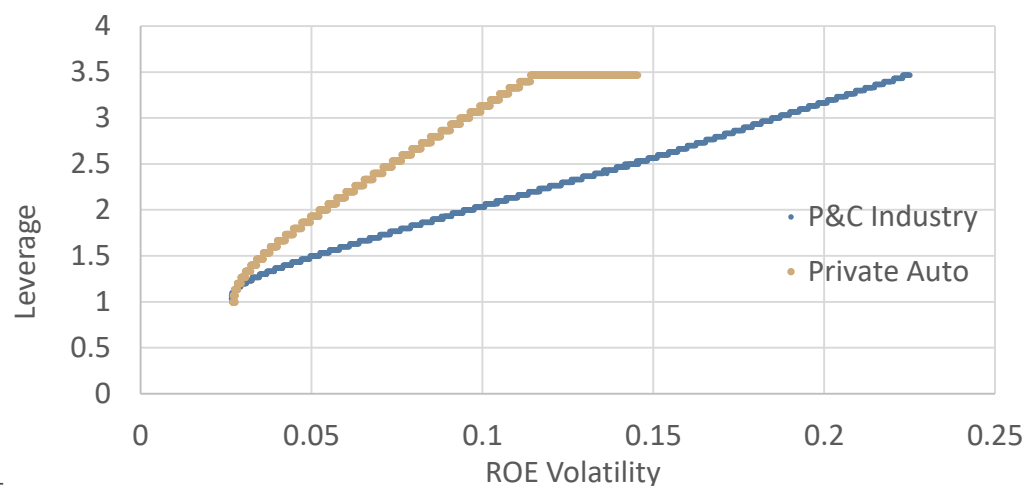


Equity Ratio vs. ROE Volatility



Underwriting Business	Modeled Return ¹ (%)	Return Vol ¹ (%)
P&C Industry	0.12	8.76
Private Auto Segment	-1.02	4.97

Leverage vs. ROE Volatility



- Balance sheet should be levered before adding risk to the investment portfolio when underwriting volatility is small
- Risk should be added to the investment portfolio before the balance sheet is levered when underwriting volatility is large

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Asset Class Assumptions & Correlation Matrix, as of 2019-04-30

Asset Class Assumptions

Asset Class	Index Source	Modeled Return ¹ (%)	Return Vol ² (%)
Equity	S&P 500	7.00	13.3
Bond	Bloomberg-Barclays	2.97	2.7
P&C Industry	SNL Financial	0.12	8.76
Private Auto Segment	SNL Financial	-1.02	4.97

Correlation Matrix

	Equity	Bond	P&C Industry	Private Auto
Equity	1.00			
Bond	-0.12	1.00		
P&C Industry	0.15	-0.38	1.00	
Private Auto	0.25	0.26	-0.28	1.00

1. Modeled return is defined as market yield to worst of public indices adjusted for expected default costs for fixed income assets and intermediate-term (5-7 year) Modeled returns for equity and alternative assets

2. 23 years historical data are used for volatility calculation. Exponential weighted moving average method is applied and half life is 5 years

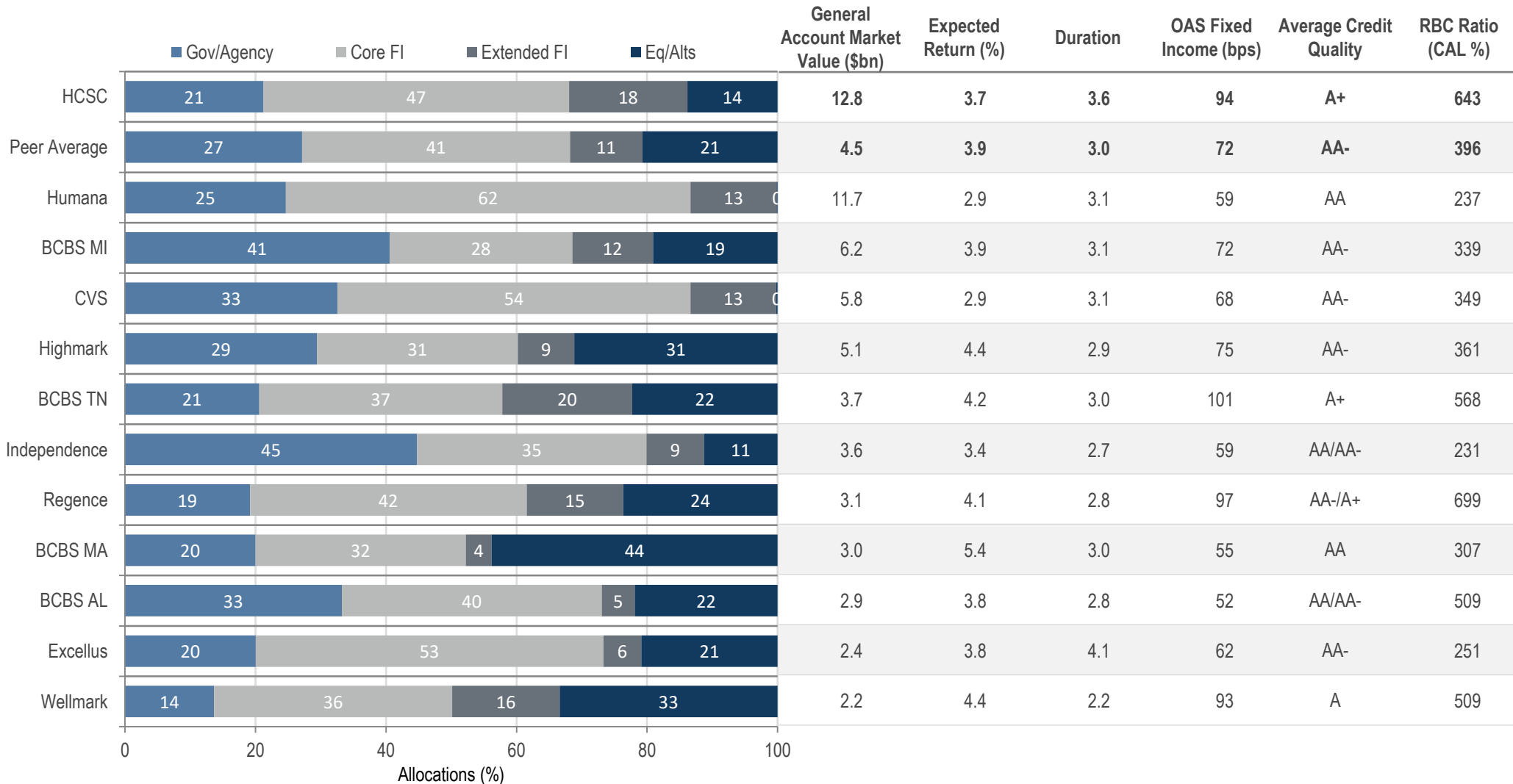
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PEER ANALYSIS CASE STUDY



Peer Summary

HCSC has more extended fixed income and less equities and alternatives compared with its peer group

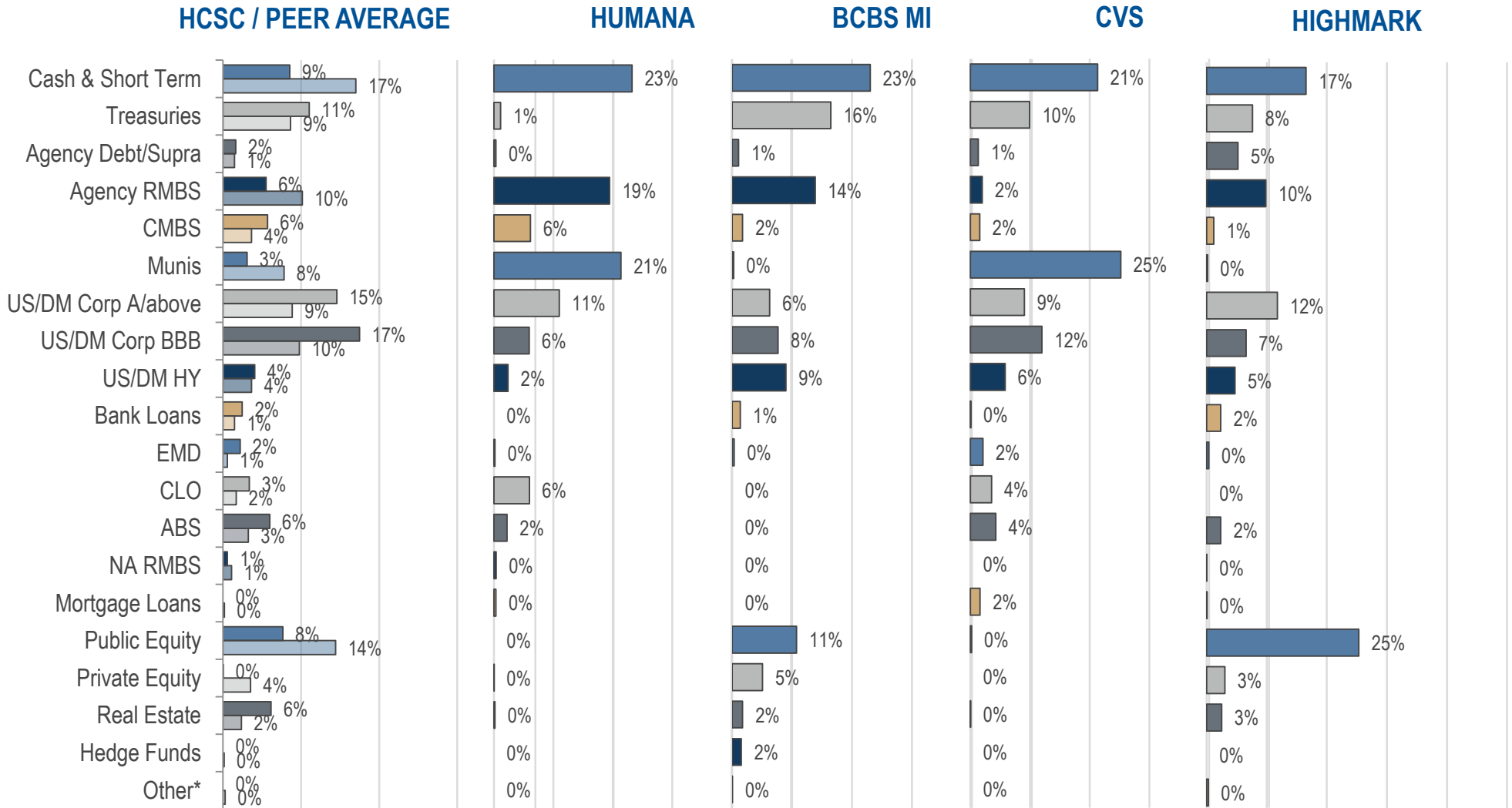


Gov/Agency: Treasuries, Agency Debt; **Core FI:** IG Corp, Munis, ABS, CMLs, Agency MBS, CMBS; **Extended FI:** HY, EMD, CLOs, NARMBS, Bank Loans; **Eq/Alts:** Equity, Private Equity, Private Debt, Real Estate, Hedge Funds, LIHTC

Sources: SNL, Bloomberg–Barclays POINT, FactSet. Expected returns are calculated using market yields for fixed income assets and NB intermediate-term capital market assumptions for equity/alts. Derivatives are excluded from this analysis. Tax-exempt municipal analytics are based off of a AAA GO municipal curve. Asset holdings are as of 2018-12-31. Analytics are as of 2019-04-30. This material is provided for informational purposes only. Views expressed herein are as of the date indicated and subject to change. Nothing herein constitutes a prediction or projection of future events or future market behavior. Due to a variety of factors, actual events or market behavior may differ significantly from any views expressed. Please see Additional Disclosures at the end of the presentation.

Detailed Company Allocation, 2018

Part 1



*Other includes Collateral Loans, FHLB stock, and LIHTC

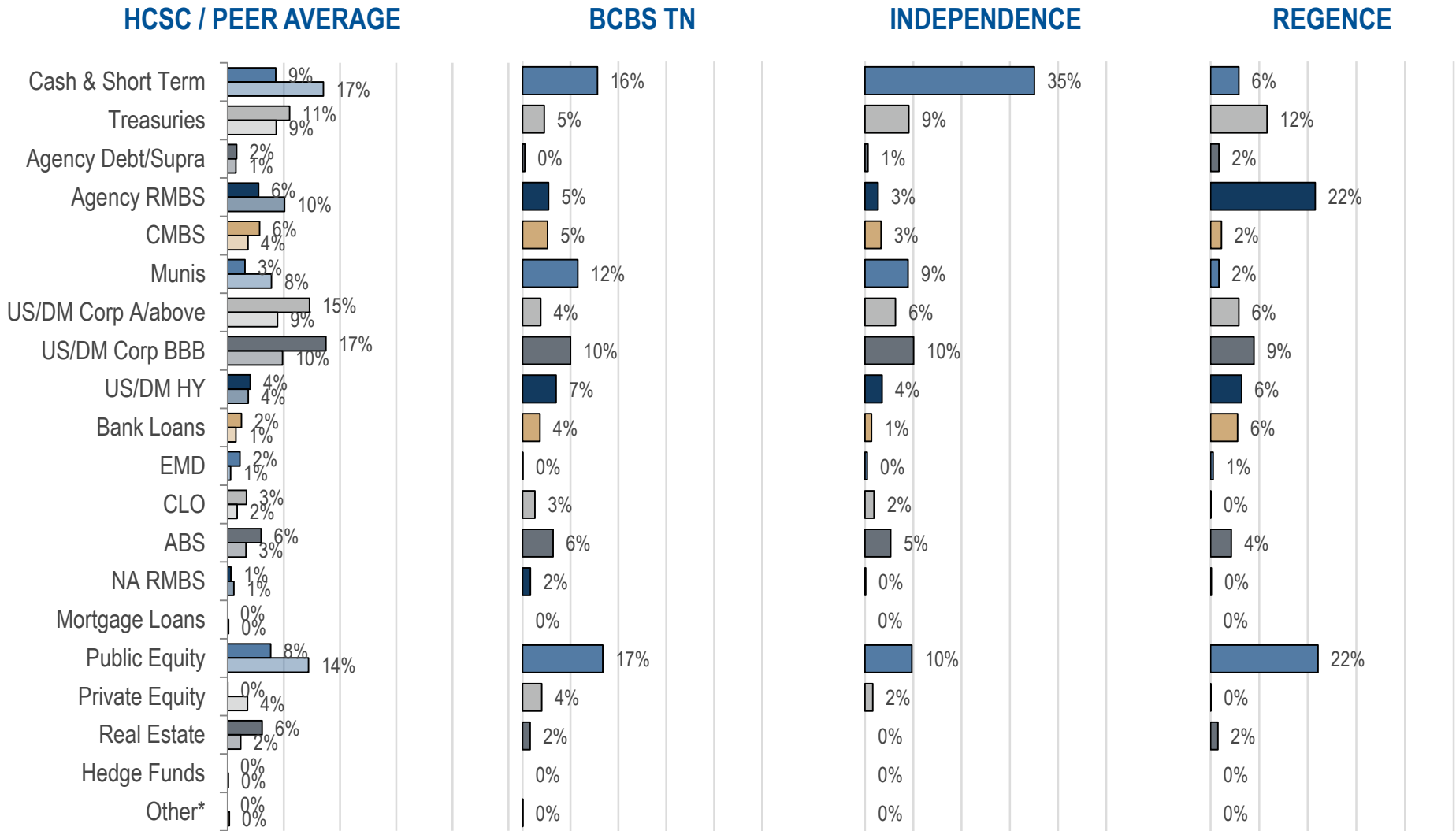
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Detailed Company Allocation, 2018

Part 2



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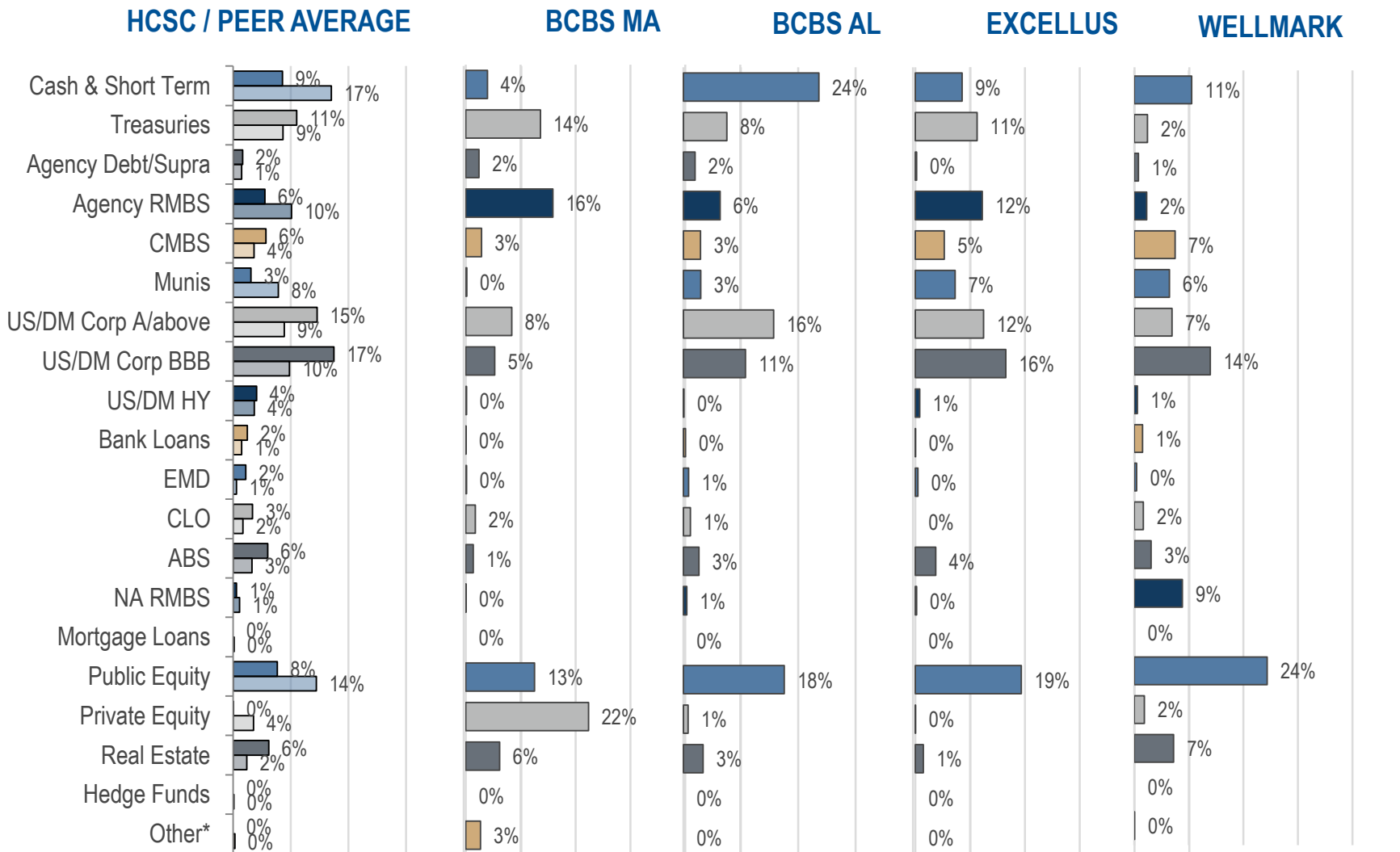
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Detailed Company Allocation, 2018

Part 3



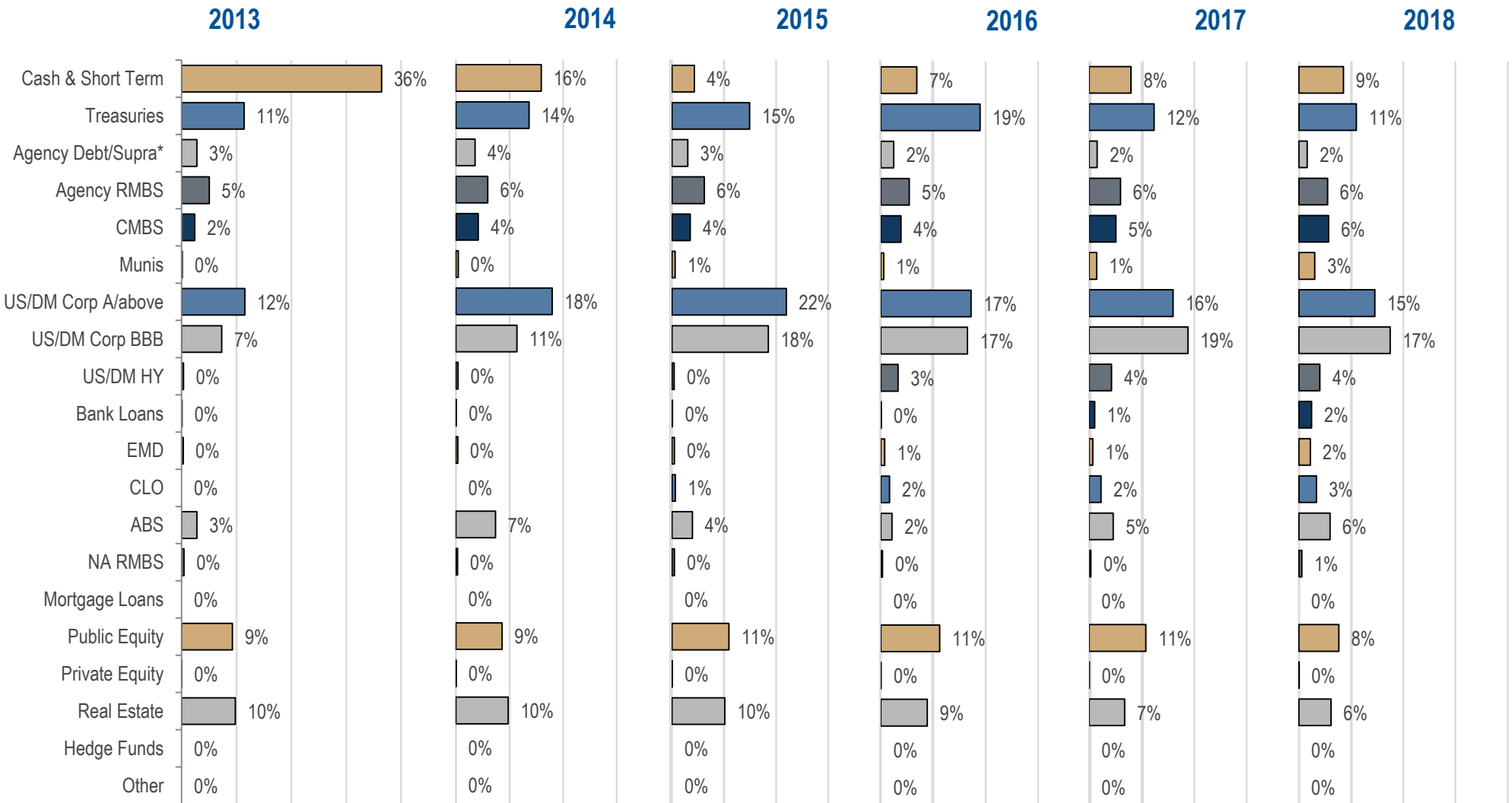
Sources: SNL, Bloomberg-Barclays POINT, FactSet. Asset holdings are as of 2018-12-31. Analytics are as of 2019-04-30.

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Due to a variety of factors, actual events or market behavior may differ significantly from any views expressed. Please see Additional Disclosures at the end of the presentation

*Other includes Collateral Loans, FHLB stock, and LIHTC

Detailed Allocation for HCSC, 2013 - 2018



Sources: SNL, Bloomberg-Barclays POINT, FactSet. Asset holdings are as of 2018-12-31. Analytics are as of 2019-04-30.

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*Other includes Collateral Loans, FHLB stock, and LIHTC

STRATEGIC ASSET ALLOCATION CASE STUDY

Objectives & Constraints

- Neuberger Berman (“NB”) performs strategic asset allocation (“SAA”) analysis on HCSC’s general account portfolio
- NB analyzes HCSC current asset allocation and produces a series of optimized model portfolios at varying levels of risk and return
- To perform SAA, NB runs portfolio optimization according to the parameters below:

Objectives

- Surplus volatility is minimized across a range of expected return targets based on the current portfolio assets and as defined below:
 - Expected return is defined as market yield to worst of public indices adjusted for expected default costs for fixed income assets and intermediate-term (5-7 year) expected returns for equity and alternative assets
 - Surplus volatility is defined as the volatility of assets minus liabilities, where liabilities are represented using the LRP
- The resulting portfolios seek to improve HCSC’s risk-adjusted returns

Key Constraints

Overall constraints:

- Income is floored at current level
- Income volatility is capped at current level 0.2%, 0.4% and 0.6% under the three optimizations, respectively
- Duration gap between assets and liability is capped at current level

Asset class constraints:

- Cash and short-term is kept at current level
- EMD and CLO are both capped at 5%
- Total risk assets allocation capped at 20%
- Taxable muni is capped at 5% given market availability
- Private debt is capped at 10%

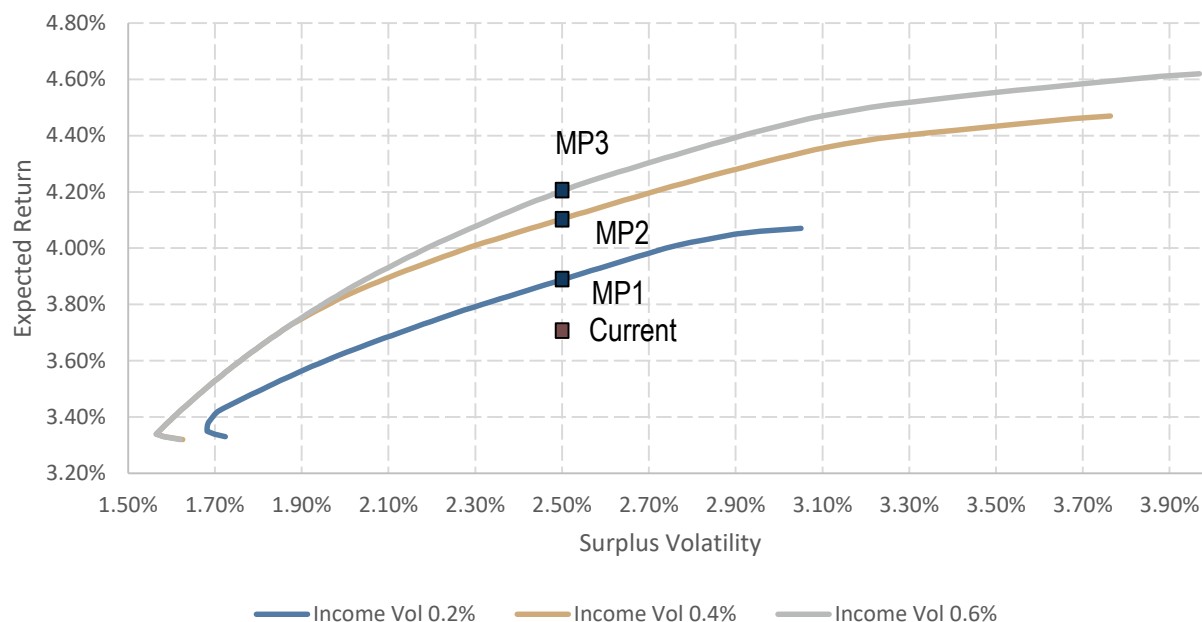
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HCSC Efficient Frontiers

	Expected Return	Surplus Volatility	Asset Volatility	Asset Duration	Surplus Duration	Spread Duration	Income	Income Volatility	Risk Assets	Asset Allocation (%)
Current	3.7%	2.5%	2.7%	3.8	3.0	3.6	3.3%	0.2%	16.8%	83 Core FI, 8 Opp FI, 9 Equity & Alts
MP1	3.9%	2.5%	2.7%	3.6	2.7	3.7	3.5%	0.2%	17.6%	80 Core FI, 12 Opp FI, 8 Equity & Alts
MP2	4.1%	2.5%	2.6%	3.7	2.9	3.8	3.9%	0.4%	20.0%	79 Core FI, 12 Opp FI, 9 Equity & Alts
MP3	4.2%	2.5%	2.7%	3.6	2.8	3.1	4.1%	0.6%	20.0%	79 Core FI, 6 Opp FI, 14 Equity & Alts

■ Core FI ■ Opp FI ■ Equity & Alts



Definitions

- **Income** is defined as default adjusted yield to worst for fixed income, dividend for public equity and expected returns for alternatives, assuming fixed income and public equity are AFS and alternatives are held as trading
- **Risk Assets** include: equities, alternatives, US HY, bank loans, CLO HY, EMD HY

Estimated returns and estimated volatility (risk) shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. Past performance is no guarantee of future results. See Additional Disclosures at the end of this presentation, which are an important part of this presentation. Nothing herein constitutes investment advice; the information should not be construed as a recommendation for any investment strategy or for the purchase or sale of any security.

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HCSC Asset Allocation (%)

Asset Class (%)	Current	MP1	MP2	MP3
Cash & Short Term	10%	10%	10%	10%
US Gov/Agency	9%	1%	3%	8%
Agency RMBS	8%	10%	10%	10%
Taxable Munis	3%	5%	5%	5%
US Corp A+	20%	15%	14%	13%
US Corp BBB	15%	23%	21%	20%
ABS	6%	10%	10%	10%
CMBS	8%	3%	3%	0%
CLO IG	3%	2%	3%	3%
Core Fixed Income	83%	80%	79%	79%
CLO HY	0%	2%	2%	2%
EMD	2%	5%	3%	2%
US HY	4%	3%	1%	0%
Bank Loans	2%	1%	5%	2%
Opportunistic Fixed Income	8%	12%	12%	6%
Private Debt	0%	0%	6%	10%
Public Equity	7%	5%	1%	0%
Private Equity	2%	2%	2%	4%
Hedge Funds	0%	0%	0%	0%
Real Estate	0%	0%	0%	0%
Equity & Alternatives	9%	8%	9%	14%
Expected Return	3.7%	3.9%	4.1%	4.2%
Surplus Volatility	2.5%	2.5%	2.5%	2.5%
Asset Volatility	2.7%	2.7%	2.6%	2.7%
Asset Duration	3.8	3.6	3.7	3.6
Surplus Duration	3.0	2.7	2.9	2.8
Income Return	3.3%	3.5%	3.9%	4.1%
Income Volatility	0.2%	0.2%	0.4%	0.6%
Risk Assets	16.8%	17.6%	20.0%	20.0%

Asset Class (%)	Current	ΔMP1	ΔMP2	ΔMP3
Cash & Short Term	10%	0%	0%	0%
US Gov/Agency	9%	-8%	-6%	-1%
Agency RMBS	8%	2%	2%	2%
Taxable Munis	3%	2%	2%	2%
US Corp A+	20%	-4%	-6%	-6%
US Corp BBB	15%	8%	6%	5%
ABS	6%	4%	4%	4%
CMBS	8%	-5%	-5%	-8%
CLO IG	3%	-1%	-1%	-1%
Core Fixed Income	83%	-2%	-4%	-3%
CLO HY	0%	2%	2%	2%
EMD	2%	3%	1%	0%
US HY	4%	-1%	-3%	-4%
Bank Loans	2%	-1%	3%	0%
Opportunistic Fixed Income	8%	4%	4%	-2%
Private Debt	0%	0%	6%	10%
Public Equity	7%	-2%	-6%	-7%
Private Equity	2%	0%	0%	2%
Hedge Funds	0%	0%	0%	0%
Real Estate	0%	0%	0%	0%
Equity & Alternatives	9%	-2%	0%	5%
Expected Return	3.7%	0.2%	0.4%	0.5%
Surplus Volatility	2.5%	2.5%	2.5%	2.5%
Asset Volatility	2.7%	2.7%	2.6%	2.7%
Asset Duration	3.8	3.6	3.7	3.6
Surplus Duration	3.0	2.7	2.9	2.8
Income Return	3.3%	3.5%	3.9%	4.1%
Income Volatility	0.2%	0.2%	0.4%	0.6%
Risk Assets	16.8%	17.6%	20.0%	20.0%

Estimated returns and estimated volatility (risk) shown are hypothetical and are for illustrative and discussion purposes only. They are not intended to represent, and should not be construed to represent, predictions of future rates of return or volatility. Actual returns and volatility may vary significantly. Unlike actual investment performance, hypothetical model results do not represent actual trading and accordingly they may not reflect the impact that material economic and market factors might have had on decision making if assets were actually managed during the relevant period. Investing entails risks, including possible loss of principal. Indexes are unmanaged and are not available for direct investment. Past performance is no guarantee of future results. See Additional Disclosures at the end of this presentation, which are an important part of this presentation. Nothing herein constitutes investment advice; the information should not be construed as a recommendation for any investment strategy or for the purchase or sale of any security.

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Tail Risk Analysis Through Monte Carlo Simulation

10,000 simulations of the portfolio market value change after one year

Distribution of changes to portfolio value after 1 year (by percentile)

Percentile	Current	MP1	MP2	MP3
90th	10.4%	10.5%	10.8%	10.8%
75th	7.2%	7.3%	7.5%	7.5%
50th	3.8%	4.1%	4.3%	4.4%
25th	0.4%	0.7%	0.8%	1.0%
10th	-3.2%	-2.9%	-2.7%	-2.5%
Mean	3.7%	3.9%	4.1%	4.2%

Distribution of changes to portfolio value after 1 year (by CVaR)

CVaR / P(X<x)	Current	MP1	MP2	MP3
95% VaR	-5.7%	-5.3%	-5.1%	-4.9%
95% CVaR	-9.1%	-8.7%	-8.6%	-8.2%
P(<0%)	23.1%	21.6%	20.6%	19.7%

Methodology & Observations

- Run 10,000 simulations on the portfolio value considering the correlations among underlying assets and assigning fat-tailed marginal distributions, fitting the third and fourth moments to historical data
- All MPs have lower modeled tail risk than the current portfolio

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STRATEGIC ASSET ALLOCATION CASE STUDY

Asset Class Assumptions, as of 2019-03-31

Asset Class	Index Name	Index Source	Exp. Return ¹	OAS	OASD	OAD	Income	Income Vol ²	Return Vol ³
Cash & Short Term - USD	Treasury 3M	Bloomberg-Barclays	2.4%	0	0.0	0.3	2.4	0.0%	0.3%
Treasuries 1-5 yrs	US Treasury 1-5 yrs	Bloomberg-Barclays	2.3%	0	0.0	2.7	2.3	0.0%	1.4%
Treasuries 5-10 yrs	US Treasury 5-10 yrs	Bloomberg-Barclays	2.4%	0	0.0	6.4	2.3	0.0%	4.2%
Treasuries 10-20 yrs	US Treasury 10-20 yrs	Bloomberg-Barclays	2.8%	0	0.0	11.8	2.5	0.0%	6.6%
Treasuries 20-30 yrs	US Treasury 20-30 yrs	Bloomberg-Barclays	3.5%	0	0.0	18.1	2.8	0.0%	10.7%
Treasury TIPS	US Treasury TIPS	Bloomberg-Barclays	2.7%	0	0.0	7.5	2.6	0.0%	3.7%
US Agencies 1-10 yrs	US Agencies 1-10 yrs	Bloomberg-Barclays	2.7%	36	3.1	3.1	2.7	0.0%	1.6%
US Agencies 10+ yrs	US Agencies 10+ yrs	Bloomberg-Barclays	4.4%	161	11.4	11.5	4.1	0.0%	7.3%
Agency RMBS	US MBS	Bloomberg-Barclays	3.1%	35	4.8	4.0	3.1	0.0%	2.4%
Muni Taxable	Taxable Municipal Index	Bloomberg-Barclays	3.6%	150	8.4	9.0	3.5	0.0%	4.8%
US Corp A/above 1-5 yrs	US Credit Corp 1-5 yrs A above	Bloomberg-Barclays	2.7%	49	2.7	2.7	2.7	0.0%	1.6%
US Corp A/above 5-10 yrs	US Credit Corp 5-10 yrs A above	Bloomberg-Barclays	3.3%	91	6.4	6.3	3.2	0.0%	4.0%
US Corp A/above 10-20 yrs	US Credit Corp 10-20 yrs A above	Bloomberg-Barclays	4.0%	137	11.3	11.4	3.8	0.0%	6.1%
US Corp A/above 20+ yrs	US Credit Corp 20+ yrs A above	Bloomberg-Barclays	4.3%	122	15.5	16.0	3.9	0.0%	8.1%
US Corp BBB 1-5 yrs	US Credit Corp 1-5 yrs BBB	Bloomberg-Barclays	3.1%	93	2.8	2.8	3.1	0.0%	1.9%
US Corp BBB 5-10 yrs	US Credit Corp 5-10 yrs BBB	Bloomberg-Barclays	3.8%	152	6.2	6.2	3.7	0.0%	4.1%
US Corp BBB 10-20 yrs	US Credit Corp 10-20 yrs BBB	Bloomberg-Barclays	4.8%	223	10.4	10.4	4.6	0.0%	6.1%
US Corp BBB 20+ yrs	US Credit Corp 20+ yrs BBB	Bloomberg-Barclays	5.1%	210	14.3	14.7	4.7	0.0%	8.5%
ABS	US ABS	Bloomberg-Barclays	2.7%	39	2.2	2.2	2.7	0.0%	1.4%
CMBS	US CMBS	Bloomberg-Barclays	3.2%	78	5.2	5.2	3.1	0.0%	3.1%
EMD ⁴	Customized	JPM / Neuberger Berman	5.0%	331	5.8	5.6	4.7	0.0%	6.5%
CLO AAA	CLO AAA	JPM CLOIE	3.9%	129	5.0	0.3	3.9	1.1%	1.1%
CLO AA	CLO AA	JPM CLOIE	4.5%	185	5.0	0.3	4.5	1.1%	2.2%
CLO A	CLO A	JPM CLOIE	5.3%	250	5.0	0.3	5.1	1.1%	3.6%
CLO BBB	CLO BBB	JPM CLOIE	6.5%	355	5.0	0.3	6.0	1.1%	6.2%
CLO BB	CLO BB	JPM CLOIE	10.5%	678	5.0	0.3	9.2	1.1%	10.0%
US HY BB&B	US HY BB&B	Bloomberg-Barclays	4.5%	306	3.5	3.5	4.3	0.0%	5.1%
US HY CCC	US HY CCC	Bloomberg-Barclays	7.5%	802	3.1	3.1	6.9	0.0%	8.9%
Bank Loans	S&P/LSTA LL 100	S&P Global	5.6%	382	3.5	0.3	5.4	1.1%	4.3%
Private Debt	US HY CCC	Bloomberg-Barclays	8.7%	802	3.1	3.1	8.7	3.1%	8.9%
US Equity	S&P 500 Index	FactSet	7.0%	NA	NA	NA	1.9	0.2%	12.2%
Real Estate	NCREIF ODCE Index	NCREIF	6.2%	NA	NA	NA	6.2	3.8%	9.6%
Private Equity	Private Equity	Cambridge Associates	10.8%	NA	NA	NA	10.8	5.6%	16.9%
Hedge Funds	HFRI Fund Weighted Composite Index	HFRI	4.6%	NA	NA	NA	4.6	4.6%	4.6%

Source: NB Insurance Analytics, Bloomberg-Barclays, Cambridge Associates, FactSet, SNL; Analytics are as of 2019-03-31

Expected return is defined as market yield to worst of public indices adjusted for expected default costs for fixed income assets and intermediate-term (5-7 year) expected returns for equity and alternative assets

Income volatility is 0 for fixed coupon fixed income asset classes, LIBOR 3M yield volatility for floating rate fixed income, and statutory return volatility for alternatives, and dividend volatility for public equity

10 year historical data are used for volatility calculation. Exponential weighted moving average method is applied and half life is 2 years.

EMD benchmark is customized based on the allocation weights of the HCSC EMD portfolio as of 3/31/2019 using the CEMBI and EMBI indices

DISCLOSURES



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Gross returns do not reflect the deduction of advisory fees and other expenses, which will reduce returns. Investment advisory fees have a compounding effect on cumulative results. For example, assume Neuberger Berman achieves a 10% annual return prior to the deduction of fees each year for a period of ten years. If an annual advisory fee of 1.00% of assets under management for the ten-year period were charged, the resulting annual average return after fees would be reduced to 8.90%. Performance results will vary based upon the period measured. Additional information regarding fees can be found in Neuberger Berman's Form ADV, Part 2, which is available upon request.

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Additional Disclosures

Neuberger Berman Fixed Income Sector Views

Neuberger Berman investment views are formulated by our specialty fixed income teams. For a variety of fixed income sectors we identify a range of outcomes that either may occur or alternatively be anticipated and then priced into the market. For each sector we formulate an investment view based on proprietary fundamental research and quantitative analysis which are used to project estimated returns and a confidence level of the return estimation. Each sector team will establish an independent view based on internal research, and a level of confidence in the outlook. The sector view is formulated by identifying various states of the economy and market (i.e. outcomes) estimation typically over a 12-month horizon. Each state or outcome is probability weighted to determine the overall sector view. The reassessment of sector views is ongoing and formally updated at least monthly.

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