



# Portfolio Investment Risk: A Primer

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## The Investment Task

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- Purpose of the Investment
- Choice of asset classes & asset allocation
  - Equities
  - Fixed Income (Bonds, other debt instruments)
  - Private Equity
  - Private Real Estate
  - Private Natural Resources
  - Commodities
- Risk Tolerance
- Within each asset class, what factors do you want the portfolio to satisfy
  - Example:
    - Large Cap Growth
      - Strength of larger organizations (lower firm-specific risk, deeper resources)
      - Return dominated by share price appreciation
- Hire investment managers to meet the objectives
  - Active manager-offers return greater than the market in general
    - Higher fees
  - Passive manager-offers return comparable to market
    - Lower fees

## What is Investment Risk?

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What is risk?

- Not all or nothing
- Variability of return
- Probability that the investment choice will achieve a stated return
- Based on history of returns of the investment
- Statistics analogy
  - Return is the mean of the series
  - Variability (standard deviation) around that mean
- Correlation-Threat to Diversification

# Types of Risk

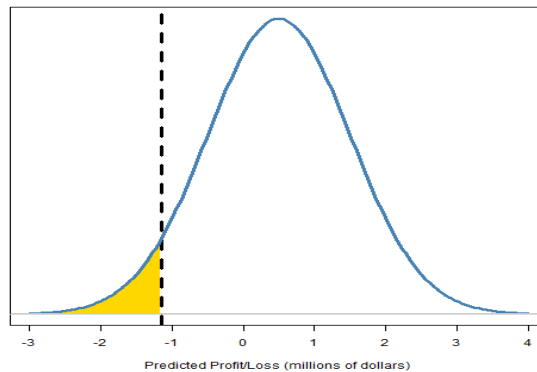
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- Types of risk
  - Portfolio Risk
    - How volatile is the expected return based upon the historical performance of the investment?
    - Given a return, how stable/reliable is that return
    - Relationship between return and risk
      - Return relationship with variability of return, a different look at return and risk
      - Equities at 7% have higher return, expect higher volatility
      - Bonds at 3% lower return, but have lower volatility
  - Active Risk or Tracking Error
    - Iceberg analogy-Knowing the what vs. the why
    - Manager proposes to follow or to exceed the market performance
      - Applies to both Active and Passive managers
    - Variability: Will return will deviate from benchmark?
    - To what degree does the manager keep the promise
    - Statistics analogy
      - The variance around a difference of means

## Types of Risk (cont.)

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- Value at Risk
  - Value at Risk shows, at a “95% confidence level, the probability that the asset class will not lose more than the specified asset dollar amount, or percentage of the assets”
  - Risk of Loss-One Tailed Risk



- Stand-alone risk vs Contribution to Aggregate Risk
- Role of Relative Weights-Warning Signs
  - Portfolio Weight
  - Policy Weight
  - Desired Weight
  - Benchmark Weight

## Characteristics of Risk

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- Characteristics of Risk of the Asset Class, Sub-Class, Manager
  - Equity Type
    - Industry Risk-Nature of the the market in which an investment operates
    - Style Risk-Nature of the business of the investment
      - Growth (price appreciation)
      - Value (price appreciation and dividend income)
      - Momentum
  - Fixed Income Type
    - Terms
      - Duration to maturity
      - How interest is paid
    - Spread Curve
  - Currency risk (exchange risk)
  - Selection Risk
  - Asset Specific (idiosyncratic risk, remainder)

# Examples

# Risk Summary

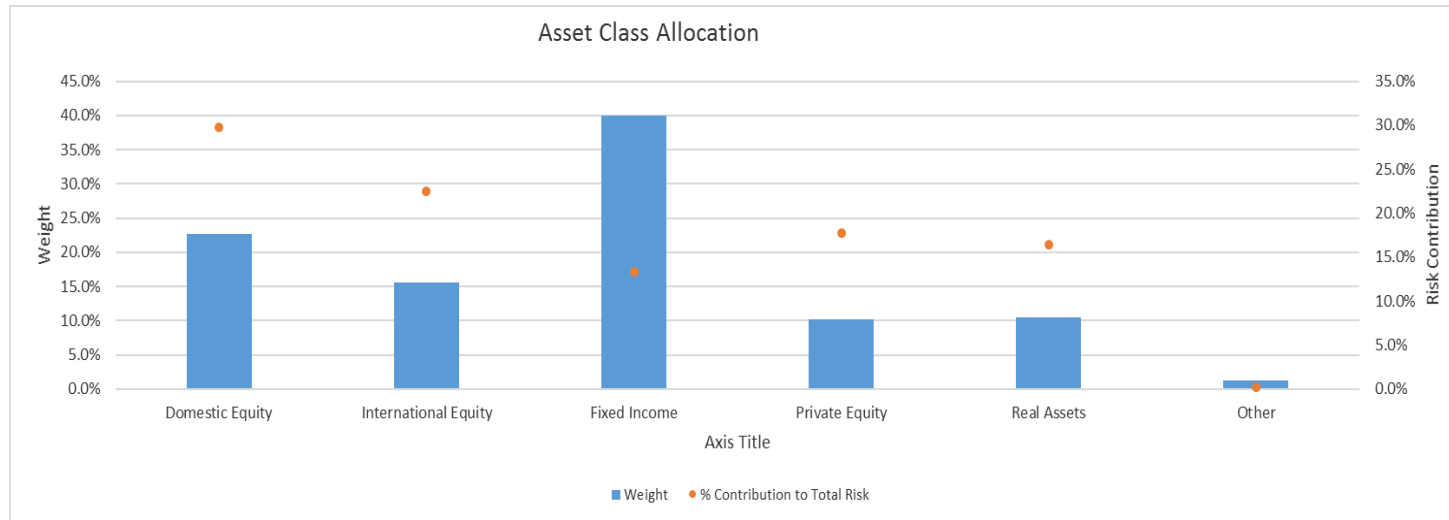
## Asset Class Contribution to Risk

Asset Class	Market Value (thous.)	Weight	Policy Weight	Over+/Under- Weight (%)	Total Risk	Risk Contribution	Percent Contribution to Total Risk	Active Total Risk	%CR to Total Tracking Error
Domestic Equity	\$ 9,945	22.67%	25.00%	-2.33%	11.23	2.20	29.78%	6.18	26.35%
International Equity	\$ 6,829	15.57%	15.00%	0.57%	12.96	1.66	22.46%	8.05	3.13%
Fixed Income	\$ 17,520	39.94%	40.00%	-0.06%	7.71	0.98	13.33%	8.76	2.46%
Private Equity	\$ 4,470	10.19%	11.00%	-0.81%	15.26	1.31	17.77%	10.32	51.32%
Real Assets	\$ 4,582	10.45%	9.00%	1.45%	13.17	1.21	16.41%	7.65	15.45%
Other	\$ 524	1.20%	0.00%	1.20%	2.95	0.02	0.24%	6.55	1.28%
<b>Total Assets</b>	<b>\$ 43,871</b>	<b>100.00%</b>	<b>100.00%</b>	<b>0.00%</b>	<b>7.39</b>	<b>7.39</b>	<b>100.00%</b>	<b>1.02</b>	<b>100.00%</b>

- Portfolio risk
- Relative weights
- Active risk/tracking error



# Allocation vs. Contribution to Total Risk



- Equal weight and contribution to risk?
- Mix of allocation and risk contribution

## Decomposition of Risk

### Risk Decomposition

Risk Source	Portfolio Risk		Active Risk	
	Risk Contribution	% Portfolio Risk	Active Portfolio Risk Contribution	% Active Risk
Total Risk	7.39	100.00%	1.02	100.00%
Local Market Risk	7.08	95.85%	1.01	99.49%
Common Factor Risk	7.06	95.54%	0.88	86.89%
Equity	6.15	83.25%	0.90	88.35%
Industry	5.73	77.59%	0.22	21.79%
Style	0.35	4.74%	0.67	66.45%
Emerging Market	0.07	0.92%	0.00	0.11%
Fixed Income	0.91	12.29%	-0.01	-1.47%
Term Structure	0.41	5.58%	-0.02	-2.17%
Spread	0.50	6.71%	0.01	0.70%
Hedge Fund	0.00	0.00%	0.00	0.01%
Selection Risk	0.02	0.31%	0.13	12.60%
Currency Risk	0.31	4.15%	0.01	0.51%

- Where is the risk?
- Cascading breakdown of the risk
- Where is the tracking error?
- Comparison to benchmark profile (manager following stated objective)

## Pension Summary Value at Risk by Asset Class

Value at Risk					
Asset Class	Market Value (thous.)	Total Risk	Value-At-Risk(\$)	Value-At-Risk(%)	
Domestic Equity	\$ 9,945	11.23	\$ 1,838	18.48%	
International Equity	\$ 6,829	12.96	\$ 1,455	21.31%	
Fixed Income	\$ 17,520	7.71	\$ 2,223	12.69%	
Private Equity	\$ 4,470	15.26	\$ 1,122	25.10%	
Real Assets	\$ 4,582	13.17	\$ 993	21.66%	
Other	\$ 524	2.95	\$ 25	4.85%	
<b>Total Assets</b>	<b>\$ 43,871</b>	<b>7.39</b>	<b>\$ 5,331</b>	<b>12.15%</b>	

- Asset class-specific variance
- How variability can drive impact
- These are strand-alone and not necessarily contribution measures

## Summary Contribution to Total Risk by Top Ten Countries

Top Ten Countries by Contribution to Total Risk

GICS Industry Segment	Rank	Market Value (Thous.)	Weight	Total Risk	Percent Contribution to Total Risk	Active Total Risk	%CR to Total Tracking Error
United Kingdom	1	\$ 736	10.8%	15.93	11.45%	8.15	19.65%
Japan	2	\$ 788	11.5%	15.36	9.06%	12.05	-0.48%
Germany	3	\$ 422	6.2%	16.39	6.80%	8.43	8.24%
France	4	\$ 340	5.0%	17.45	6.01%	8.01	4.35%
Canada	5	\$ 353	5.2%	17.11	5.35%	10.55	1.24%
Switzerland	6	\$ 313	4.6%	15.90	4.64%	9.22	-1.72%
Australia	7	\$ 220	3.2%	18.73	3.79%	10.82	4.47%
Netherlands	8	\$ 197	2.9%	16.75	3.23%	8.61	2.30%
Korea	9	\$ 162	2.4%	20.83	2.67%	15.00	-0.26%
Italy	10	\$ 106	1.6%	24.58	2.31%	16.13	0.00%

- Exposure and country-specific risk
- Exposure vs. the benchmark
- Contributions to Total Risk and contribution to deviation from benchmark exposure

# Summary Contribution to Risk by GICS Industry Segment

## Top Ten GIC Industry Segments by Contribution to Active Risk

GICS Industry Segment	Rank	Market Value (Thous.)	Weight	Total Risk	Percent Contribution to Total Risk	Active Total Risk	%CR to Total Tracking Error
Banks	1	\$ 562	8.23%	17.13	10.11%	6.39	10.56%
Oil Gas & Consumable Fuels	2	\$ 220	3.22%	21.60	4.34%	12.84	9.89%
Metals & Mining	3	\$ 115	1.68%	27.19	2.50%	19.58	8.09%
Capital Markets	4	\$ 181	2.66%	17.38	3.24%	7.62	3.04%
Health Care Equipment & Supplies	5	\$ 85	1.25%	12.96	1.02%	8.68	2.55%
Automobiles	6	\$ 84	1.23%	19.08	1.50%	10.72	2.52%
Insurance	7	\$ 295	4.32%	15.85	4.82%	6.63	2.45%
Airlines	8	\$ 31	0.46%	18.25	0.37%	15.77	1.72%
Beverages	9	\$ 117	1.71%	13.56	1.52%	7.77	1.67%
Media	10	\$ 117	1.71%	17.36	1.97%	9.01	1.57%

- Exposure and industry sector risk
- Exposure vs. the benchmark
- Contributions to Total Risk and contribution to deviation from benchmark exposure

# Domestic Equity Summary

## Asset Class Contribution to Risk: Domestic Equity

Asset Class	Market Value (thous.)	Weight	Policy Weight	Over+/Under- Weight (%)	Total Risk	Percent Contribution to Total Risk	Active Total Risk	%CR to Total Tracking Error
Large Cap	\$ 7,642	92.25%	90.00%	2.25%	12.12	90.72%	0.54	53.76%
Small Cap	\$ 642	7.75%	10.00%	-2.25%	15.70	9.28%	5.92	46.24%
Total Physical Domestic Equity	\$ 8,283	100.00%	100.00%	0.00%		100.00%	0.20	100.00%

- Relative contributions to Total Risk and Tracking Error
- Interplay of relative weight and risk

# Brokerage Example #1

TRBCX

T. Rowe Price Blue Chip Growth Fund

52 Week H/L: **95.16 - 70.76** SEC 30 Day Yield: (3/29/2018) **0.00%**

\$101.69 -2.29 (-2.20%)

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## Risk Measures

Measure	1 Year	3 Years	5 Years	10 Years	15 Years	20 Years
Alpha	11.26	2.85	3.44	2.60	1.34	1.29
Beta	1.24	1.14	1.10	1.05	1.06	1.06
R-Squared	73.76	76.75	74.32	86.86	87.69	90.78
Standard Deviation	12.29	13.40	12.56	16.99	15.12	16.59
Mean	2.31	1.26	1.47	1.11	1.04	0.75
Sharpe Ratio	2.16	1.08	1.38	0.77	0.74	0.42
Skewness	0.94	0.07	(0.01)	(0.74)	(0.71)	(0.61)
Kurtosis	2.02	1.14	0.53	2.08	2.58	1.38
Sortino Ratio	7.36	2.04	2.80	1.16	1.13	0.61
Tracking Error	6.64	6.61	6.43	6.22	5.38	5.14
Information Ratio	2.52	0.67	0.78	0.50	0.34	0.28
Upside Capture Ratio	162.66	125.11	116.84	111.09	108.36	109.24
Downside Capture Ratio	73.25	108.55	89.50	99.49	101.81	104.36
Batting Average	58.33	52.78	56.67	54.17	52.22	52.08
Treynor Ratio	23.70	12.79	16.36	11.65	10.04	5.59

## Brokerage Example #2

### Sector Breakdown As of 12/31/2017

<b>Equity Sector Allocation</b>	<b>Fund Weighting</b>	<b>Equity Weighting</b>	
Technology	29.70%	29.84%	
Consumer Cyclical	23.82%	23.93%	
Healthcare	16.50%	16.57%	
Financial Services	15.86%	15.93%	
Industrials	10.38%	10.43%	
Consumer Defensive	1.19%	1.19%	
Communication Services	0.90%	0.90%	
Basic Materials	0.62%	0.62%	
Real Estate	0.38%	0.38%	
Utilities	0.20%	0.20%	
Total Equity	100%		



## Brokerage Example #3

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### Regional Exposure As of 12/31/2017

Americas	
United States	92.29%
Canada	0.21%
Latin America	0.00%
Europe	
United Kingdom	0.00%
EuroZone & ExEuro	0.18%
Europe Emerging	0.00%
Asia	
Japan	0.00%
Australasia	0.00%
Asia (Ex-Japan/Australasia)	7.32%
Other	
Other	0.00%

## Applications

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- Ongoing portfolio assessment
- Potential change in allocations
- Manager evaluation
- Scenario analysis



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