

Deconstructing Black-Litterman*

Richard Michaud, David Esch, Robert Michaud
New Frontier Advisors
Boston, MA 02110

Presented to:
fi360 Conference
Sheraton Chicago Hotel & Towers
April 25-27, 2012, Chicago, IL

* Forthcoming: Michaud, Esch, Michaud, 2012. "Deconstructing Black-Litterman: How to Get the Optimal Portfolio You Already Wanted." NFA White Paper.



About New Frontier

- Institutional research and investment advisory firm
- Pioneers in asset allocation theory and practice
 - Michaud and Michaud, 1998, 2nd ed. 2008. *Efficient Asset Management*, Oxford
- Inventors of Michaud Resampled Efficient Frontier™
 - Four U.S. patents, two pending; worldwide patents pending
- Managers of over \$1B global ETF model portfolios
- Institutional software providers to managers/consultants worldwide
- Sponsors of fi360 optimization system

Outline

- Limitations of Markowitz mean-variance (MV) optimization
- Black-Litterman (BL) proposal to solve Markowitz instability
 - Illustrate BL optimization
 - “Tilt” asset allocation framework relative to benchmark
 - Same as Markowitz under identical conditions
 - Michaud resampling alternative better diversified portfolios
- BL benchmark relative view tilted asset allocation
 - Unrealistic assumptions
 - Unsolved estimation error instability
 - Statistical inference, optimization, risk aversion limitations
 - Not recommendable in practice relative to alternatives

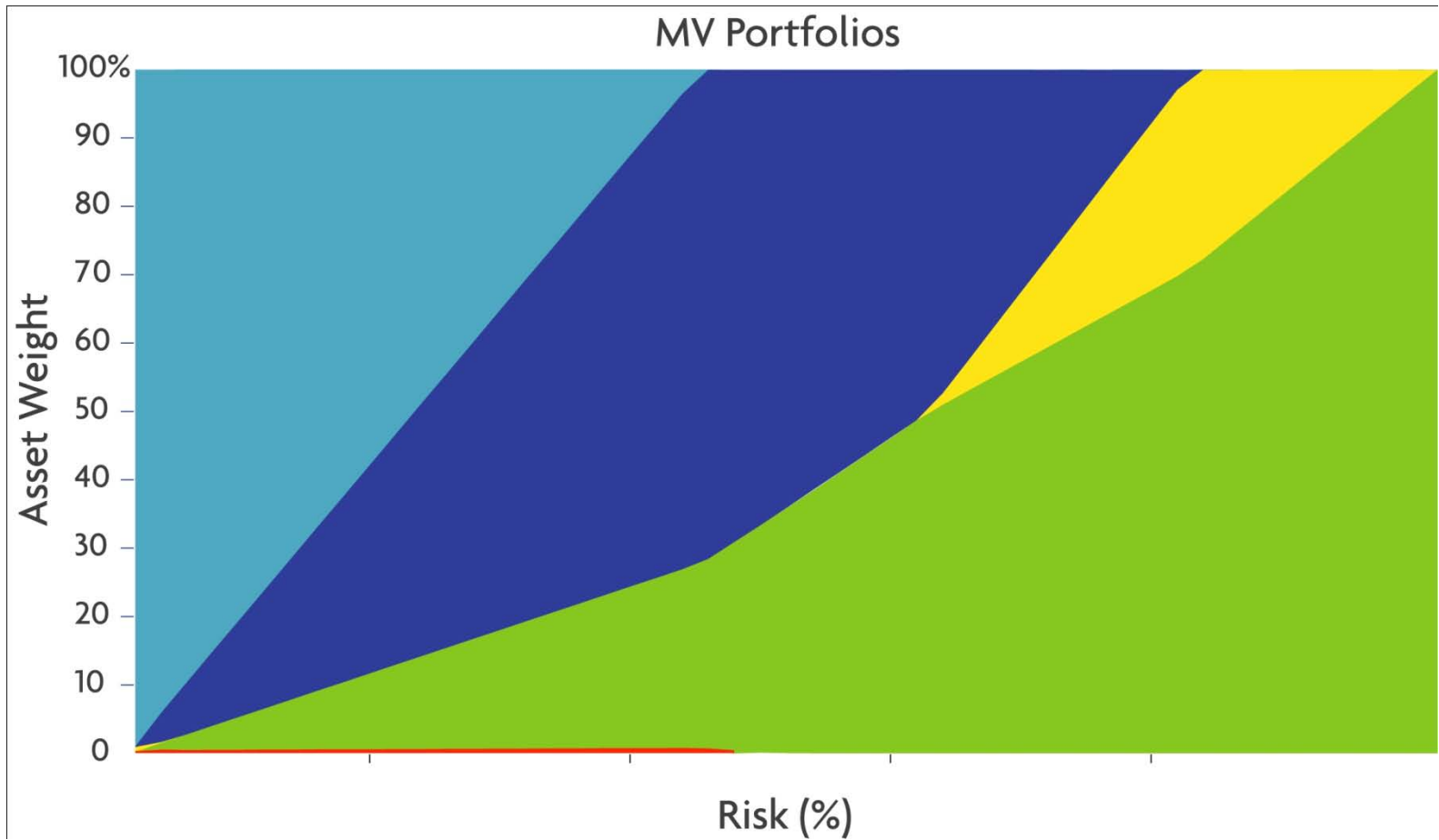
Creating Optimized Asset Allocations

- Markowitz mean-variance (MV) efficiency
 - The standard for half a century
- Theoretically correct
 - Promise of optimally diversified portfolios
 - Central to all of modern finance and investment theory

But MV Has Severe Limitations

- Poor diversification
- Often poor performance
- Example: Ten Asset Classes
 - Money market, intermediate fixed, long-term fixed, High yield, small cap value, small cap growth, large cap value, large cap growth, international equity, real estate
 - Thirty years of historical monthly returns

MV Composition Map



Asset Allocation In Practice

- Manage the inputs
- Heavily constrain the solution
- Why bother asset allocations (Michaud 1989)
 - Managers/consultants ignore MV optimized portfolio
 - Essentially disguised active management
 - Don't blame Markowitz

Two Alternative Solutions

- Black-Litterman optimization
 - Benchmark portfolio relative to investor view “tilts”
 - Unconstrained MV optimization
- Michaud Patented Resampled Efficient Frontier™ alternative
 - Generalized Markowitz efficient frontier
 - Resampling inputs
 - Patented averaging of simulated MV frontiers

Illustrating Black-Litterman Optimization

Black-Litterman (BL) Optimization Process

1. Begin with optimization universe and risk estimates (covariance)
2. Posit a “market” or benchmark portfolio in “equilibrium”
 Implies “market” portfolio MV max Sharpe ratio (MSR) “optimal”
3. Compute “inverse” returns that make benchmark MSR “optimal”
4. Posit investor “tilt” views
5. Compute BL view means relative to investor views
6. BL = unconstrained MV efficient frontier MSR optimal portfolio

BL a “tilted” benchmark portfolio reflecting investor views

Step 1: Risk-Return Estimates

Example: Michaud (1998, Ch. 2)

| Asset Name | Mean | Std Dev | Euro Bonds | US Bonds | Canada | France | Germany | Japan | UK | US |
|------------|--------|---------|------------|----------|--------|--------|---------|-------|------|------|
| Euro Bonds | 3.22% | 5.40% | 1.00 | 0.92 | 0.33 | 0.26 | 0.28 | 0.16 | 0.29 | 0.42 |
| US Bonds | 2.96% | 6.98% | 0.92 | 1.00 | 0.26 | 0.22 | 0.27 | 0.14 | 0.25 | 0.36 |
| Canada | 4.64% | 19.04% | 0.33 | 0.26 | 1.00 | 0.41 | 0.30 | 0.25 | 0.58 | 0.71 |
| France | 10.53% | 24.36% | 0.26 | 0.22 | 0.41 | 1.00 | 0.62 | 0.42 | 0.54 | 0.44 |
| Germany | 6.36% | 21.55% | 0.28 | 0.27 | 0.30 | 0.62 | 1.00 | 0.35 | 0.48 | 0.34 |
| Japan | 10.53% | 24.37% | 0.16 | 0.14 | 0.25 | 0.42 | 0.35 | 1.00 | 0.40 | 0.22 |
| UK | 9.53% | 20.83% | 0.29 | 0.25 | 0.58 | 0.54 | 0.48 | 0.40 | 1.00 | 0.56 |
| US | 8.53% | 14.89% | 0.42 | 0.36 | 0.71 | 0.44 | 0.34 | 0.22 | 0.56 | 1.00 |

Step 4: Posit Investor View

Example: Arbitrage Portfolio of US vs. European Equities

| Asset Name | Market | Mean | Std Dev | BL Mean | Investor Views |
|------------|--------|--------|--------------------|---------|----------------|
| Euro Bonds | 20.00% | 3.20% | 5.40% | 2.20% | 0.00% |
| US Bonds | 20.00% | 3.00% | 7.00% | 2.60% | 0.00% |
| Canada | 6.00% | 4.60% | 19.00% | 9.20% | 0.00% |
| France | 6.00% | 10.50% | 24.40% | 10.90% | -40.00% |
| Germany | 6.00% | 6.40% | 21.50% | 8.60% | -30.00% |
| Japan | 6.00% | 10.50% | 24.40% | 7.80% | 0.00% |
| UK | 6.00% | 9.50% | 20.80% | 10.00% | -30.00% |
| US | 30.00% | 8.50% | 14.90% | 8.50% | 100.00% |
| | | | View Prior Return | | 5.00% |
| | | | View Prior Std Dev | | 5.00% |

MSR Unconstrained MV Optimal Portfolio

BL Optimal: Tilted Allocations Relative to Benchmark

| Asset Name | Market | BL View Means | BL Optimal |
|------------|--------|------------------|---------------|
| Euro Bonds | 20.00% | 2.20% | 20.00% |
| US Bonds | 20.00% | 2.60% | 20.00% |
| Canada | 6.00% | 9.60% | 6.00% |
| France | 6.00% | 5.50% | -6.50% |
| Germany | 6.00% | 3.80% | -3.40% |
| Japan | 6.00% | 4.90% | 6.00% |
| UK | 6.00% | 7.30% | -3.40% |
| US | 30.00% | 10.00% | 61.20% |
| Return | 6.10% | | 7.20% |
| Risk | 9.60% | | 10.30% |

Black-Litterman τ -Adjustment

Black-Litterman BL* In Practice

- BL optimal portfolios are often uninvestable in practice
 - Often short and/or leveraged allocations
- BL introduce τ -adjusted inputs to the optimization process
 - τ -adjustment finds a sign constrained MSR optimal portfolio
- BL* is “tilted” benchmark relative sign constrained portfolio
 - Often BL* optimal BL portfolio in actual practice

Find τ -Adjusted MSR Optimal Portfolio

BL*: Sign Constrained Tilts Relative to Benchmark

| Asset Name | Market | BL View | BL | BL* |
|------------|--------|---------|---------|---------|
| | | Means | Optimal | Optimal |
| Euro Bonds | 20.00% | 2.20% | 20.00% | 20.00% |
| US Bonds | 20.00% | 2.60% | 20.00% | 20.00% |
| Canada | 6.00% | 9.60% | 6.00% | 6.00% |
| France | 6.00% | 5.50% | -6.50% | 0.00% |
| Germany | 6.00% | 3.80% | -3.40% | 1.50% |
| Japan | 6.00% | 4.90% | 6.00% | 6.00% |
| UK | 6.00% | 7.30% | -3.40% | 1.50% |
| US | 30.00% | 10.00% | 61.20% | 45.00% |
| Return | 6.10% | | 7.20% | 5.40% |
| Risk | 9.60% | | 10.30% | 9.50% |

τ -Adjusted Returns and Markowitz

- Compute Markowitz sign constrained efficient frontier with τ -adjusted returns
- BL* identical to Markowitz MSR portfolio!
 - BL* a point on the Markowitz efficient frontier
 - BL* is Markowitz for a given set of inputs
 - BL* is nothing new!
- BL* inherits Markowitz optimization limitations!
 - Does not solve input estimation error instability

BL Benchmark Framework

- Benchmark relative optimization nothing new
 - Often used to stabilize optimization process
 - CAPM “alpha” defined in a benchmark context
- But BL requires market equilibrium!
 - Equilibrium market unknown and indefinable
- Also Roll 1992 critique of benchmark optimization:
 - Optimization on the wrong frontier
 - Always portfolios with more return and less risk

Why Markowitz Optimization Unstable?

- Computers misuse investment information
 - Assume 100% certainty up to 16 decimals accuracy
 - Unrealistic for finance
 - Reason optimization sensitive to changes in inputs
 - Why portfolios don't make sense or have investment value
- Need to include realistic uncertainty in optimization process
- Michaud efficient frontier resampling process
 - Monte Carlo simulate statistically equivalent frontiers
 - Resampling allows measurement of information uncertainty
 - Average frontiers with patented process

BL* vs. Markowitz vs. Michaud

- Compute Michaud optimal portfolios with BL* inputs
- Compare BL*/Markowitz MSR vs Michaud MSR
- Compare Markowitz and Michaud composition maps

BL*/Markowitz vs. Michaud

| Asset Name | Market | BL*/Markowitz z | Michaud |
|------------|--------|--------------------|---------|
| Euro Bonds | 20.00% | 20.00% | 23.00% |
| US Bonds | 20.00% | 20.00% | 19.90% |
| Canada | 6.00% | 6.00% | 9.90% |
| France | 6.00% | 0.00% | 4.30% |
| Germany | 6.00% | 1.50% | 4.70% |
| Japan | 6.00% | 6.00% | 6.60% |
| UK | 6.00% | 1.50% | 5.40% |
| US | 30.00% | 45.00% | 26.20% |
| Return | 6.10% | 5.40% | 5.90% |
| Risk | 9.60% | 9.50% | 9.30% |

Conclusions - 1

- Black-Litterman (BL) propose to solve MV optimization instability
 - Putative MSR MV optimal benchmark tilt asset allocation
 - Investability often requires BL* τ -adjusted inputs
- Ad hoc asset allocation framework
 - BL* identical to Markowitz MSR
 - Does not solve estimation error
 - Requires equilibrium market assumption
 - Unconstrained optimization limitations
 - Often investor risk inappropriate
 - Standards of statistical inference often violated
 - Mirrors traditional non-quantitative asset allocation
 - Not recommendable relative to alternatives

Conclusions - 2

- Effective asset management requires
 - Constrained MV optimization framework
 - Efficient frontier of optimal risk managed portfolios
 - Consistency with standards of modern statistical inference
 - Estimation error effective estimation and optimization technology

Thank You

New Frontier Advisors, LLC
Boston, MA 02110
www.newfrontieradvisors.com



NFA Research

- Portfolio Monitoring in Theory and Practice, Michaud, Esch, Michaud
 - Forthcoming, JOIM 2012
<https://www.joimconference.com/index0.asp>
- Non-Normality Facts and Fallacies, Esch
 - Published in *JOIM* 1st quarter 2010
 - Markowitz Special Distinction Award winner, March 2011
- Deconstructing Black-Litterman, Michaud, Esch, Michaud
 - NFA White Paper, forthcoming 2012

New Frontier in the News

- **Markowitz Award Sponsorship**

NFA proud sponsor *Harry M. Markowitz Award* at JOIM.

<http://www.newfrontieradvisors.com/Announcements/MarkowitzAward.html>

- ***Institutional Investor* Article**

“From Markowitz to Michaud:” New Frontier's Michaud Efficient Frontier is featured as the latest evolutionary step in Modern Portfolio Theory.

http://www.newfrontieradvisors.com/Announcements/documents/Institutional_Investor_Modern_Portfolio_Theory_Evolutionary_Road.pdf

Richard O. Michaud

- President, Chief Investment Officer
- Co-inventor (with Robert Michaud) of Michaud Resampled Efficient Frontier™, three other patents, two pending
- Author: *Efficient Asset Management*, 1998. Oxford University Press, 2001, 2nd Edition 2008 (with Robert Michaud)
- Many academic and practitioner refereed journal articles
- CFA Institute monograph on global asset management.
- Prior positions include:
 - Acadian Asset Management; Merrill Lynch
 - Graham and Dodd winner for work on optimization
 - Former Director and research director of the “Q” Group
 - Advisory Board member, *Journal Of Investment Management*
 - Former Editorial Board member *Financial Analysts Journal*, *Journal of Investment Management*

