Portfolio Tilts Using Views on Macroeconomic Regimes

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Gustavo Amarante

Key Findings

- Methodology to tilt a portfolio according to macro regimes rather than expected returns
- More robust to input errors than Black-Litterman
- Cosistency across asset classes and leads to less extreme weights

Introduction

- **Black-Litterman (and extensions)**
  - Require investors to input their views as **expected returns and covariances.**
  - Typically lead to **unstable** weights
  - Inputs may imply **inconsistent premiums** when analyzed by asset pricing models

- **Regime Based Asset Allocation**
  - Investor inputs are **probabilities of macro regimes**
  - Separates investors' views from **portfolio construction** methodology
  - **Lower Dimensionality**: Number of regimes is lower than number of expected returns and covariances

Methodology

1. Define economic regimes based on their preferred macro or market variables
2. Define (prior) probabilities for each regime
3. Form views for being in each regime in the future
4. Compute posterior probabilities for each regime
5. For each regime, compute historical moments required by their portfolio construction method of choice
6. Combine them across regimes using posterior probabilites

Analysis

- **Controlled Experiment**
  - Compare their methodology to Black-Litterman using Monte Carlo Simulations
  - Evaluate how portfolio performance is affected by forecast errors
  - Higher sharpe ratios and with less variance out of sample

- **Demonstration of Practical Application**
  - Regimes based on GDP and Inflation
  - 4 regimes based on rising/falling surprises on growth and inflation

Prior Probabilities

$$S_{x,t} \equiv x_t - \hat{x}_t$$
$$S_{\pi,t} \equiv \pi_t - \hat{\pi}_t$$

- Prior distribution of the surprises

$$\mathbb{P}(s) = \mathcal{N}(\mu, \Sigma)$$

- Regime probabilities

$$\Pr(S_\pi < 0 \ \& \ S_x < 0) = F_s(0,0)$$
$$\Pr(S_\pi \geq 0 \,\&\, S_x < 0) = \Pr(S_x < 0) - \Pr(S_\pi < 0 \,\&\, S_x < 0) = F_s(\infty, 0) - F_s(0, 0)$$
$$\Pr(S_\pi < 0 \,\&\, S_x \geq 0) = \Pr(S_\pi < 0) - \Pr(S_\pi < 0 \,\&\, S_x < 0) = F_s(0, \infty) - F_s(0, 0)$$
$$\Pr(S_\pi \geq 0 \,\&\, S_x \geq 0) = 1 - \Pr(S_\pi < 0) - \Pr(S_\pi < 0 \,\&\, S_x < 0) = 1 - F_s(0, \infty) - F_s(0, 0)$$

Investor's Views

- Views on regime probabilities

$$\Pr(S_\pi \geq 0 \,\&\, S_x \geq 0 | v) \equiv Q_{HGHI}$$
$$\Pr(S_\pi \geq 0 \,\&\, S_x < 0 | v) \equiv Q_{LGHI}$$
$$\Pr(S_\pi < 0 \,\&\, S_x < 0 | v) \equiv Q_{LGLI}$$
$$\Pr(S_\pi < 0 \,\&\, S_x \geq 0 | v) \equiv Q_{HGLI}$$

- If you have a distribution for these variables, you can compute

$$\Pr(S_\pi < 0 \,\&\, S_x < 0) = F_v(0,0)$$
$$\Pr(S_\pi \geq 0 \,\&\, S_x < 0) = \Pr(S_x < 0) - \Pr(S_\pi < 0 \,\&\, S_x < 0) = F_v(\infty, 0) - F_v(0,0)$$
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Investor's Views

- Assume a distribution for the average surprises and their correlation

$$\mathbb{P}(v) = \mathcal{N}\left(\mu_v, \Omega(\rho)\right)$$

$$\Omega(\rho) = \sqrt{diag(\Sigma)}\begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}\sqrt{diag(\Sigma)}$$

- Based on the investor's views on probabilities, find the paramenters of the distribution using numerical procedures

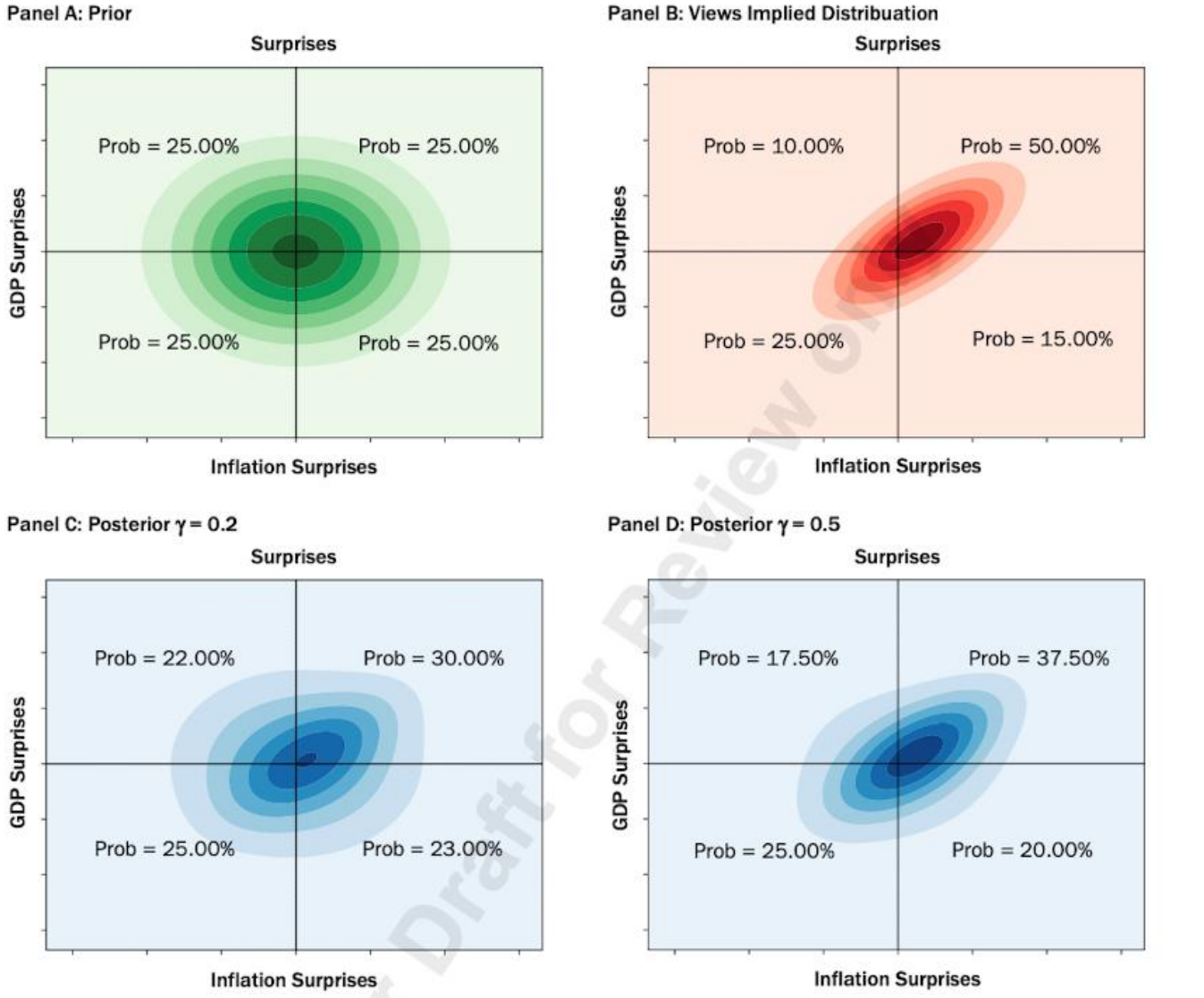
$$\min_{\mu_v,\rho}[Q_{HGHI} - (1 - F_v(0,\infty) - F_v(0,0))]^2 + [Q_{LGHI} - (F_v(\infty,0) - F_v(0,0))]^2$$
$$+ [Q_{LGLI} - F_v(0,0)]^2 + [Q_{HGLI} - (F_v(0,\infty) - F_v(0,0))]^2$$

Posterior Distributions

- Combine Priors with Investors' views

$$\mathbb{P}(s|v) = (1-\gamma)\mathbb{P}(s) + \gamma\mathbb{P}(v)$$

- Gamma allows the investor to input their confidence on their views



NOTES: This exhibit provides a visualization of our framework that proposes views on economic regimes (i.e., growth and inflation). Panel A plots the distribution of growth and inflation surprises that investors can estimate using historical information (the prior distribution). In Panel B, we plot the distribution that is consistent with investors' views on probabilities of economic regimes (the views distribution). Panels C and D show the resulting distributions that combine the prior and views distributions for two different levels of investors' confidence, $\gamma = 0.2$ and $\gamma = 0.5$, respectively.

Portfolio Construction

- changes in the regime probabilities lead to changes in the optimal portfolio allocation

- framework allows for any type of allocation rule (mean-variance, risk-partity, etc)

$$w \equiv \Sigma_{s \in S} \, w_s p_s$$

$$w^* = \arg \min_{\{w_s\}_{s \in S}} \frac{1}{2} \sum_{s \in S} p_s w_s' \, \Sigma_s w_s$$

$$\sum_{s \in S} p_s w_s' \, \mu_s = \bar{\mu} \quad \text{and} \quad \sum_{s \in S} p_s w_s' \, I_N = 1$$

$$w_u^* = \frac{\Sigma_u^{-1} \mu_u}{| \mathbf{1}' \Sigma_u^{-1} \mu_u |}$$

$$\mu_u = \Sigma_{s \in S} \, p_s \mu_s, \; \Sigma_u = \Sigma_{s \in S} \, p_s \Sigma_s,$$

Monte Carlo Simulations

- assume investors' views are correct on average but are subject to forecast errors in each simulation
- For each regime, calibrate covariances and expected returns to empirical data on an equity index, long-term Treasuries, and an index of commodities
- set the true expected returns and covariances equal to the average of the historical conditional values of the regimes

Monte Carlo Simulation

- For BL, the expected returns' forecasts are drawn from a very narrow multivariate normal distribution with means equal to the true expected returns and covariance equal to the true covariance times 1/50 representing **very precise** forecasts.

- For their framework, draw from a uniform distribution centered around the true values of probabilities and with a range of +/- 10 percentage points around the true value, representing **non-precise forecasts**

- Choice of parameters are admittedly arbitrary but aims to keep an **unfair comparison on purpose**

- To evaluate the performance, use the ratio between the SR of the strategy with views and without views

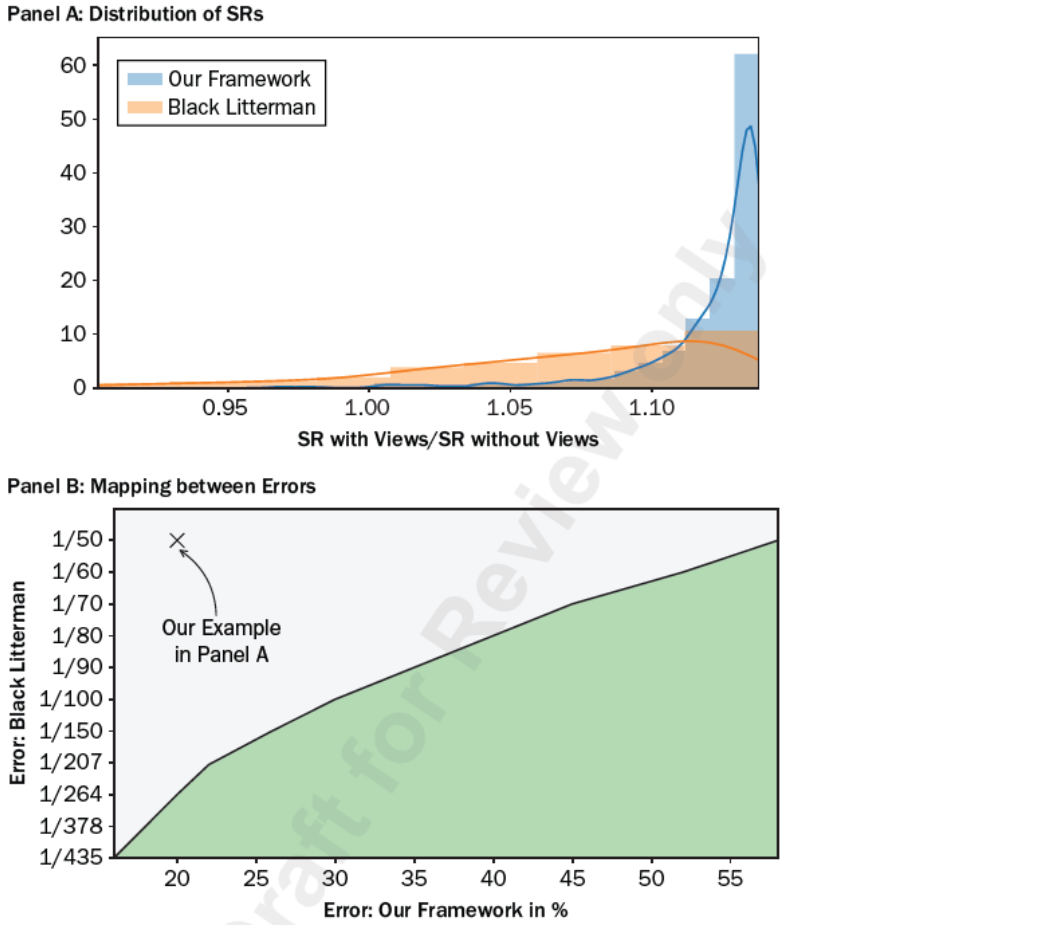
Monte Carlo

Both models have averages of SR ratio greater than one. This is expected because the views are on average correct for both

Their framework generates a distribution that has a higher mean and more positively skewed

EXHIBIT 2

Distribution of Out-of-Sample SRs under Error



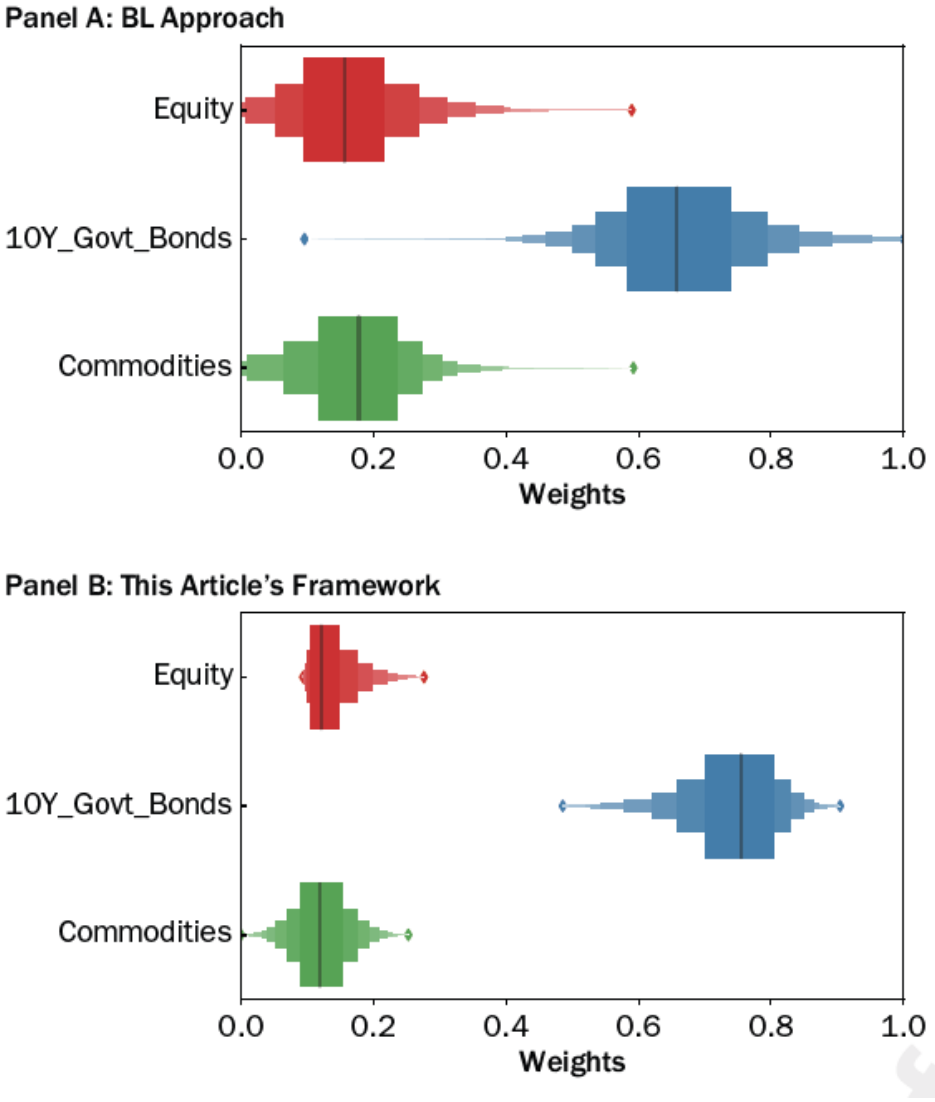
NOTES: Panel A plots the distribution of SRs implied by both our framework and BL. We use 1,000 simulations in this exercise. We assume that investors have views that are correct on average but subject to forecast error. For BL, the forecast error entails drawing expected returns from a multivariate normal distribution centered around the true values and covariance equal to the true covariance times 1/50. For our framework, we draw from a uniform distribution centered around the true values of probabilities and with a range of 20% (+/– 10%). For ease of readability, we report the distribution of the ratio between the SR using the views and the SR without views. We calibrate the covariance matrices and expected returns to empirical data on equities, fixed income, and commodities. Panel B shows the mapping between the error in our framework that leads to the same average SR using BL. For example, a +/– 10% range in our framework is equivalent to having a precision in BL approximately equal to 1/264 of the true covariance matrix (i.e., 264 times more precise than the actual distribution of returns).

Monte Carlo

Dispersion of the weights is larger for BL, even though it has more precise views

EXHIBIT 3

Distributions in Portfolio Weights between Methodologies



Empirical Example

- S&P 500 (equity), 10-year US government bonds (fixed income), and Bloomberg Commodity Index (commodities).

- Economic regimes defined in terms of inflation and economic growth surprises
  - Difference between actual and the survey of professional forecasters of the Philly Fed
  - Vintage data is used when available

- "It is important that assets have a considerably different behavior in the various regimes for our framework to be effective"

EXHIBIT 4

Conditional Excess Returns, Volatilities, and Correlations

Rising Growth and Rising Inflation						
	Excess Ret	Volatility	Correlation Matrix	Equity	10Y Govt Bonds	Commodities
Equity	13.23%	10.48%	Equity	1	–0.084	0.215
10Y Govt Bonds	–0.39%	6.64%	10Y Govt Bonds	–0.084	1	–0.247
Commodities	11.07%	12.21%	Commodities	0.215	–0.247	1
Rising Growth and Falling Inflation						
	Excess Ret	Volatility	Correlation Matrix	Equity	10Y Govt Bonds	Commodities
Equity	15.03%	11.82%	Equity	1	0.314	0.277
10Y Govt Bonds	5.12%	9.20%	10Y Govt Bonds	0.314	1	–0.124
Commodities	–2.34%	12.49%	Commodities	0.277	–0.124	1
Falling Growth and Rising Inflation						
	Excess Ret	Volatility	Correlation Matrix	Equity	10Y Govt Bonds	Commodities
Equity	–0.22%	15.69%	Equity	1	–0.560	–0.137
10Y Govt Bonds	2.69%	5.93%	10Y Govt Bonds	–0.560	1	0.199
Commodities	6.74%	12.84%	Commodities	–0.137	0.199	1
Falling Growth and Falling Inflation						
	Excess Ret	Volatility	Correlation Matrix	Equity	10Y Govt Bonds	Commodities
Equity	1.43%	18.56%	Equity	1	0.244	0.481
10Y Govt Bonds	8.82%	7.35%	10Y Govt Bonds	0.244	1	0.215
Commodities	–8.37%	15.22%	Commodities	0.481	0.215	1

NOTES: This exhibit shows the conditional excess returns, volatilities, and correlations for the assets used in this study. Equity indicates the S&P 500 Index, 10Y Govt Bonds indicates the constant maturity index of 10-year US Treasuries, and commodities indicates the Bloomberg Commodity index. The four conditional regimes are: rising growth and rising inflation, rising growth and falling inflation, falling growth and rising inflation, and falling growth and falling inflation. For details on the estimation of conditional regimes, see "Data Description and Setup".

Empirical Example

- Rebalance the portfolio yearly at the end of January for each year *t*
- On every rebalancing date, compute the monthly economic surprises from 1947 up to the end of December of the previous year and use them to define historical economic regimes
- Use the historical frequencies of those regimes to calibrate their prior probabilities
- Compute historical returns and covariances for each regime
- Compute optimal portfolios with and without views
  - "When investors have **prescient views**, we assume their views are equal to the probabilities of economic regimes in the following 12 months and use them to derive the posterior probabilities of economic regimes"

Empirical Example

Annualized monthly excess return

With views 4.5%

Without views 2.8%

Annualized Vols

With views 6.6%

Without views 6.3%

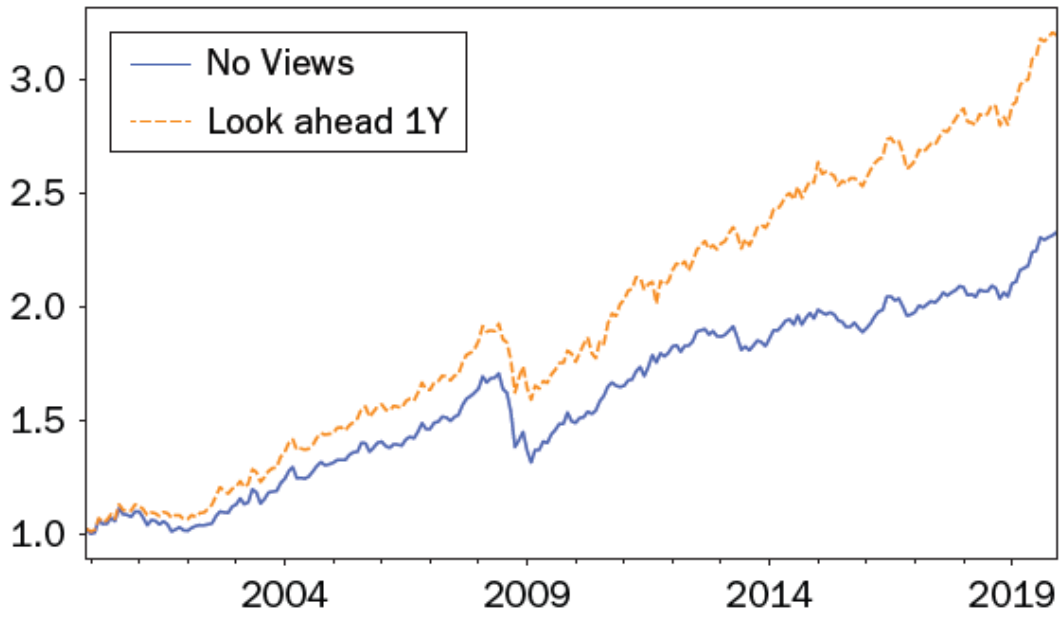
Sharpe Ratios

With views 0.68

Without views 0.44

EXHIBIT 5

Demonstration for Our Framework: Total Returns



NOTES: This exhibit plots the total returns for the demonstration of our framework using mean–variance. The assets used for this exercise are the S&P 500 Index (equity), the 10-year Treasury returns (fixed income), and the Bloomberg Commodity index (commodities). We assume that investors have prescient views on the probability of future economic regimes (growth and inflation) one year ahead. The orange dashed line and the blue solid line show the performance of a portfolio with and without views, respectively. We test our strategy from 1999 to 2019, and weights are rebalanced yearly.

Empirical Example

Discussion

- **What I don't like**
  - Not very innovative methodology
  - Does not tackle the key performance aspect: Identifying regimes the regimes and their parameters
  - In the end, it looks like a BL model with shrinkage
  - Strong look-ahead bias

- **What I like**
  - Discussing regimes keeps parameters estimates consistent with asset behavior
  - Reasonable methodology for practitioners