

Sector Rotation with Tactical Tilting Towards Robust Stocks

Indexation and Trading Strategies in Hong Kong Stock Market

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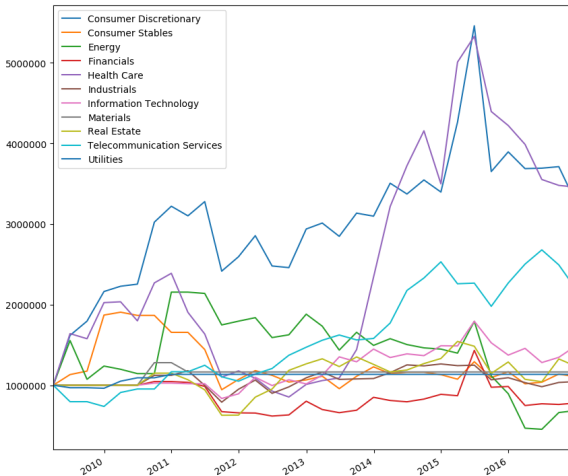
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Overview

Key Points

- We design and implement a **sector rotation** investment strategy with tactical tilting towards **robust** stocks.
- Our **strategy**, which trades **quarterly**, yields a total return of **237%** from Q1 2009 to Q4 2016, compared to 113% of the total return in HSI in the same period.
- **annualized volatility** 27%, compared to 16% in HSI
- **maximum drawdown** -30%
- **investment horizon** Q1 2009 to Q4 2016
- **out-of-sample period** Q1 2013 to Q4 2016

Decomposition of Returns



Algorithmic Quantitative Finance Knowledge Applied

The course knowledge we have applied in the project includes

- **Principal Component Analysis** in selecting stocks ;
- **Hidden Markov Models** in detecting economic stages in the business cycle ;
- **Monte Carlo simulation** combined with ideas of **Gibbs sampling** in optimizing the multiplier matrix ;
- **Skewness, Kurtosis, and Variance Ratio Test** for tactical tilting ;
- **Arbitrage Pricing Theory** to implement another strategy for comparison.

Economic Rationale

Over the intermediate term, asset performance is often driven largely by cyclical factors tied to the stages of the economy.

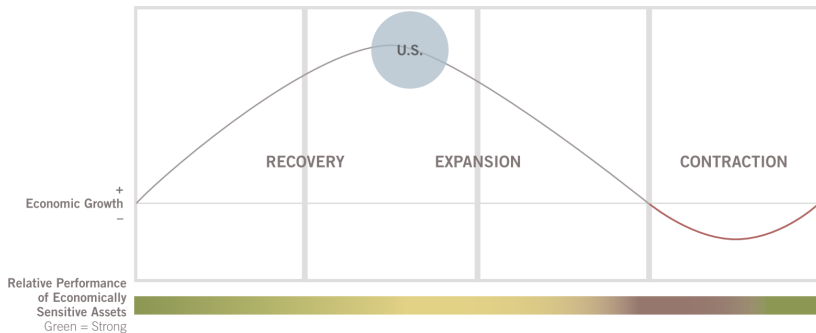


FIGURE – Business Cycle

Economic Rationale

The business cycle can be a critical determinant of equity market returns and the performance of equity sectors.

Sector	Early	Mid	Late	Recession
Energy				
Materials				
Industrials				
Consumer Discretionary				
Consumer Staples				
Health Care				
Financials				
Information Technology				
Telecommunication Services				
Utilities				
Real Estate				

FIGURE – Decisions

Two Key Questions

We need to answer two key questions to bridge the gap between the economic theory and the strategy implementation :

- 1 How do we **determine** the stage in the business cycle ?
- 2 Given a stage in the business cycle, and the corresponding decision, for example a strong buy, how to **quantify** the decision (how *strong* is a strong buy) ?

Our answers are :

- 1 use **Hidden Markov Models** to determine the economic state ;
- 2 use **Monte Carlo** methods to optimize the parameters.

GDP Growth Rates & Changes in Inventories

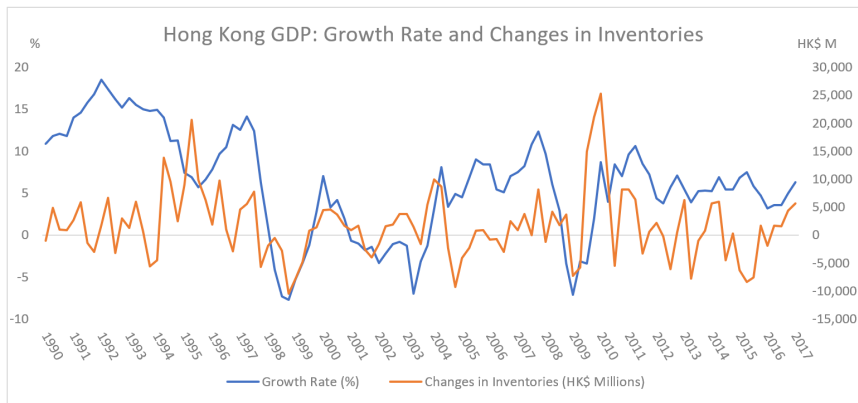


FIGURE – GDP & Changes in Inventories

Hidden Markov Models

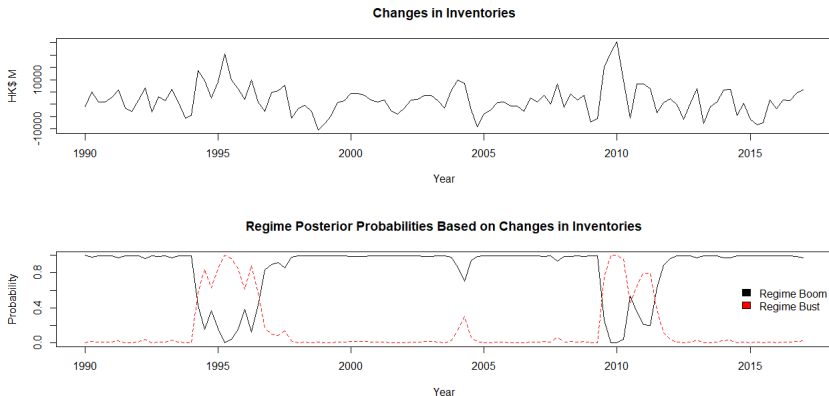


FIGURE – Regime Posterior Probabilities

Hidden Markov Models

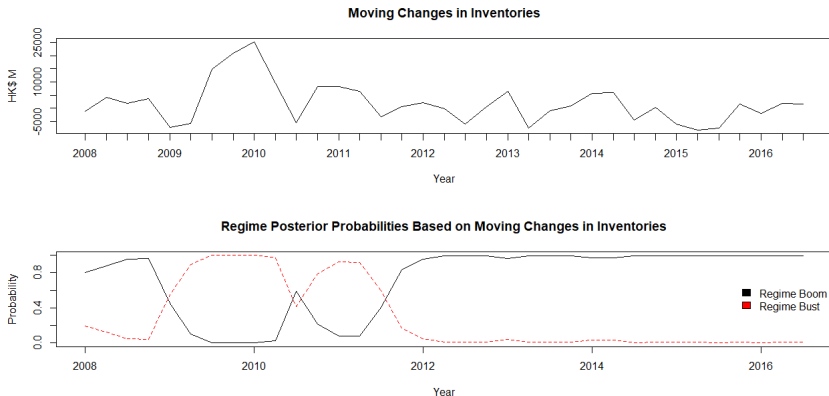


FIGURE – Regime Posterior Probabilities : Moving Windows

Stage Detection

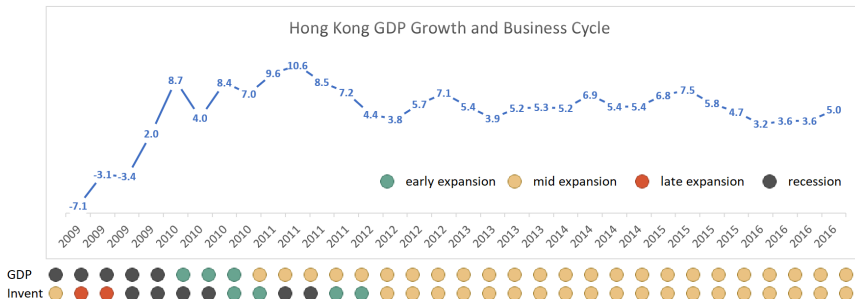


FIGURE – Cycle

GICS

By and large, the industry sectors can be divided into 2 categories

- 1 the **economically sensitive**, which performs well in the **early stages of expansion** ;
- 2 the more **defensive**, which enjoys higher returns during a **recession**.

The GICS divides all major public companies into 11 sectors.

- 1 **Energy** : *Kunlun Energy (0135)* ...
- 2 **Materials** : *Grand Ocean Advanced Resources (0065)* ...
- 3 **Industrials** : *CK Hutchison (0001)* ...
- 4 **Consumer Discretionary** : *Galaxy Entertainment (0027)* ...
- 5 **Consumer Staples** : *Hong Kong Food Investment (0060)* ...
- 6 **Health Care** : *Mingyuan Medicare (0233)* ...
- 7 **Financials** : *Hang Seng Bank (0011)* ...
- 8 **Information Technology** : *China Aerospace (0031)* ...
- 9 **Telecommunication Services** : *PCCW (0008)* ...
- 10 **Utilities** : *Hong Kong and China Gas (0003)* ...
- 11 **Real Estate** : *Henderson Land (0012)* ...

Strategy Decision

Sector	Early	Mid	Late	Recession
Energy				
Materials				
Industrials				
Consumer Discretionary				
Consumer Staples				
Health Care				
Financials				
Information Technology				
Telecommunication Services				
Utilities				
Real Estate				

FIGURE – Decisions

Stock Selection with PCA

We apply PCA in stock selection

- 1 apply PCA to the correlation matrix of stock prices ;
- 2 for each principal component $PC^{(k)} = \sum_j c_j s_j^{(k)}$ whose eigenvalue $\lambda_k < \lambda_D$, find the stock $s_m^{(k)}$ with the largest coefficient in absolute value $|c_m|$, and then delete it ;
- 3 repeat steps 1 and 2 until
 - 1 the number of stocks is below a minimum, or
 - 2 the lowest eigenvalues are above λ_S .

In one word, we remove the stocks that are **most representative of the less representative**.

Monte Carlo methods with ideas from Gibbs sampler

Definition Let θ_{SS} , θ_S , θ_B , and θ_{SB} stand for the multipliers respectively for strong sell, sell, buy, and strong buy.

Object find θ_{SS} , θ_S , θ_B , and θ_{SB} such that portfolio value $V(\theta_{SS}, \theta_S, \theta_B, \theta_{SB})$ is maximized.

Constraints $0 < \theta_{SS} < \theta_S < 1 < \theta_B < \theta_{SB} < \infty$

Method

- initialize $\theta_{SS}^{(0)} = 0.25, \theta_S^{(0)} = 0.5, \theta_B^{(0)} = 2, \theta_{SB}^{(0)} = 4$.
- iteratively draw one θ while fixing 3 other θ s
 - 1 draw a random sample $\theta_{SS}^{(1)}$ from $f_{SS}(\theta_{SS} | \theta_S^{(0)}, \theta_B^{(0)}, \theta_{SB}^{(0)}; \mathbf{X})$, s.t. $\theta_{SS}^{(1)} < \theta_S^{(0)}$;
 - 2 draw a random sample $\theta_S^{(1)}$ from $f_S(\theta_S | \theta_{SS}^{(1)}, \theta_B^{(0)}, \theta_{SB}^{(0)}; \mathbf{X})$, s.t. $\theta_{SS}^{(1)} < \theta_S^{(1)} < 1$;
 - 3 draw a random sample $\theta_B^{(1)}$ from $f_B(\theta_B | \theta_{SS}^{(1)}, \theta_S^{(1)}, \theta_{SB}^{(0)}; \mathbf{X})$, s.t. $1 < \theta_B^{(1)} < \theta_{SB}^{(0)}$;
 - 4 draw a random sample $\theta_{SB}^{(1)}$ from $f_{SB}(\theta_{SB} | \theta_{SS}^{(1)}, \theta_S^{(1)}, \theta_B^{(1)}; \mathbf{X})$, s.t. $\theta_B^{(1)} < \theta_{SB}^{(1)}$;
- repeat m times to obtain a sequence of random draws :

$$(\theta_{SS}^{(1)}, \theta_S^{(1)}, \theta_B^{(1)}, \theta_{SB}^{(1)}), \dots, (\theta_{SS}^{(m)}, \theta_S^{(m)}, \theta_B^{(m)}, \theta_{SB}^{(m)})$$

Snapshot of Market Cap

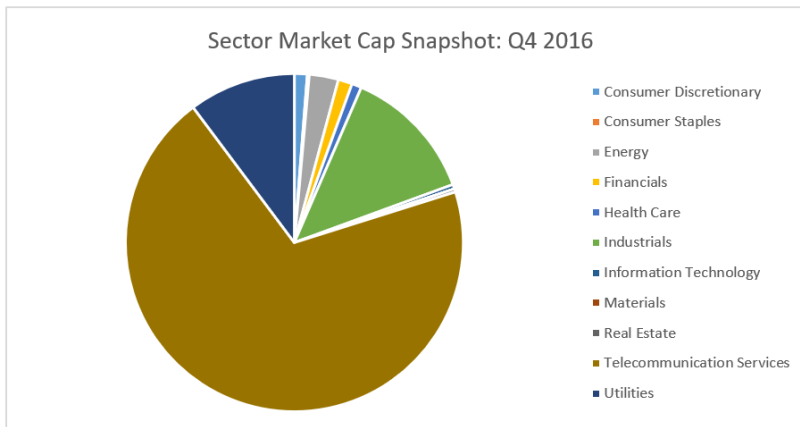


FIGURE – Snapshot

Tactical Titling Towards Robust Stocks

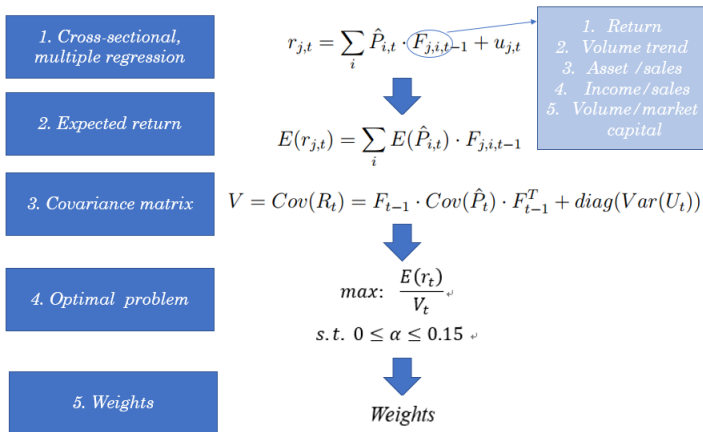
	Negative Mean	Positive Mean
Positive Skewness	No Man's Land	Holy Grail of Investing
Negative Skewness	Dead on Arrival	Most Cases

FIGURE – Skewness

We also consider applying kurtosis analysis and variance ratio tests.

Comparison with an APT Model Strategy

This strategy extends the idea of **fundamental indexation** by the Arnott et al paper. It forecasts the future returns and volatilities using fundamental figures, and then fits the prediction into a Markowitz framework, using **Arbitrage Pricing Theory**. The annualized return is around 10%.



Comments ... and (Self-) Criticism

Reliance on Long-Term Cycles

- largely relies on the alternation of economic stages, which may take years
- requires longer-term historical data

Sector Rotation Causes Volatility

- shifting from one sector to another may cause volatility, transaction fees
- may under-perform others in terms of return/risk measure such as Sharpe ratio

We Invested in Hanergy Thin Film !

- stock has been suspended since 20 May, 2015
- price on 20 May, 2015 = HK\$3.91
- price on 19 May, 2015 = HK\$7.37
- price on 4 Jan, 2009 = HK\$0.072