

# Asset Performance Management

Gerald B Sheblé  
Maseeh Professor  
Portland State University

4/5/2006

© 2005 epmt, inc., all rights reserved

1

## Asset Management

- Replace poles before failure
- Maintain transformers before failure
- Replace insulators before failure
- Maintain tree trimming before failure
- Maintain inventory of spare transformers
- Etc.

4/5/2006

© 2005 epmt, inc., all rights reserved

2

## Equivalences

- Asset Management
  - Maximize profit within contract constraints
  - Subject to sufficient cash flow
  - Subject to time horizon
  - Without taking significant risk
- Risk Management
  - Limit losses
  - Mitigate potential losses

4/5/2006

© 2005 epmt, inc., all rights reserved

3

## Supply Chain

- Fuel resource
  - Coal, oil, natural gas, wind, water, etc.
- Transportation to conversion facility
- Conversion to electricity – GENCO
- Transportation to customer site – TRANSCO and DISTCO
- Customer use
  - Light, heat, movement, communication, analysis, etc.

4/5/2006

© 2005 epmt, inc., all rights reserved

4

## Other Supply Chains

- Natural gas pipelines
  - Connect NG to customer application
  - Storage, limited
- LNG, CNG
  - Global connection for NG
- Oil pipelines, and truck delivery
  - Storage, limited
- Wind, hydrogen, biomass, etc.
  - Distributed generation

4/5/2006

© 2005 epmt, inc., all rights reserved

5

## Selection of Supply Chain

- Customer buys commodity
  - Heat – (electricity, natural gas, oil, coal, hydrogen, wood, etc.)
  - Lights – (electricity, ?)
  - Movement – (gas, oil, hydrogen, biomass, diesel or other petroleum based fuels)
  - Cooling – (electricity, natural gas)
  - Customer can store some of these on site especially in the hydrogen economy with fuel cells

4/5/2006

© 2005 epmt, inc., all rights reserved

6

## Timing of Selection

- Customer can alter the time table of consumption
  - Cold storage
  - Heat storage
  - Fuel storage
  - Compressed air
  - Hydrogen generation

4/5/2006

© 2005 epmt, inc., all rights reserved

7

## Company Position

- Framework for financial audit and corporate governance, based on economic laws
- Provides ability:
  - Identify important risks to firm
  - Classify risks as controllable and uncontrollable
  - Identify causes
  - Identify mitigation strategies
  - Provide measured feedback on changes in risks
  - Relate changes to management

4/5/2006

© 2005 epmt, inc., all rights reserved

8

## Portfolio

- Firm builds a portfolio of assets
  - Equipment
  - Materials
  - Labor
  - Customers
- Asset Portfolio Characteristics
  - Liquid
  - Predictable to build business plan

4/5/2006

© 2005 epmt, inc., all rights reserved

9

## Framework Implementation

- Establish business model with value adding processes and activities
- Determine risk factors and earnings functions
- Determine loss models (distributions)
- Determine threshold for loss
- Capture excess loss data (filters, scenarios, etc.)

4/5/2006

© 2005 epmt, inc., all rights reserved

10

## Framework Assumptions

- Operational risk measure & control
  - must reflect variability of earnings as a result of losses due to errors and omissions and control breakdowns or rare events,
  - reflecting the two categories of
    - (a) high frequency, low impact events that are expected and cause operation losses and
    - (b) low frequency, high impact events that occur unexpectedly and cause extraordinary or excess losses.

4/5/2006

© 2005 epmt, inc., all rights reserved

11

## Framework

- Integrates a measurement methodology with the business model
- Firm
  - Creates earning potential by buying and selling a portfolio of assets/commodities
  - Creates earning potential by buying resources (materials and labor)
  - Creates earnings by providing services (production)

4/5/2006

© 2005 epmt, inc., all rights reserved

12

## Positions in Supply Chain

- Contracts are the glue between supplier and buyer at each point in the supply chain, for each supply chain.
- Contracts form a portfolio.
- Portfolio has to provide a suitable ROI subject to a constrained risk frontier, as suitable for a company in the same line of business, with the same WACC.

4/5/2006

© 2005 epmt, inc., all rights reserved

13

## Each Link in Chain

- Each link in the chain is a company that has to provide a business plan to yield a ROI for the risk for that business.
- Each company must be able to predict (forecast) the future vector of payoffs with acceptable accuracy.
- Strategic strength of each company is it's capability to maintain it's present position in the link and, with diligence, to improve that position.

4/5/2006

© 2005 epmt, inc., all rights reserved

14

## Focus Analysis

- Control of trading floor is extended to corporate wide handling of contracts
- Contracts
  - Procurement (equipment, materials, labor, etc.)
  - Sales (transportation to customer, customer procurement)
  - Contingent contracts (“insurance”)

4/5/2006

© 2005 epmt, inc., all rights reserved

15

## Math

- Optimization
  - maximize active returns
  - minus
  - adjusted risk penalty
- Compare-to
  - Capital Asset Pricing model (CAPM)
  - Arbitrage pricing Theory (APT)

4/5/2006

© 2005 epmt, inc., all rights reserved

16



# CAPM

**Assume:** (1) All investors are Markowitz mean-variance investors.  
 (2) Short selling is allowed.  
 (3) There exists a risk free asset.  
 (4) Investors share same predictions of means, variances and covariances

**Theorem:** (Capital Asset Pricing Model)

If the market portfolio M is efficient, the expected return  $\bar{r}_i$  of any asset i satisfies

$$\bar{r}_i - r_f = \beta_i (\bar{r}_M - r_f)$$

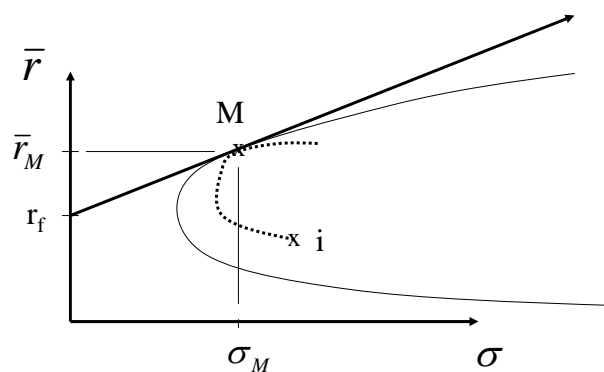
where  $\beta_i = \frac{\sigma_{iM}}{\sigma_M^2}$

4/5/2006

© 2005 epmt, inc., all rights reserved

17

## CAPM Graphic



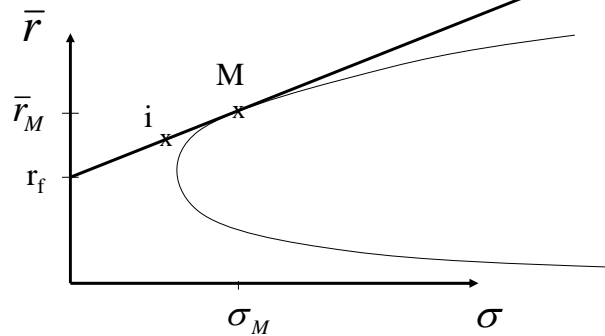
4/5/2006

© 2005 epmt, inc., all rights reserved

18

## Minimum variance

If  $e_i = 0$ , then this security has minimum variance for its expected return. Hence, it lies on the capital market line



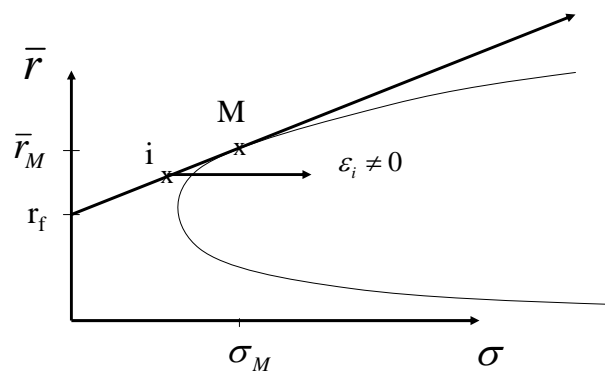
4/5/2006

© 2005 epmt, inc., all rights reserved

19

## Non-minimum variance

If  $\varepsilon_i \neq 0$ , this just increases the variance.



4/5/2006

© 2005 epmt, inc., all rights reserved

20

## Implications of CAPM

- You are only rewarded (expected return) for risk that you cannot diversify away.
- Risk is measured by  $\beta$ , not the variance of your asset.
- The return on an asset is determined by how it fits into the market portfolio, not by its characteristics alone.

4/5/2006

© 2005 epmt, inc., all rights reserved

21

## Portfolio and Security Risk

We started at the Portfolio Level

Markowitz theory minimized the risk (variance) in optimal portfolios.

At the portfolio level, we measured risk by the portfolio variance.

---

... and arrived at the Security Level

At the security level, CAPM says risk is given by beta.

In fact, CAPM says beta is appropriate at any level, security or portfolio.

4/5/2006

© 2005 epmt, inc., all rights reserved

22

# CAPM Investment Implications

One fund theorem:

Buy the **market** plus **treasury securities**.

CAPM helps to evaluate the performance of assets and funds!

Existing Indices

- Jensen
- Treynor
- Sharpe

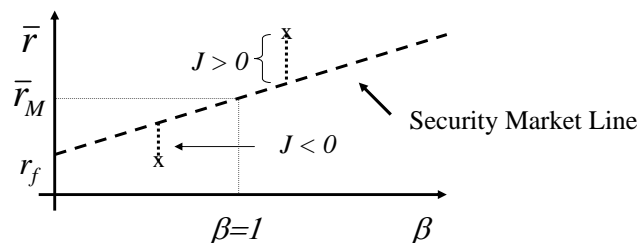
4/5/2006

© 2005 epmt, inc., all rights reserved

23

## Jensen Index

J is known as the Jensen Index.



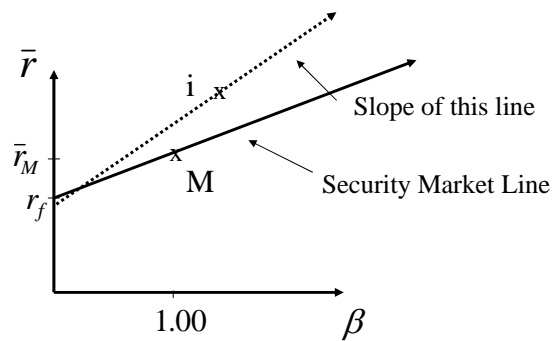
4/5/2006

© 2005 epmt, inc., all rights reserved

24

# The Treynor Index

Compute excess return per unit of risk taken.



$$\text{Treynor Index: } = \frac{\bar{r}_i - r_f}{\beta_i}$$

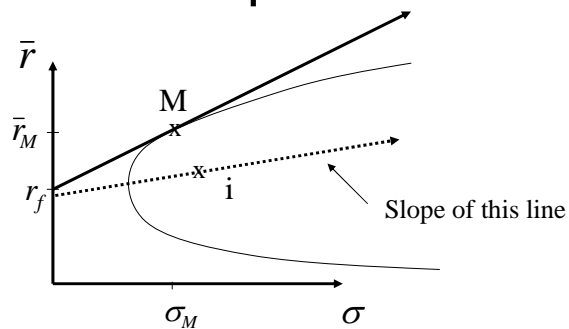
Treynor index is appropriate for securities, but not portfolios

4/5/2006

© 2005 epmt, inc., all rights reserved

25

# The Sharpe Index



$$\text{Sharpe Index (Ratio)} = \frac{\bar{r}_i - r_f}{\sigma_i}$$

If fund is efficient, it has the same slope as the capital market line.

Sharpe index is appropriate for portfolios.

4/5/2006

© 2005 epmt, inc., all rights reserved

26

## Refinements

- Examples of statistical refinements include Bayesian corrections and adjustments for heteroskedasticity and autocorrelations.
- Extract more financial information from the time series:
  - Benchmark timing
  - A priori betas
  - Analyzing value added
  - Controlling for public information
  - Style analysis
  - Controlling for size and value

4/5/2006

© 2005 epmt, inc., all rights reserved

27

## Method

- Analysis steps:
  - Performance attribution
  - Performance analysis
- Attribution focuses on a single period, attributing return to each component.
- Analysis focuses on times series of returns attributed to each component.
- Where is skill and added value found?

4/5/2006

© 2005 epmt, inc., all rights reserved

28

## Factors Chosen

- Typically use standard risk-model factors as in typical investment themes
  - Value
  - Momentum
  - Data known at beginning of period (ex ante)
- Use ex post factors for return attribution
  - Data known at end of period
- Beyond manager's returns attributed to factors will remain the specific return to the portfolio, specific asset selection.

4/5/2006

© 2005 epmt, inc., all rights reserved

29

## Performance Analysis

- Begins with attributed returns each period, and looks at the statistical significance and value added of the attributed return series
- This relies on t statistics and information ratios to determine statistical significance and value added.

4/5/2006

© 2005 epmt, inc., all rights reserved

30

## Extension

- Next step
- Separate time series into components:
  - Average active beta and benchmark return
  - Average active beta and deviation of realized benchmark return from its expectation
  - Benchmark timing, deviations of active beta from its mean.
- First component is not a component of active management.

4/5/2006

© 2005 epmt, inc., all rights reserved

31

## Key

- Balance of profit with risk appropriate for that industry
- Mitigation of risk with contingent contracts
  - Suppliers
  - Labor
  - Equipment Vendors
  - Customers
  - Other services

4/5/2006

© 2005 epmt, inc., all rights reserved

32



## Advanced Tools

- Delta (error propagation)
- Extreme Value Theory (EVT)
- Event studies
- Causal modeling
- Bayesian methods
- Cross-sectional studies
- Six Sigma

4/5/2006

© 2005 epmt, inc., all rights reserved

33

## Performance Attribution

- Assign returns over a single period to each factor
- Underlying principle is multiple-factor model
- Examining ex post, portfolio's exposure is known at beginning of period, as well as portfolio's realized return and estimated factor returns over the period.

4/5/2006

© 2005 epmt, inc., all rights reserved

34

# Foundation

- DATA
  - Cost of production
  - Cost of negotiation
  - Cost of mitigation
  - Transaction costs
  - Regulatory costs
  - Competitor position
  - Cost of analysis
  - Etc.

4/5/2006

© 2005 epmt, inc., all rights reserved

35

# FIN

## Questions?

4/5/2006

© 2005 epmt, inc., all rights reserved

36