

# Portfolio Theory, Speculation and the PRC Stock Market

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# Setting Investment Policies

- DiBartolomeo, Dan and Erik Witkowski. "Mutual Fund Misclassification: Evidence Based On Style Analysis," Financial Analyst Journal, 1997, v53(5,Sep/Oct), 32-43. (Required for CFA III)
- Wilcox, Jarrod, "Better Policy for Capital Growth", Panagora Working Paper, 2002
- Emmanuel Derman, "Perception of Time, Return and Risk During Periods of Speculation", Goldman Sachs Working Paper, 2002
- Dan diBartolomeo, "Risk of Equity Securities and Portfolios", AIMR CFA III Readings, 1997

# Traditional Utility Theory

- ▼ Bernoulli and the three stochastic dominants
  - Investor's prefer more return to less
  - Investor's prefer less risk to more
  - There is a marginal decreasing utility for wealth
- ▼ Log of wealth fits nicely
- ▼  $U = E[R] - L * E[V]$  (Markowitz and Levy)
  - First two terms of Taylor series expansion
  - R is the arithmetic mean of returns
  - V is the variance of returns

# Theoretically Optimization is the Answer [Right?]

- ▶ Harder than it looks
- ▶ Estimation error issues are huge
- ▶ Is the risk definition admissible?
- ▶ What's your risk aversion?
- ▶ But what is the alternative?
  - Risk limits are economically indefensible
    - ◆ The short sale constraint

# People Believe Chinese Market is about Trading Not Investing

- ▼ Investing derives wealth from economics rent earned by supplying capital. Trading is gambling with the assumption of forecasting skill.
- ▼ But wealth creation over long horizons arises from compound returns

$C \sim R - V/2$  (Messmore, 1995)

- ▼ So compound return and utility are comparable if  $L = .5$
- ▼ More on this later from Derman (2002)

# So Why Doesn't $L = .5$ for Everybody

- ▼ Time Horizons
  - Traditional Markowitz is a Single Period Model. The future is one long period.
- ▼ Estimation Errors
  - Problem Parameters are not known
  - Problem Parameters are transient
- ▼ Relative Returns may matter

# Implying Risk Aversion From Benchmarks – A Caveat

- ▼ Active managers measure risk relative to benchmark indices
- ▼ Indices are presumed to be mean-variance efficient
- ▼ But if the index is efficient, active management can't work. If active management works, the index cannot be efficient.
- ▼ Roll (1992), Wilcox (2000)
- ▼ Tracking error is an inadmissible estimator of risk for active managers

# Implying Risk Aversion From Benchmarks

- ▶ Despite the foregoing, we march forward on an DJ China example
- ▶ Assume: Risk free rate 5%, expected return 10%, variance  $400\%^2$
- ▶ Portfolio of 99% DJ China, 1% Cash has expected return 9.95%, variance of  $392\%^2$
- ▶ Portfolio of 101% DJ China, -1% Cash has expected return 10.05%, variance of  $408\%^2$
- ▶ Look at finite differences. We're willing to trade  $16\%^2$  units of variance for .1% return,  $L = .625$
- ▶ Really an upper limit since we've left out estimation risks

# An Alternative Approach

- ▶ If we are trying to maximize wealth in the long run, we know the answer  $L = .5$
- ▶ But to have a long-run, we have to survive. Introduce a floor-like portfolio insurance
- ▶ Lets assume we can lose 20% of our wealth before we go broke
- ▶ If we're fully invested, we're leveraged 5 to 1 compared to our "risk capital", so  $L = .5 \text{ time } 5 = 2.5$
- ▶ Wilcox (2000)
- ▶ If we lose 10% of our wealth, we're now leveraged 10 to 1, so  $L = .5 * 10 = 5$

# Inference of Risk Aversion from a Risk Limit

- ▶ Assume our mandate is a 10% annual volatility limit
- ▶ Lets take the “worst case scenario” as a three standard deviation event ( $p > .99$ )
- ▶ Our floor is therefore 30%, and  $L = .5 * 100/30$  or 1.67
- ▶ In Northfield notation,  $RAP = 1/L * 100$

# Relative and Absolute Risk

- ▶ Managers manage to benchmarks, but investors such as plan sponsors can't spend relative returns
- ▶ An explicit dual goal problem: the Harvard endowment
- ▶ How about  $U = E[R] - L1 * E[Vr] - L2 * E[Va]$ ?
- ▶ Three terms aren't needed. Absolute risk is just relative risk around the risk free asset
- ▶ Create a joint benchmark that includes benchmark for active management and cash
- ▶ Wilcox (1994), Chow (1995)
- ▶ Options approach, Kritzman and Rich (1997)

# Deal with Multiple Active Benchmarks

- ▼ Common in mutual funds
  - Benchmark is the index
  - Implicit benchmark is the composite of competing funds
- ▼ Wang (1999)
- ▼ Shectman (2000)

# Considering The Costs of Risk Limits

- ▼ The expected values of risk are not true parameters, only estimates. Estimation risks are large. We have to consider the extent to which we are indifferent to small changes in risk. Michaud (1998)
- ▼ Transactions costs are known imprecisely but with probably greater precision than risks or returns
- ▼ Avoidance of risk accrues economic value over time. Transaction costs occur at a moment in time, so costs must be amortized over a reasonable time horizon, so  $U = E[R] - L1 * E[V] - C * A$
- ▼ Tax costs are more complex. After-tax risk levels are smaller and are dependent upon the nature of applicable taxes

# Time Horizon

- ▶ We always quote conventional risk values in annual terms. We usually quote VAR in daily terms.
- ▶ We model some data frequency (daily, monthly, etc.) and present “annualized values”
- ▶ If volatility is time varying, “annualizing” is not a simple process.
- ▶ diBartolomeo (2000)
- ▶ Brooks, et al (2000)

# Higher Moments

- ▼ Skewness and Kurtosis
  - Arises mostly with high frequency returns
  - Derivatives and leveraged positions
  - For stock portfolios, it probably is not worth worrying about, the Central Limit Theorem takes care of it
    - ◆ Hlawitscka and Stern (1995)
  - Wilcox (2000) shows importance for implicit leverage

# Markets with Speculative Participants (Derman)

- ▶ Assume investors are maximizing profit per trade, rather than return per unit time
- ▶ Time is now endogenous
- ▶ Derive basic portfolio theory, CAPM and APT in the new framework
- ▶ Expected returns are now a function of the product of risk and trading activity
- ▶ Predicts “bubbles” as investors are drawn to trading opportunities. Investors now have negative risk aversion when measured in conventional terms

# Alternative Measures of Risk

- ▼ Return Volatility
  - Expresses Risk in Terms of Impact on Wealth Creation
- ▼ Tracking Error
  - Expresses Business Risk for Asset Managers
  - The Risk of Under-performing Peers
- ▼ VAR
  - Risk of Monetary Loss to a Specified Confidence Interval
  - Developed for bank trading where capital is borrowed, not invested by equity participants
  - If returns are symmetrically distributed, it is just an arithmetic function of Volatility
  - $\text{VAR} = \text{portfolio value} * \text{volatility} * Z(p) / (250^{.5})$

# Basic Multi-Factor Model Design

- ▼ Consistent with Northfield models for other countries. Sensitivity to factors obtained by statistical inference
  - Market Risk
  - Six Sectors
  - Size (Market Capitalization), Dividend Yield
  - Energy Costs, Interest Rates
  - “In Residual” Blind Factors
  - Exponential Weighting

# “In Residual” Blind Factors

- ▶ Ideal for emerging markets such as China allowing the model to adapt to changing conditions
- ▶ Unlike full blind factor model, expected value of eigenvalues is zero. This means that when new factors appear, the cause must be recent
- ▶ Take a 60 month estimation period: if residuals are uncorrelated, the residual covariance matrix has no structure
- ▶ Move up one month, again use 60 months. Drop one old month at the beginning, add one new month at the end. Dropping one month of old data with no structure cannot create structure, so if structure is found it must be from events in the new month of data added

# Testing Predictive Power of the Model

- ▼ Form 30 random portfolios and random benchmarks each month for 18 months from April 2000 to August 2001
  - Portfolios of 25 to 100 stocks equal weighted
  - Benchmark of 100 stocks capitalization weighted
  - Very difficult test, small cap bias, monthly rebalancing
  - Forecast tracking errors for each portfolio then observe portfolio for 12 months to find realized tracking error
- ▼ Compare for bias, discriminating power and consistency of discriminating power
- ▼ Average Bias 20%, Average Correlation .61
- ▼ Last Two Months Bias 10%

# Unstable Nature of Chinese Market

- ▼ “A” Shares have much higher volatility than “B” Shares
- ▼ Financial Statements are not Trusted
- ▼ Impact of Price Change Limits
  - Serial Correlation
  - Model for Chinese Stock Options Being Developed by Boston University and Northfield
- ▼ Heteroskedasticity
  - See diBartolomeo, “Recent Variations in the Risk Level of US Equity Securities”, (2000)
- ▼ Use of Daily Returns Instead of Monthly
  - diBartolomeo “Making Covariance Based Portfolio Risk Models Sensitive to the Rate at which Markets Reflect New Information”, (2002)

# Other References

- ▶ Bailey, Warren. "Risk And Return On China's New Stock Markets: Some Preliminary Evidence," Pacific-Basin Finance Journal, 1994, v2(2/3), 243-260.
- ▶ Chen, Gongmeng, Chuck C. Y. Kwok and Oliver M. Rui. "The Day-Of-The-Week Regularity In The Stock Markets Of China," Journal of Multinational Financial Management, 2001, v11(2, Apr), 139-163.
- ▶ Chen, Sheng-Syan, Tsai-Yen Chung and Ly-Inn Chung. "Investment Opportunities, Free Cash Flow And Stock Valuation Effects Of Corporate Investments: The Case Of Taiwanese Investments In China," Review of Quantitative Finance and Accounting, 2001, v16(4, Jun), 299-310.
- ▶ Fan, Chuen-mei and Liang-Shing Fan. "The Embryonic Development Of A Stock Exchange In Communist China: The Shanghai Securities Exchange," Advances in Pacific Basin Business Economics and Finance, 1996, v2(1), 33-42.
- ▶ Huang, Bwo-Jung, Chin-Wei Yang and John Wei-Shan Hu. "Causality And Cointegration Of Stock Markets Among The United States, Japan And The South China Growth Triangle," International Review of Financial Analysis, 2000, v9(3), 281-297.

# Other References

- ▼ Huang, Bwo-Nung, Chin-Wei Yang and John Wei-Shan Hu. "Causality And Cointegration Of Stock Markets Among The United States, Japan And The South China Growth Triangle," *International Review of Financial Analysis*, 2000, v9(3), 281-297.
- ▼ Mookerjee, Rajen and Qiao Yu. "Capital Market Reform On The Road To A Market-Oriented Economy: The Case Of Stock Markets In China," *Journal of Developing Areas*, 1995, v30(1,Oct), 23-39.
- ▼ Sjoo, Boo and Jianhua Zhang. "Market Segmentation And Information Diffusion In China's Stock Markets," *Journal of Multinational Financial Management*, 2000, v10(3-4,Dec), 421-438.
- ▼ Yeh, Yin-Hua and Tsun-Siou Lee. "The Interaction And Volatility Asymmetry Of Unexpected Returns In The Greater China Stock Markets," *Global Finance Journal*, 2000, v11(1-2), 129-149.
- ▼ Yu, Qiao. "A Conditional Variance Model For Daily Stock Returns In China's Emerging Stock Markets: Empirical Evidence On The Shanghai And Shenzhen Exchanges," *Journal of International Financial Markets, Institutions and Money*, 1996, v6(4), 1-19.
- ▼ Zhao, Zing-Qiu. "Stock Prices, Inflation And Output: Evidence From China," *Applied Economics Letters*, 1999, v6(8,Aug), 509-511.

# Other References

- ▶ Bergstrom, Clas and Ellen Tang. "Price Differentials Between Different Classes Of Stocks: An Empirical Study On Chinese Stock Markets," *Journal of Multinational Financial Management*, 2001, v11(4-5,Dec), 407-426.
- ▶ Chen, C. J. P., F. A. Gul and X. Su. "A Comparison Of Reported Earnings Under Chinese GAAP Vs. IAS: Evidence From The Shanghai Stock Exchange," *Accounting Horizons*, 1999, v13(2,Jun), 91-111.
- ▶ Chen, Charles J. P., Shimin Chen and Xijia Su. "Is Accounting Information Value-Relevant In The Emerging Chinese Stock Market?," *Journal of International Accounting, Auditing and Taxation*, 2001, v10(1), 1-22.
- ▶ Chen, Yea-Mow and Yuli Su. "An Examination Into Market Segmentation In The Chinese Stock Market," *Advances in Pacific-Basin Finance Management*, 1998, v4(1), 49-70.
- ▶ Chui, Andy C. W. and Chuck C. Y. Kwok. "Cross-Autocorrelation Between A Shares And B Shares In The Chinese Stock Market," *Journal of Financial Research*, 1998, v21(3,Fall), 333-353.

# Other References

- ▶ Liu, Xiaming, Haiyan Song and Peter Romilly. "Are Chinese Stock Market Efficient? A Cointegration And Causality Market," Applied Economics Letters, 1997, v4(8, Aug), 511-515.
- ▶ Ma, Xianghai. "Capital Controls, Market Segmentation And Stock Prices: Evidence From The Chinese Stock Market," Pacific-Basin Finance Journal, 1996, v4(2-3, Jul), 219-239.
- ▶ Mookerjee, Rajen and Qiao Yu. "Seasonality In Returns On The Chinese Stock Markets," Global Finance Journal, 1999, v10(1, Mar), 93-105.
- ▶ Song, Haiyan. "Stock Returns And Volatility: An Empirical Study Of Chinese Stock Markets," International Review of Applied Economics, 1998, v12(1, Jan), 129-139.
- ▶ Su, Dongwei and Belton M. Fleisher. "Risk, Return And Regulation In Chinese Stock Markets," Journal of Economics and Business, 1998, v50(3, May/June), 239-256.
- ▶ Su, Dongwei and Belton M. Fleisher. "Why Does Return Volatility Differ In Chinese Stock Markets?," Pacific-Basin Finance Journal, 1999, v7(5, Dec), 557-586.

# Other References

- ▶ Su, Dongwei. "Earnings Announcements And Stock Returns In Emerging Chinese Markets," *Emerging Markets Quarterly*, 2000, v4(2,Summer), 55-61.
- ▶ Su, Dongwei. "Ownership Restrictions And Stock Prices: Evidence From Chinese Markets," *Financial Review*, 1999, v34(2,May), 37-56.
- ▶ Wood, Adrian. "Joint Stock Companies With Rearranged Public Ownership: What Can We Learn From Recent Chinese And East European Experience With State Enterprises?," *China Economic Review*, 1993, v4(2), 181-193.
- ▶ Xu, Cheng Kenneth. "The Microstructure Of The Chinese Stock Market," *China Economic Review*, 2000, v11(1), 79-97.
- ▶ Xu, X. and Y. Wang. "Ownership Structure And Corporate Governance In Chinese Stock Companies," *China Economic Review*, 1999, v10(1), 75-98.