

# Risk Considerations for International Investors

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7<sup>th</sup> Annual London Seminar

London, UK November 7<sup>th</sup> , 2012

# Things We Want To Discuss

- What are appropriate measures of risk for international investors?
- What are the key analytical decisions in modeling risk across multiple countries?
- Do risk models really work globally?
- How can risk modeling methods be used for forecast future crises?
- Risk based asset allocation, parity strategies for controlling risk

# Risk Model Objectives

## 1. Measuring Risk

- Statistical model of the past, complete replication.
- Does complete replication of past help forecast?
- What are the sources?

## 2. Managing Risk

- Identify: where do our risk come from?
- Diversify: which assets behave differently?

## 3. Hedging Risk

- Negative correlation: buy
- Positive correlations: short

## 4. Dynamic allocation

- Too risky: buy less risky assets
- Can afford to take more risk: take more risk

# Are We Using the Right Risk Measures?

- Benchmark-relative risk (Tracking Error):
  - Most institutional asset managers pay most attention to tracking error.
  - Useful for determining relative peer bets or relative performance.
  - Every active manager and their investors must believe their future returns will be above average but it's impossible for everyone to be above average, roughly half of managers must underperform.
    - Tracking error ignores the risk of being wrong.
  - Investors don't pay their obligations with benchmark relative money, investors are focused on absolute risk.
  - Recent global crisis illustrated many portfolios were unprepared for wealth preservation.
- Short-horizon, capital based measures like VaR
  - Appropriate for leveraged investors (i.e. hedge funds) that must be concerned with solvency, but such measures can distort rational policies for long term investors.

# Is parametric VaR OK with “fat tailed” return distributions?

- There are a couple different theories on how the fat tailed nature of security return distributions comes about.
  - It is a relatively simple exercise to adjust tail probability values from the normal distribution to be more realistic for a particular context.
  - We do this by having risk models that are conditioned on contemporaneous information so as to rapidly capture changes in volatility levels. Near-term horizon models.
  - In addition, we explicitly adjust for kurtosis by using rescaled range volatility estimators (see Parkinson, 1980) and Cornish and Fisher (1937).
- Measures risk and accounts for tail risk, but doesn't identify the sources.
- For additional information see diBartolomeo (2007) and diBartolomeo (2008).

# Relative Market Risk: Beta

- Market risk is the largest contributor to risk models.
  - In a purely statistical model, market factor is the first.
  - Risk is measured and identified as a single factor.
- Riskier assets don't always have higher beta.
  - Beta measures an asset's exposure to Market movement.
  - Large capitalization stocks move capitalization weighted market measures.
- Securities cannot be compared cross country or regions.
  - A security with a beta of 0.9 vs. a German market index may have a beta of 1.2 vs. a European market index.
- Historically a global market beta was not relevant.
  - (Spoiler alert) recent research illustrates this has changed.

# What other techniques are available to address volatile conditions?

- Any coherent risk measures (e.g. CVaR) is probably sufficient (i.e. NOT VaR)
  - The issue is not the nature of the measure as much as how the existence of higher moments should or should not be incorporated depending on the time horizon and utility function.
- Stress-testing and simulation are of limited value for unleveraged investors for whom risk management is an exercise in making intelligent risk reward tradeoffs over the future horizon.
  - These techniques are more suitable for financial intermediaries for whom day to day solvency is the key aspect of risk management:  
<http://www.northinfo.com/documents/133.pdf> and  
<http://www.northinfo.com/documents/213.pdf>.

# The Oldest Question in Risk: Sector or Country

- Long debate in the finance literature on whether sector or country risk dominates for international investors.
  - See Heston and Rouwenhorst (1994,1995,2004)
- If your framework is capitalization weighted, sector dominates country.
  - Ford is worried about Toyota and Daimler Benz
- If your framework is equal weighted (e.g. emerging markets), country dominates sector.
  - Smaller cap's become more important
  - Local economic and political stability is the dominant risk
- Recent research indicates sectors move more closely together as a global economy.
  - Is individual country risk less important?

# The Second Debate: Cross-sectional Versus Time-Series Models

- Endogenous (fundamental) models were invented because exogenous models were hard to estimate at the security level, not because the risks to investor portfolios are actually endogenous.
  - See Rosenberg and Guy (1976).
  - Too much data to process.
  - Ground breaking “at the time”, but so was the VAX.
  - Statistical estimation techniques have come quite a long way since the 1970s.
- Cross-sectional models have about the same degree of estimation error irrespective of portfolio diversification.
- Times series models have more error on concentrated portfolios and less on diverse portfolios.

# Are Model Factors Stable Over Time?

- The short answer is NO.
  - But our modelling techniques do not require that the factors be completely stable.
  - Since 2003, almost all of our models used a hybrid approach that involves both specified factors and statistical factors (principal components) estimated only within the residual return observations.
  - Allowing almost all of the volatility of markets to be described by a parsimonious set of identifiable factors, while still providing the flexibility of a statistical model to adapt to new pervasive factors within the market as conditions evolve.
  - With respect to the recent GFC, there has been no evidence that a permanent restructuring of our factors is called for, but the influence of the statistical factors was certainly increased on a transient basis.
    - Internet factor in 2000.

# Data Frequency and Illiquidity

- If you treat country or currency risks as separate factors you're going to need lots of observations to estimate a stable correlation matrix.
- One obvious way to get lots of data is to use daily return observations.
  - Fundamental data is updated at most quarterly so most of what you see daily at the stock level are just price momentum effects.
  - Daily return data across global markets occurs at different times. Which day matters during a correction?
  - Daily returns have high degrees of kurtosis.
- Many smaller markets are highly illiquid
  - Odds of guessing on the Bahrain stock exchange.

# International Accounting Standards

- Endogenous risk models often use accounting variables (e.g. E/P) as factors.
  - Earnings can be manipulated.
- Accounting standards still vary widely across countries although a few hundred global firms are trying to report on purportedly international standards.
  - Depreciation Standards.
  - Recognition of pension obligations.
- Country standardization is generally not the solution.
  - Is buying the largest stock in Poland a large cap bet in the context of a global portfolio?
- In many emerging and frontier countries most local investors don't believe financial statements are credible.

# Developed Country Risks

- If there was one lesson that should be learned in the financial crisis it was that “too big to fail is real”.
- The financial stability of national governments and the stability of the banking system is inextricably linked.
  - We’ve modeled government securities as part of the “financial sector” since 1999.
- The US is low on the scale of vulnerability.
  - The “systemic risk banks” in the US have assets of 65% of GDP.
  - France 249%, UK 337%, Switzerland (just 2 banks) 550%, DB alone is 84% of Germany.
- We now model government bond credit in contingent claims framework assuming bank bailouts will be normal.
  - Linking sovereign credit risk to equity factors.

# The Problem of Volatile Currencies

- Just calculating the time series volatility of the exchange rate of any two currencies is problematic.
- Consider an exchange rate of 80 JPY to 1 US\$.
  - A Japanese investor puts 80 JPY in the US.
  - An American investor \$1 in Japan.
  - Lets assume the exchange rate changes to 100 JPY to the US\$.
  - The Japanese investor's US position can be converted back to 100 JPY, a gain of 25%.
  - The US investor's 80 JPY can now be converted back to 80 cents, a loss of 20%.
- Repeated over many periods, the difference in return will generate differences in volatility.
- Currency risk must re-calculated from both currencies perspective and not simply the inverse.
  - See de Jong (2010, 2011) <http://www.northinfo.com/documents/381.pdf>

# Cross-listings, ADRs and GDRs

- To understand country exposure requires proper handling of cross-listings, GDRs and ADRs.
- Most equity risk models treat ADRs as simply having the same characteristics as the underlying local share.
- This makes perfect sense for a company like Nippon Telephone
  - NTT is a very Japan centric company. Almost all the trading is in Japan and the vast majority of company revenue arises from Japan.
- Would the same logic apply for Royal Dutch or BP?
  - Is the Netherlands the key country exposure for RD?
  - Not much trading, not much revenue and no oil.
- How about AgloAmerica? A London based mining company which primarily trades in London with majority of mining operations in South Africa and selling primarily within Asian markets.

# Do Risk Models Really Work?

- Generally, they work very well
  - Especially given the financial crisis in the sample period but security level models for some emerging markets are still problematic.
- Here are some results for MV portfolios (200 names maximum) 1/1/2000 through 12/31/2010

Monthly SD	Ex-Ante	Realized
Brazil MV	8.83	9.29
Brazil MC	11.26	12.21
Asia MV	2.95	2.56
Global LC MV	.44	1.82
Global SC MV	2.18	2.29

# What made models robust during the global financial crisis?

- Our models tightly link information across asset classes.
  - Our internal model of corporate bond credit risk adjust the volatility of the equity to reflect the probability of bankruptcy.
  - Information from equity option markets has been very valuable in risk assessment of the European sovereign debt crisis.
- Again, statistical factors captured the transient systematic volatility which was unidentifiable, but not ignored.
  - Conjectures about the temporary factors.
- Near term horizon risk models.
  - Since 2008, for shorter horizons the parameters of our models are conditioned on contemporaneously observable information regarding financial markets (e.g. VIX, TED spread). In essence the model is based on an information set that includes the present as opposed to merely looking at the past.

# Will models help to detect the next crisis or regime shift?

- Our models incorporate a hybrid structure involving both permanent specified factors and transient statistical factors (within residual).
  - Under typical conditions the in-sample explanatory power of the statistical factors should be close to zero for the market portfolio. To the extent that the explanatory power of statistical factors increases to meaningful levels this is an indication of changes in the market factor structure.
- Our process of conditioning each key aspect of the risk estimates on contemporaneously observable information set.
  - Allows for rapid changes in the model estimates of factor and security correlation as well as volatility.
  - Observations of the cross-sectional dispersion of security returns and implied option volatilities are useful inputs to this adjustment process.
  - See diBartolomeo and Warrick (2005), diBartolomeo (2006), and diBartolomeo (1998).

# Does the model time horizon contribute to the ability to detect regime shifts?

- Our models are available in three distinct forecasting horizons, one trading day (US equities only), ten trading days and one year.
  - The limitation on availability of the one day horizon models is based on the lack of liquid options trading on most individual stocks outside the US.
- Since 2004 our systems have incorporated CUSUM, a sequential probability ratio test as a formal test of change in long-term changes in regime.
  - The test can be applied to time series of factor returns or other aspects of market structure.
  - For background, see diBartolomeo and Warrick (2005b).
- Why is this topic only important when the market crashes?
  - Short term risk is lower than longer term risk.
  - When will it be a topic again? When short term volatility increases?

# How can linear models deal with non-linear derivative instruments?

- We routinely provide factor representations of more than a hundred types of derivative instruments.
  - Users can input the terms and conditions on more than 100 types of derivative positions for our system to calculate exposures.
  - For instruments with asymmetric payoffs we use Cornish-Fisher. Take into account whether the position is a long or a short position to get the tail probabilities correct even though the linear model computes a symmetric measure. For downside risk, we only care about getting the downside tail right.
  - For selected instruments with highly non-linear properties (e.g. barrier options), we have an additional system called “Collection of Positions” that uses Monte-Carlo simulation of the factor model components to estimate the price distribution of an entire set of derivative positions simultaneously, and create a factor representation of the spectrum of portfolio value changes.
- Our risk measures can be used in a one-tailed test such as parametric VaR

# Risk Parity: Risk Based Asset Allocation

- Risk parity is one of several allocation strategies that do not require explicit forecasts of asset class (or country) returns.
  - Although there are implicit return forecasts involved in leverage assumption.
- Qian (2011) describes risk parity allocation as “capturing risk premiums from a risk diversified portfolio”. <http://www.northinfo.com/documents/458.pdf>

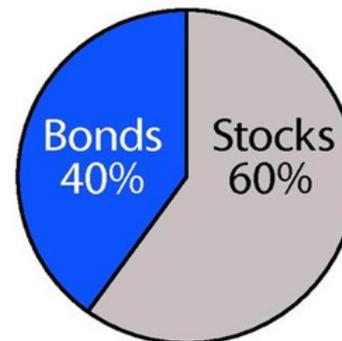
– Traditional 60/40 Portfolio  
Asset Allocation

– Risk Allocation is closer  
to 90/10

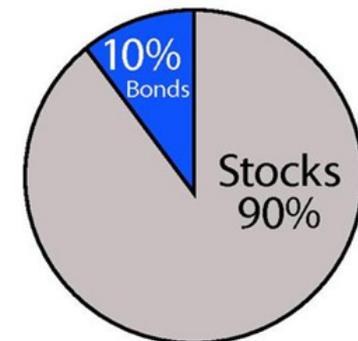
– Source of Graph: Wikipedia

## Traditional Portfolio

Asset Allocation

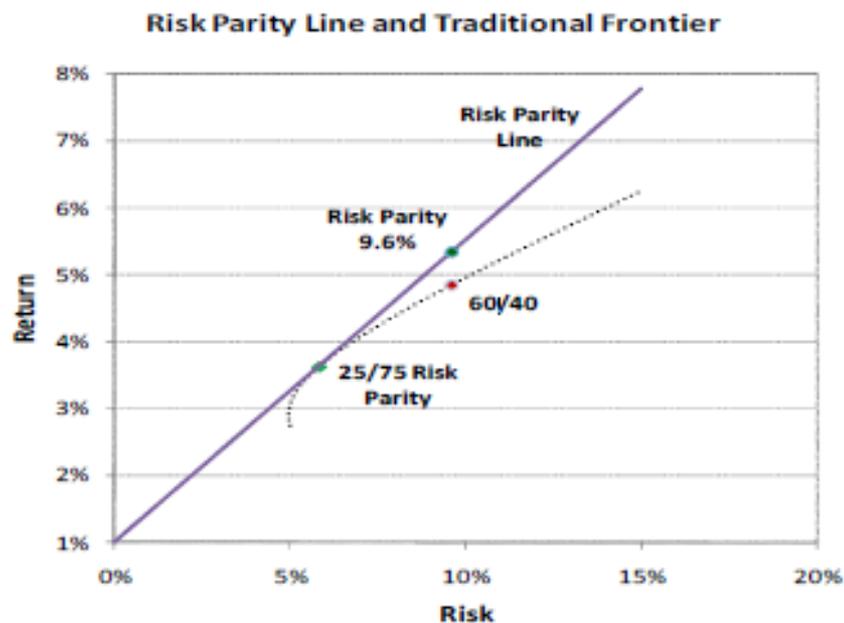


Risk Allocation



# “Efficient” Risk Parity Portfolio

- Using Quin’s example:
  - An equal risk portfolio is 25/75
  - Leveraging the 25/75 portfolio provides the same risk parity as the 60/40 portfolio with a greater “implied return”



# Literature on Risk Parity Allocation and Related Strategies

- Other allocation approaches without return forecasts
  - Equal Weighted
  - Global Minimum Variance
  - Most Diversified
- Literature:
  - Two basic industry pieces from consultants
    - Allen (Callan, February 2010)
    - Foresti and Rush (Wilshire, February 2010)
  - A good overview of risk based allocation strategies
    - Lee (Journal of Portfolio Management, Summer 2011)
  - Empirical analysis of risk based strategies
    - Bhansali (Journal of Investing, Spring 2011)

# Possible Rationales for Using Risk Based Allocation Methods

- Explicit asset class or country return forecasting is counterproductive. When we do it, we get it wrong!
  - Forecasting asset class covariance is much more accurate.
  - Under MPT if we can't forecast return, but we can forecast risk we should hold the minimum variance portfolio of risk assets.
- If we can't forecast returns, and our beliefs about risk are vague.
  - Under MPT we should use risk parity to spread the risk out as much as possible.
  - Avoid holding large amounts of what we incorrectly thought was the low risk asset.
- Achieve higher Sharpe ratios.

# Increases Sharpe ratios?

- Empirically observed Sharpe ratios are higher for low risk assets than high risk assets.
  - In many countries, low risk equities are better than high risk equities.
  - Bonds are better than equities.
  - Illiquid asset classes falsely look really good.
  - Global economy is experiencing an extended period of lower returns in riskier equities. Can we assume this will continue?
- Restructure asset allocations so that an equal (or more) amount of the risk comes from low risk assets which empirically have higher Sharpe ratios than higher risk asset classes by leveraging them up.
  - What is the starting combination? Min variance portfolio?
  - What is optimal leverage without a concept of returns?
  - How much of the lower risk asset must be leveraged to achieve some ideal return?

# Ambiguities Around Risk

- Risk parity uses beta as the relevant risk measure.
  - The use of beta as a risk measure arises from the CAPM which introduces certain conceptual complications (low beta is not necessary least risky).
  - The use of beta provides for a unique solution to the problem (i.e. 50/50):
    - 50% min-variance equity and 50% high yield bond portfolio
    - 50% Small Cap equity and 50% treasury bonds
- Other risk-based strategies such as “maximum diversification” or “minimum variance” are based on the full expected covariance matrix.
  - Decomposing portfolio volatility (standard deviation) or portfolio variance into additive components is common but controversial
  - Non unique solutions that are dependent on your assumptions of how covariance should be allocated and the “contra asset”
  - Standard deviations are not naturally additive, variances are
  - Consider a portfolio of equities and short Treasuries: Should we credit half of the covariance to the bonds?

# Conclusions

- Basic decisions about what risk measures to use are often controversial.
- There are a lot of subtleties in estimating models that have to cover lots of countries across different asset classes in the same model.
  - For developed markets country risks revolve around stability of banking systems and “too big to fail”
  - Many of the challenges peculiar to emerging and frontier markets remain outstanding
  - Bond issues relevant to only a particular country
- Existing models of equity risk across international markets are reasonably effective and can reasonably handle derivatives.
- New risk based strategies such as parity and MV are consistent with MPT under particular sets of assumptions.
  - Greater granularity at the asset level than beta.
  - Leverage implies some return assumptions.

# Selected References

- diBartolomeo, Dan. Fat Tails, Tall Tales, Puppy Dog Tails, *Professional Investor*, 2007.
- diBartolomeo, Dan. Fat Tails, Liquidity Limits and IID Assumptions, March 2008.  
<http://www.northinfo.com/documents/285.pdf>
- Parkinson, M., 1980. "The extreme value method for estimating the variance of the rate of return." *Journal of Business* 53, 61–65.
- Cornish, E., and R. Fisher. 1937. "Moments and Cumulants in the Specification of Distributions.", *Extrait de la Revue de l'Institute International de Statistique* 4: 1–14.
- diBartolomeo, Dan. and Sandy Warrick. (2005). "Making covariance based portfolio risk models sensitive to the rate at which markets reflect new information" Chapter 12 in *Linear Factor models Edited*. Knight, J. and Satchell, S., Elsevier Finance.
- diBartolomeo, Dan. (2006). "Applications of Portfolio Variety" Chapter in *Forecasting Volatility* Edited Knight J. and Satchell, S., Elsevier Finance.
- diBartolomeo, Dan. (1998). "Optimization with Composite Assets Using Implied Covariance Matrices", Northfield Working Paper.
- diBartolomeo, Dan. and Sandy Warrick. (2005). "Using CUSUM Methods for Monitoring External Asset Managers", <http://www.northinfo.com/documents/72.pdf>
- Margrabe, William. "The Value Of An Option To Exchange One Asset For Another," *Journal of Finance*, 1978, v33(1), 177-186.