

The XRD Equity Risk Models

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The Northfield Global Equity Risk Model

- Northfield has a number of different equity risk models, serving different purposes, and forecasting risk over a variety of different investment horizons
- The Northfield Global Equity Risk Model is designed to give investors a broad-brush overview of the risk structure of a well-diversified global portfolio
- As such, it includes a number of Global factors, including the Global Market itself, seven Global Industrial Sectors, eight Geographic Regions and an Oil factor
- It also has a USD Bond Market factor, a Size factor, a Market Development factor and a combined Value/Growth factor

The Northfield XRD Risk Models

- However, the XRD Global Risk model has no Global factors
- It effectively consists of six Country and Regional models bolted together, with a common set of Currency factors, and a common set of Statistical factors
- Each of the Country and Regional models are also available separately with their own Currency and Statistical factors
- We have XRD risk models for the USA, Japan, Europe, Natural Resources, Asia ex Japan and Latin America
- Natural Resources covers Canada, Australia, New Zealand and South Africa.

The XRD Risk Models - Overview

- We will first describe the XRD US Risk model in some detail
- Then we will discuss the XRD European Regional model to illustrate the differences between a single Country XRD model and a multi-country Regional XRD model
- The construction of the XRD Japan model is essentially the same as that of the XRD US model
- Likewise, the construction of the XRD Asia ex Japan model, the XRD Latin America model and the XRD Natural Resources model is essentially the same as that of the XRD European Regional model

The XRD US Model - Universe & Factors

- The US model universe contains about 12,000 securities, including ETFs and indices as well as individual stocks
- The XRD US model has 4 factor blocks:
 - Currency factors
 - Style factors
 - Market and Industry factors
 - Statistical factors
- As with all the Northfield equity risk models, the XRD models are hybrid models, meaning they combine a set of defined factors with a small number of Statistical factors

The XRD US Model - Currency factors

- Assume the base currency of the model is the US Dollar
- Then the XRD US model has 6 foreign Currency factors : the Euro, the Japanese Yen, the British Pound, the Swiss Franc, the Canadian Dollar and the Australian Dollar
- Although the US model universe consists mainly of US securities, there will also be some foreign stocks, in the form of ADRs, GDRs, Canadian stocks, and so on
- The Currency factors are used to estimate the sensitivity of these foreign securities to their home Currency
- Note that we are NOT allowing US stocks to have sensitivity to the foreign Currency factors

The XRD US Model - Style factors

- The XRD US model contains 9 US Style factors as follows :-
 - Dividend Yield
 - Value (composite of B/P, E/P & CF/P)
 - Growth Trend (composite of EGR, BVGR & SGR)
 - Growth Momentum (composite of EMM, BVMM & SMM)
 - Short-term Price Momentum (4 weeks, a.k.a. Reversal)
 - Long-term Price Momentum (1 year, from 4 weeks ago)
 - Leverage (Debt/Equity ratio)
 - Liquidity (time-wtd ADV over 10 days/ADV over 60 days)
 - Quality (composite of ROE, ROA, CF/Sales, Sus Growth)

The XRD US Model - Market factors

- For larger Equity markets, such as the US, we have both a Large Market factor and a Small Market factor
- The US Large Market factor consists of the top 500 stocks by market capitalisation (think S&P 500)
- We then skip the next 500 stocks (think Mid-Caps)
- The US Small Market factor consists of the next 2,000 stocks by market capitalisation (think Russell 2000)
- The Large Market factor represents the top 80% or so of the market, we then skip the next 8-10% of Mid-Caps, and the Small Market factor represents the next 8-10%

The XRD US Model - Size Effects

- Most defined factor risk models can be used to determine whether a portfolio has a Size tilt
- There are a number of different ways of doing this:
 - Fama-French use a Small – Large (SML) factor
 - Alternatively, Size can be treated as a Style factor, using normalised $\text{SQRT}(\text{MktCap})$, for example, as the Size beta
- In the XRD model we have Large Market and Small Market factors, which means a relative portfolio risk analysis can distinguish between being overweight small stocks and being underweight large stocks relative to a benchmark
- With a single Size factor, these will look the same

The XRD US Model - Industry factors

- We use Industry Groups to define 20 Industry factors :-

Energy Equipment & Services

Materials

Aerospace & Defence

Building & Construction

Industrials

Transport

Consumer Discretionary

Retailers

Consumer Staples

Health Care

Biotechnology & Pharmaceuticals

Banking

Diversified Financials

Capital Markets

Insurance

Real Estate

Software & IT Services

Hardware & Technology

Telecom Services

Utilities

XRD Models - Capitalisation-weighted factors

- Both the Market and Industry factors are based on capitalisation-weighted indices
- The US Banking factor consists of all the US stocks classified as Banks, capitalisation-weighted
- However, we use fixed capitalisation weights through time, based on the most recent market capitalisations
- So the historic returns of the US Banking factor will differ from the actual historic returns of the US Banking industry
- However, the volatility forecast of the US Banking factor will reflect the current composition of the Banking industry

The XRD US Model - Statistical factors

- Although the 37 defined factors do explain most of the systematic variance of most stocks, we do not wish to assume that they capture ALL the systematic risk
- *(Unlike all the other risk model vendors!)*
- We therefore add 4 Statistical factors to the model to soak up any residual systematic risk, so that we can be confident that Stock Specific Risk really is uncorrelated
- The Statistical factors are the first 4 Principal Components derived from a correlation matrix formed from the residual returns of all the stocks with full histories

Risk Model Construction - 1

- The XRD models are actually hybrid models in two ways
- They combine defined and statistical factors and they also use both time-series regressions and cross-sectional regressions to build the model
- Time-series regressions are used to estimate stock betas in cases where the betas are stable over time
- This includes the Currency betas (for foreign stocks), the Market and Industry betas, and the Statistical betas
- However, for the Style factors, we derive the stock betas from fundamental data, and use cross-sectional regressions to estimate the Style factor returns

Risk Model Construction - 2

- To estimate the stock betas, we use a combination of Bayesian priors and statistical significance tests
- For example, EXXON would have a prior on the US Large Market factor and on US Energy Equipment & Services
- Similarly, the BP ADR, traded in New York, would have a prior on the Pound Sterling factor
- The model is built sequentially, one factor group at a time
- First, the foreign stock returns (in USD terms) are regressed on their home Currency factor to get the currency beta
- XRD models do NOT use dummy variables for stock betas

Risk Model Construction - 3

- We then run cross-sectional regressions of the set of Style betas at the beginning of each period against the set of stock returns over the period to estimate the Style factor returns for that period, and repeat this for all periods
- Each stock will have a Market prior and an Industry prior
- We run a double regression of the residual stock returns on the relevant Market and Industry factors to get these betas
- We then take the residual stock returns from this regression, and run a double stepwise regression on all the remaining Market and Industry factors to see if any of the resulting 'secondary' betas pass the significance test

Risk Model Construction - 4

- About 15% of all stocks have these 'secondary betas'
- However, this is a very misleading statistic, because the kind of stocks that do get secondary betas tend to be larger, conglomerate type stocks, which tend to dominate most institutional portfolios
- The remaining residual returns for each stock are regressed on the four Statistical factors, and the resulting betas are again subject to a significance test.
- Any betas that fail the significance test are set to zero
- Finally, we derive the Stock Specific Risk for each stock from its remaining residual return series

The XRD Europe Regional Model - 1

- The XRD Europe model has 13 Currency factors, as the European universe includes stocks with other home currencies, such as Norwegian, Russian and Turkish stocks
- Otherwise, the Currency factors are treated the same way
- Each model has its own set of Style factors, as we do not believe in Global Style factors
- European Value works much of the time, as does US Value, but they do not necessarily work at the same time
- The main difference between a single Country model like the US and a regional model like Europe is that the regional model will have many Market factors

The XRD Europe Regional Model - 2

- The XRD Europe model has 25 Market factors, of which 8 have Large/Small Market pairs, giving 33 factors altogether
- We sometimes put neighbouring countries with small stock markets into combined factors
- In Europe we have
 - a Baltic Region factor for Latvia, Lithuania and Estonia,
 - a combined Greece & Cyprus factor,
 - a combined Russia & Kazakhstan factor
- Otherwise the Europe model structure is basically the same as the US model

The XRD Models - Investment Horizon 1

- We have Long-term and Short-term XRD models
- The Long-term model uses 80 4-week returns, so it has a look-back period of 320 weeks, or about 6.1 years
- The XRD models are time-weighted, so that more recent data has more weight in the model than older data
- In the Long-term XRD model, the half-life is 3.6 years, so half the weight comes from the most recent 2.2 years, and the other half comes from the previous 3.9 years
- The Long-term model would therefore be used to forecast portfolio risks from 3 months up to about one year ahead

The XRD Models - Investment Horizon 2

- The Short-term model uses 80 1-week returns, so it has a look-back period of about 18.4 months, or 1.53 years
- The Short-term model is time-weighted using the same decay factor as the Long-term model
- In the Short-term XRD model, the most recent 0.55 years gives half the weight, while the previous 0.98 years gives the other half
- The Short-term model would therefore be used to forecast portfolio risks from 1 week up to about 3 months ahead

The Reference Day Effect

- Most equity risk models are based on a single sample of historic stock returns, such as 60 calendar month returns, looking back over 5 years
- In April 2006, Daniella Acker & Nigel Duck published a paper called Reference Day Risk and the Use of Monthly Returns Data : A Warning Note
- They had replicated a number of well-known academic studies on anomalies using monthly returns, but NOT running from the end of one month to the end of the next
- They found that using different Reference Days could make a significant difference to the results!

Using Monthly Returns may be Problematic

- Apart from the Reference Day Effect itself, there are a couple of other reasons why using calendar monthly returns may be problematic
- When we take a sample of historic returns to build a risk model, they are supposed to be a random sample
- Since there exist very well-documented end-of-month, end-of-quarter and end-of year effects, it is not clear that using calendar monthly returns constitutes a true random sample
- There is also the minor point that calendar month returns are not all the same length

So What Does XRD Actually Mean?

- In the Long-term XRD model, we begin by taking 80 4-week returns, using Wednesday closing prices
- Some of the returns in this sample may run to the end of a calendar month, or calendar quarter, or to a year-end, but they will be distributed randomly in the sample
- We use this sample of 80 4-week returns to build an SRD (Single Reference Day) risk model
- We then take a second sample of 80 4-week returns, starting one week before the first set, and build a second SRD model

So What Does XRD Actually Mean?

- Then we take a third sample of 80 4-week returns, starting two weeks before the first set, and build a third SRD model
- Finally we take a fourth set, starting three weeks before the first set and build a fourth SRD model
- If we compare these four SRD models, we find that while they are all very similar, they are also slightly different
- This is because each sample of stock returns data has its own idiosyncracies
- To create an XRD model, we simply average the four SRD models together

XRD Risk Models

- The factor volatilities and correlations are averaged
- The stock specific risks are averaged across the 4 SRD models
- For the stock betas, note that secondary betas have to pass a statistical significance test; it may be that a beta is not significant in all 4 SRD models, so it is set to zero in some
- When we average the stock betas, we impose an additional rule that if the average beta has an absolute value of less than 0.1, it is set to zero
- This helps to guard against spurious significant betas due solely to quirks in the data

Choices in Building Risk Models

- There is no 'right' way to build a multi-factor risk model
- To paraphrase Jack Treynor, all risk models are just "different ways of parsing the covariance matrix"
- Different models will serve different purposes
- The XRD models have a relatively large number of factors, and will therefore give a fairly detailed risk decomposition of a portfolio, either in absolute terms, or relative to a benchmark
- We have also chosen a particular ordering of the factor groups in the XRD risk models

Factor Order in the XRD Risk models

- Currency factors usually need to go first, because otherwise the model is not base currency invariant, meaning that the non-currency risk of a portfolio varies depending on what the base currency of the model is
- Style factors go second, because they co-vary with the Market and Industry factors, so whichever goes first will pick up the covariance between them
- We want the Style factors to be as significant as possible in a portfolio risk decomposition, so they get the covariance between the Style factors and the rest of the factors

Explanatory Power of the XRD Risk Models

- If the Market and Industry factors went before the Style factors, we would find that the Style factors explained almost nothing of a typical portfolio's risk
- The XRD risk models explain between 35-40% of the variance of large capitalisation stocks, and between 25-35% of smaller capitalisation stocks

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- We hope this has been a useful summary of Northfield's XRD risk models; please contact us if you have any further questions about them