Quantitative Monographs

When is the stock market likely to correct?

Equities

Global
Quantitative

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Are equities in a bubble and is there a mispricing?

We think of valuation as a function of growth and risk premia. Overall, we find that the equity market is pricing in a world of low growth and low inflation, but surprisingly also low risk. Given the significant increase in macro risk and the apparent end of the credit cycle we believe that an overall re-pricing of risk is likely. We also find that low volatility assets are trading well above their long term average relative to the market. Given their credit exposure, we think it is likely that low volatility stocks with high levels of gearing underperform as the credit cycle ends.

What causes markets to crash?

We differentiate between 'Bear Markets' and 'Market Crashes'. Bear markets are driven by the end of the credit and earnings cycles, whilst stock market crashes are liquidity events. We use a market impact model (Kyle's Lambda) to identify market crashes.

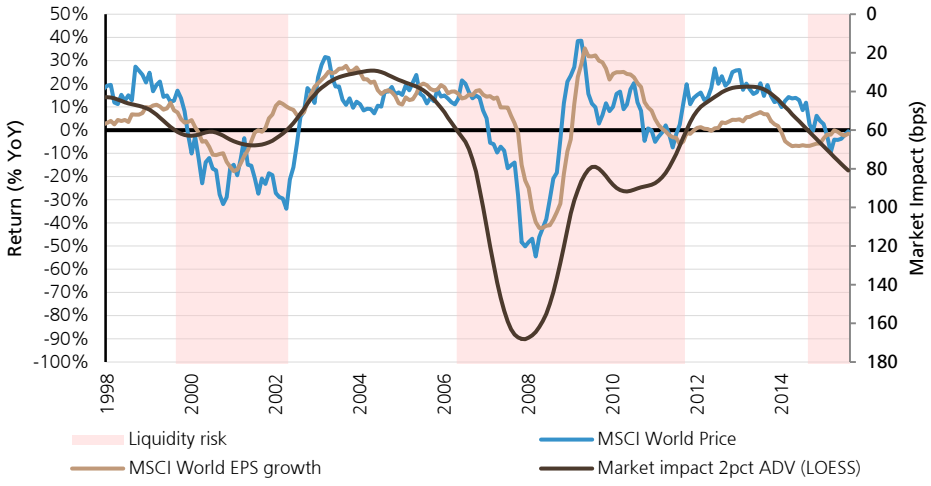
Where are we in the cycle and where is the risk?

We believe we are witnessing the end of the credit cycle. Earnings growth rates are flat and the stock market impact has been increasing. Importantly, from a risk perspective, Systemic Risk is rising, and Economic Policy Uncertainty has hit all-time highs. Across major developed markets the equity market impact is currently running at 80bps, a level commensurate with negative returns and an elevated risk of correction. We think the key risk today lies in low-volatility stocks with a high residual beta to credit.

What to invest in?

We like high-quality stocks with improving fundamentals and sustainable levels of gearing. Our key picks are: Alphabet Inc, Nestle S.A., NTT DoCoMo Inc, China Mobile Ltd, and Amcor Ltd.

Figure 1: Returns, earnings growth and Market Impact (MSCI World)



Source: Factset, UBS Quant

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Executive Summary

What causes bubbles and where are they now?

Conventional wisdom defines a bubble as any asset driven by 'irrational exuberance' that exhibits valuations that have drifted significantly from their long term valuations. In this paper, we think of valuation as a function of expected growth and risk premia. In theory, bubbles perpetuate themselves due to the business risk of asset managers. This motivates institutional herding and rational 'bubble-riding'. So where are the bubbles right now? Given a world of structurally low growth and low inflation, we expect bond yields and hence earnings yields on the market to remain at lower levels compared with their long term history. However, we identify two key areas that may be overvalued. Firstly, equities in general are trading at very high multiples, which makes sense given the level of bond yields, however, this doesn't appear to be pricing the level of macro risk that we're witnessing in the market. Secondly, low volatility equities are trading at significantly higher multiples relative to the market. These stocks tend to have higher levels of gearing and as such carry a higher beta to credit markets. If this is indeed the end of the credit cycle (as Matthew Mish points out), we believe low volatility stocks that are highly geared are likely to underperform.

Two key risks:

1. **Equities do not appear to be pricing the level of macro risk that we're witnessing in the market,**
2. **Low volatility equities are trading at significantly higher multiples relative to the market.**

What causes markets to crash?

In order to predict corrections or 'crashes', we need to understand the investment cycle. Bubbles tend to form during periods of excess liquidity. As a consequence, valuations become stretched and perpetuated through 'rational bubble riding'. However, eventually the competitive landscape increases and costs pressures build, placing pressure on margins and squeezing earnings. At this stage, credit becomes more challenging to raise as lenders (witnessing the tighter environment) increase lending standards. As a consequence, credit spreads increase and place further pressure on company earnings. The net result is the end of the earnings cycle. As earnings come under pressure, the stock market starts to drift lower and multiples begin to compress. It's at this point that the risk of a market correction increases. We make the distinction between a market downturn or 'Bear Market' and a stock market 'Crash' as the two have different drivers. A market downturn is driven by the credit and earnings cycle, whilst a stock market crash is a liquidity event.

Where are we in the cycle and where is the risk?

We are currently witnessing the end of the credit cycle. Credit spreads have been increasing, global earnings growth rates are in aggregate flat and market impact has been increasing. Market impact is currently running at 80bps across developed markets, a level that tends to be commensurate with negative returns and an elevated risk of correction. The risk today, oddly is in so-called 'low risk' assets. We show that low volatility assets are generally more highly geared than higher volatility stocks. As a consequence, they tend to have a high residual beta to credit. As lending standards tighten and credit spreads increase, it is likely that highly geared stocks underperform regardless of their volatility.

We are currently witnessing the end of the credit cycle… the risk of a stock market correction seems to be increasing, in our view.

What should we own right now?

We like High Quality stocks with improving fundamentals and sustainable levels of gearing. Key picks are: Alphabet Inc, Nestle S.A., NTT DoCoMo Inc, China Mobile Ltd, and Amcor Ltd.

What causes bubbles, and where are they now?

Conventional wisdom defines a bubble as any asset driven by 'irrational exuberance' that exhibits valuations that have drifted significantly from their long term valuations. This opens the door for bonds, property and equities to all be defined as bubbles right now, and perhaps they are. So how should we frame our thinking in terms of 'What's priced in?" and 'Where's the mispricing?".

In theory, bubbles perpetuate themselves due to the business risk of asset managers. This motivates institutional herding and 'rational bubble-riding'. As a consequence, bubbles, once formed, can last a long time. (Please see our paper on Crowding)

Data note: All data used in this study is based off the MSCI world universe unless otherwise stated. Long term relationships are modelled using US data back to 1871 (as this is the only reliable long term price, earnings and inflation data set that we have).

What's priced in?

If we think of asset bubbles in terms of expected growth, valuations and risk premia, then given a world of structurally low growth and low inflation, we expect structurally low bond yields, and hence earnings yields on the market to trade at lower levels. (Please see our paper on Demographics). However, we identify two key areas that may be overvalued.

Where's the mispricing?

Equity risk premia

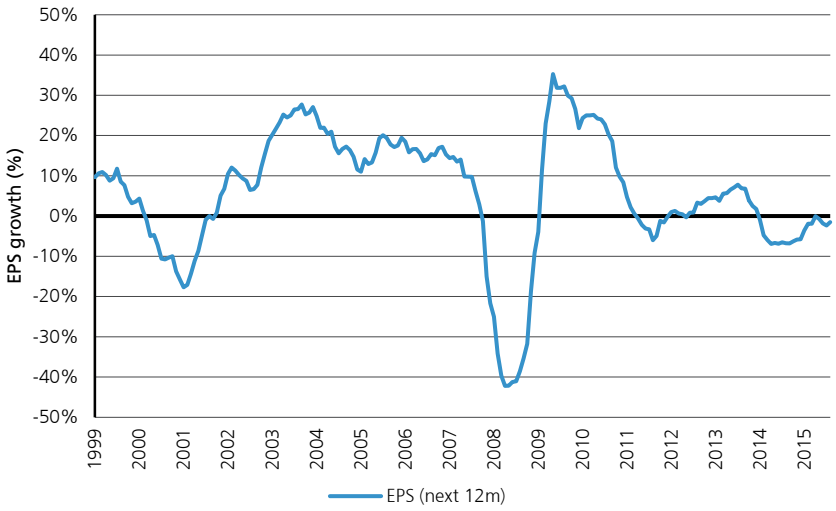
Firstly, equities in general are trading at very high multiples given the level of growth that the world is experiencing, which makes sense given the level of bond yields, however, this doesn't appear to be pricing the level of macro risk that we're witnessing in the market. Developed world earnings yields are at 4.8% and bond yields at 0.5%, as a consequence, the simple equity risk premium is trading at 4.3% (Earnings Yield – Bond Yield).

However, following Cliff Asness's (2000) paper 'Explaining the Equity Risk Premium' we show the relationship between ten year earnings growth rates and the ten year volatility differential between equities and bonds (Figure 3), and subsequently the ten year volatility differential and the ten year average equity risk premium (Figure 4). The thesis simply put is that earnings growth risk drives the volatility differential between equities and bonds, and it is this volatility differential that explains the equity risk premium. Why use ten year averages? Quite simply the short term relationships between these variables are not stable. However, Asness theorises that there is a long term generational phenomenon whereby investors frame their risk preferences and return expectations in terms of their prior experiences, as a consequence, using ten year averages (Asness uses 20 year averages) captures this effect.

Given that earnings growth rates are currently running at -1.5% per annum, we should expect a volatility differential of 11% and an equity risk premium of around 6% (assuming historical preferences hold true).

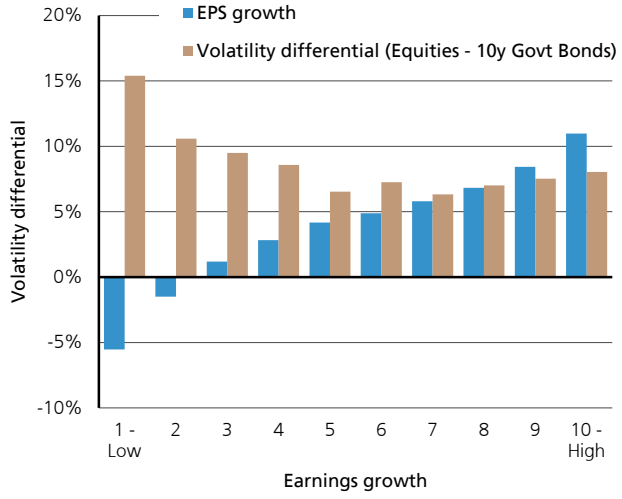
Note: the relationship that we have modelled the earnings growth rate, volatility differential and equity risk premium is based on US data as this is our only long term data set for which we have reliable data.

Figure 2: World earnings growth (Rolling next 12 months)



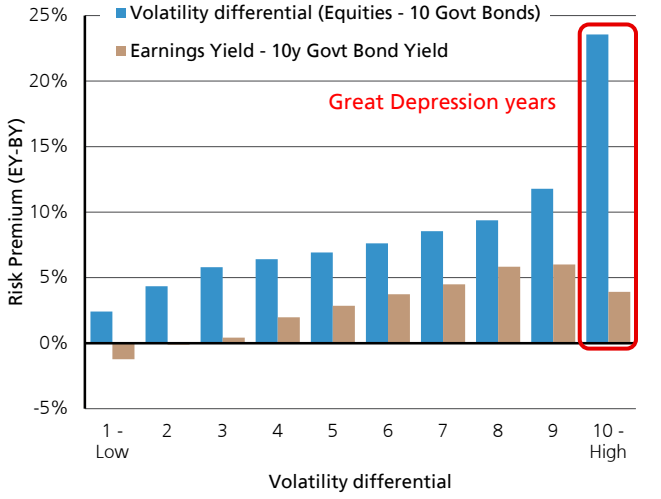
Source: MSCI World, UBS Quant

Figure 3: Earnings growth and Volatility Differential



Source: Factset, UBS Quant

Figure 4: Volatility differential and the Risk Premium



Source: Factset, UBS Quant

Data: S&P500 1871 to July 2016

So whilst the simple equity risk premium is currently at 4.3%, the historical relationship between earnings growth, volatility differentials and risk premia, would suggest a more appropriate risk premium of around 6%.

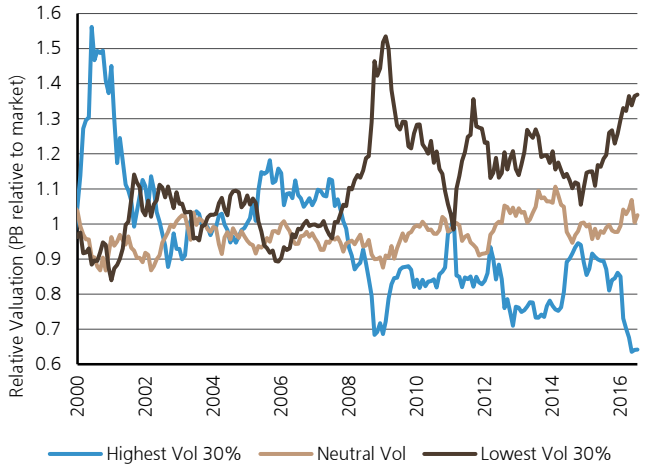
How does this correct itself? Either earnings need to pick up to around 4%, which would suggest a decline in equity market volatility and justify a 4% risk premium. Or alternately, equities would need to correct by around 20% to bring the equation back into equilibrium.

Low volatility risk

Secondly, low volatility equities are trading at significantly higher multiples relative to the market. Importantly, whilst low volatility stocks appear to be trading on a premium to their own history, it should also be noted that these stocks make up a significant proportion of the market by weight. Low volatility deciles 1, 2 and 3 make up approximately 45% of the market by market capitalisation. As a result, the overvaluation of low volatility stocks is significantly contributing to the valuation of the market as a whole.

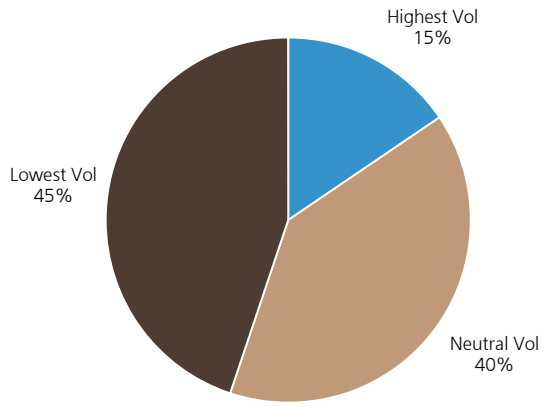
Low volatility equities are trading at significantly higher multiples relative to the market

Figure 5: The valuation of low volatility stocks



Source: FactSet, UBS Quant.Universe is MSCI World. Trailing Price/Book using last reported book value

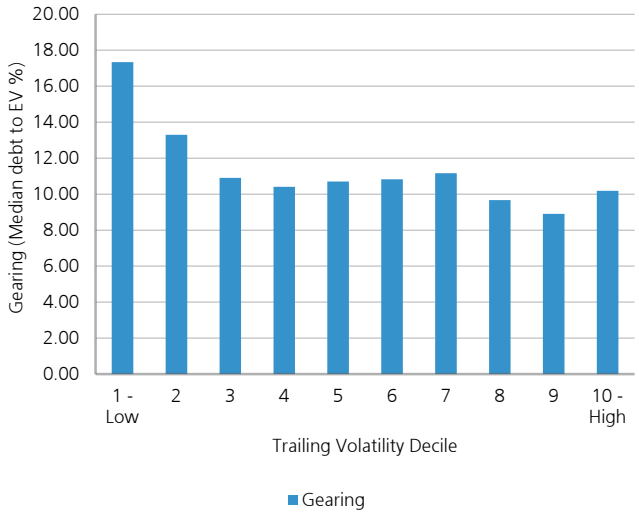
Figure 6: Market weight of low volatility stocks



Source: Factset, UBS Quant

These stocks tend to have higher levels of gearing and whilst they have a low beta to equity markets (Figure 7), they carry a higher residual beta to credit markets (Figure 8). If this is indeed the end of the credit cycle (as Matthew Mish points out), we believe these stocks are likely to underperform.

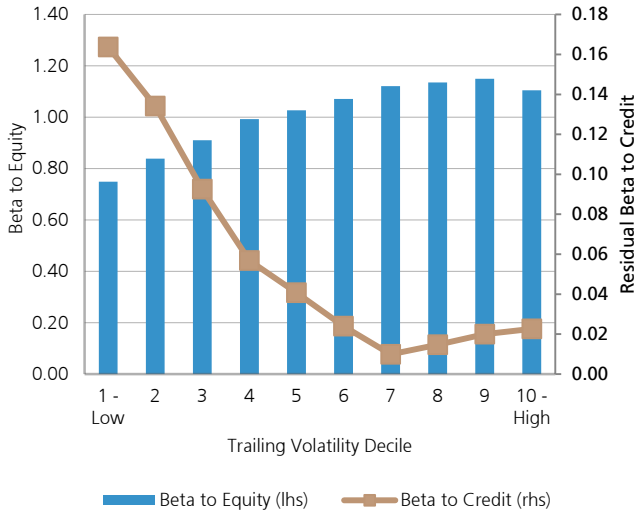
Figure 7: Volatility and gearing



Source: Factset, UBS Quant

Data: MSCI World country neutral

Figure 8: Volatility and beta to equity and credit



Source: Factset, UBS Quant

What causes markets to crash?

We make the distinction between a market downturn or 'Bear Market' and a stock market 'Crash' as the two have different drivers. A market downturn is typically driven by either an exogenous shock, or the credit and earnings cycle, whilst a stock market crash is a liquidity event and whilst this could occur at any time (eg the 2010 Flash Crash), it typically occurs during a market downturn.

Stock market drawdowns can be classified into two types:

There are two types of stock market drawdowns: Exogenous shocks and Credit/Earnings events

1. **Exogenous shocks:** are by definition difficult (if not impossible) to predict, an example being the 1973 Oil price shock. Importantly, as we have traversed from a world of high growth into a post financial crisis world of lower growth, macro-economic risk has picked up significantly.

   We measure these risks using three different approaches:

   (a) **Macro factor model**: the level of market risk explained by macro factors,

   (b) **Policy uncertainty**: the level of policy uncertainty measured using a keyword search in major news publications,

   (c) **Systemic risk**: an estimate of the capital that financial institutions would need to raise in the event of another financial crisis.

2. **Credit and Earnings cycle:** These are by definition regular, cyclical events that are reasonably easy to predict by following indicators such as the:

   (a) **Senior Loan Officer Survey, credit spreads and the earnings cycle**: measuring the level of credit risk lenders currently perceive in the market and the impact on earnings,

   (b) **Default risk (KMV Merton model)**: measuring the distance to default of equities by region and sector.

Exogenous Shocks

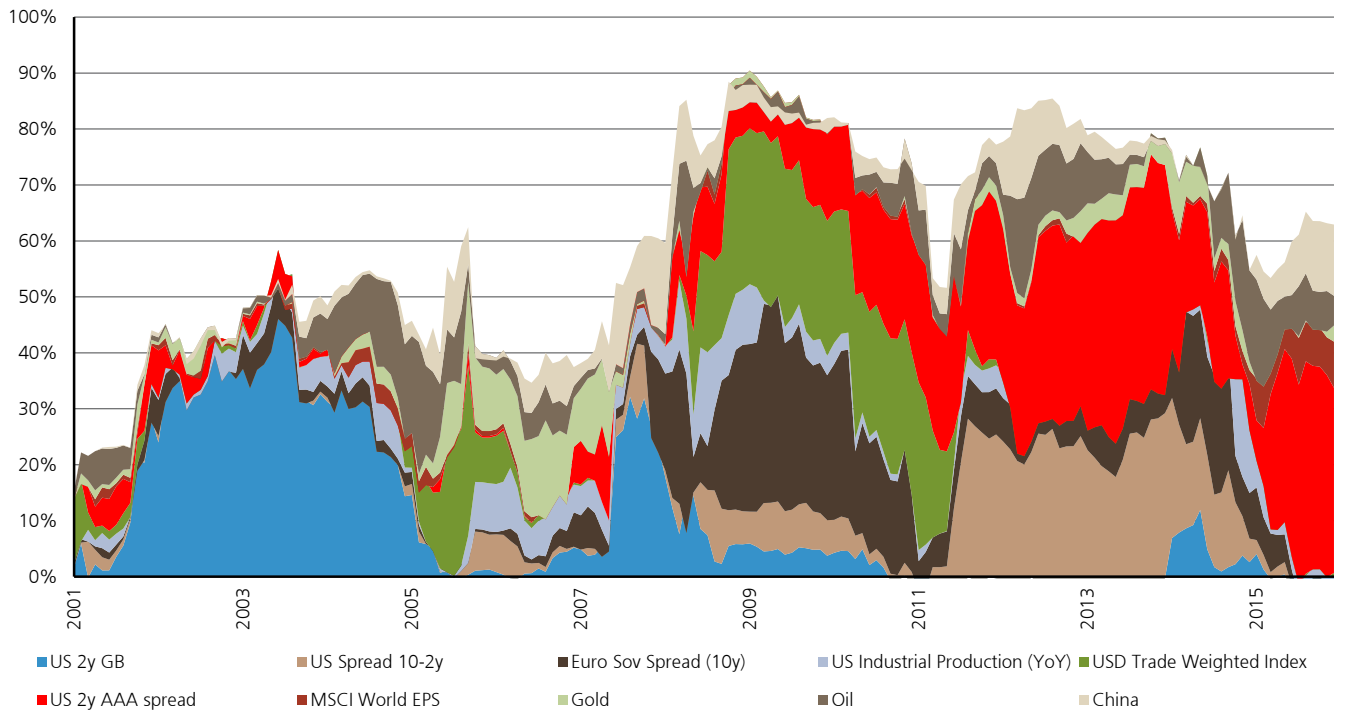
Macro shocks

Macro risk has been dormant for many years, however, post the Global Financial Crisis, we have traversed into a world of structurally lower growth, and macro risk is dominating as a driver of returns. Below we show the percentage of returns driven by macro factors over time. The key point here is that pre-2007 the two-year bond yield was a key driver of returns. However, post-2007, the market has been driven by a broader variety of macro risk factors, a key driver of which is the Corporate Credit Spread (shown below in red).

Pre-2007 the two-year bond yield was a key driver of returns.

Post-2007, the market has been driven by a broader variety of macro risk factors, a key driver of which is the Corporate Credit Spread

Figure 9: Market risk explained by each macro factor through time, developed markets



Source: DJ World Index, Factset, UBS Quant

In this environment, understanding the key risk factors (drivers of volatility) is critical. From our perspective, the principal risks that we would like to understand are systemic risk and economic policy risk.

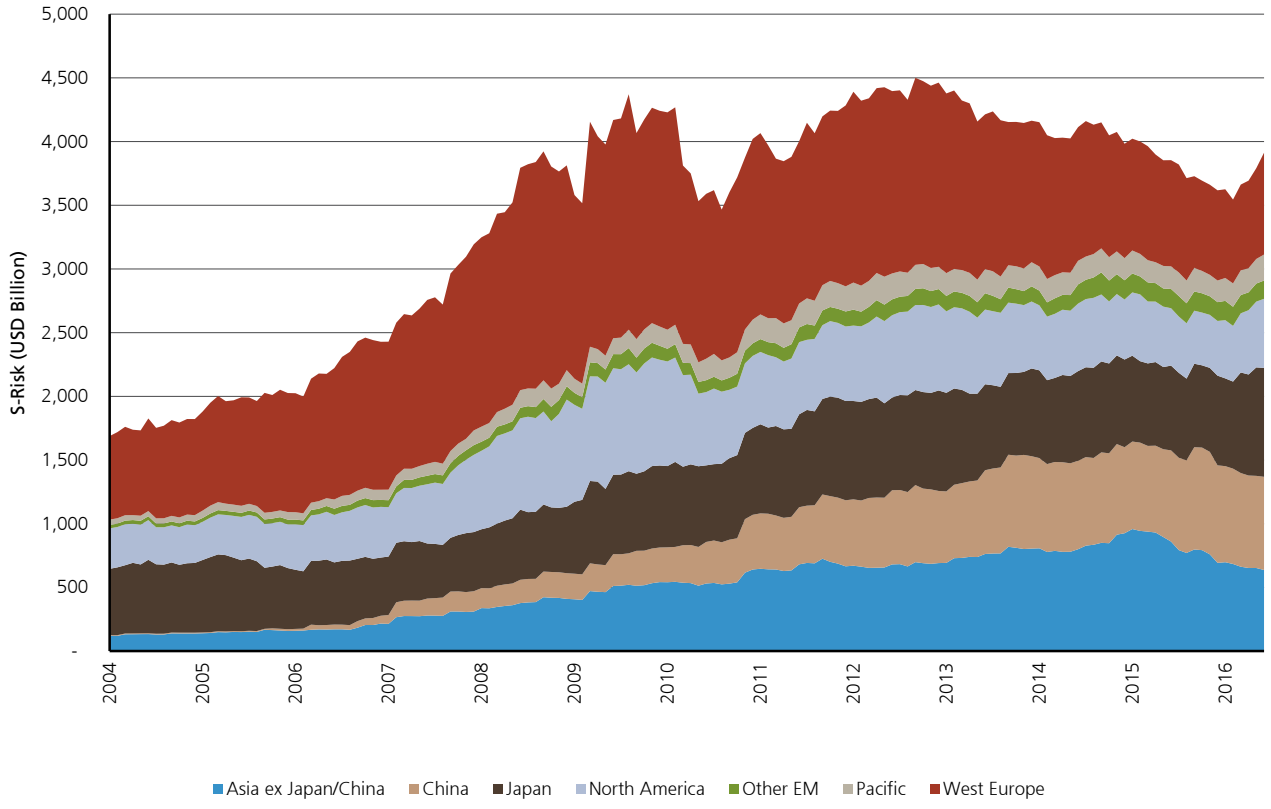
Systemic risk

This is measured as the capital shortfall within the financial system in the event of a significant market correction. We use the Robert Engle S-Risk methodology (Brownlees and Engle, 2007). It is a function of market capitalisation, leverage and volatility.

Please see the appendix for details on the S-Risk methodology.

As part of their study Brownlees and Engle found that the SRISK model delivered useful rankings of financial institutions at various stages of the Global Financial Crisis and correctly identified the key contributors as early as 2005. Interestingly, they also found that aggregate SRISK provided early warning signals of weakness in indicators of real activity.

Figure 10: Systemic risk measured as S-Risk by region



Source: Factset, UBS Quant. Data: Data: Dow Jones World universe Banks sector S-Risk

Policy uncertainty

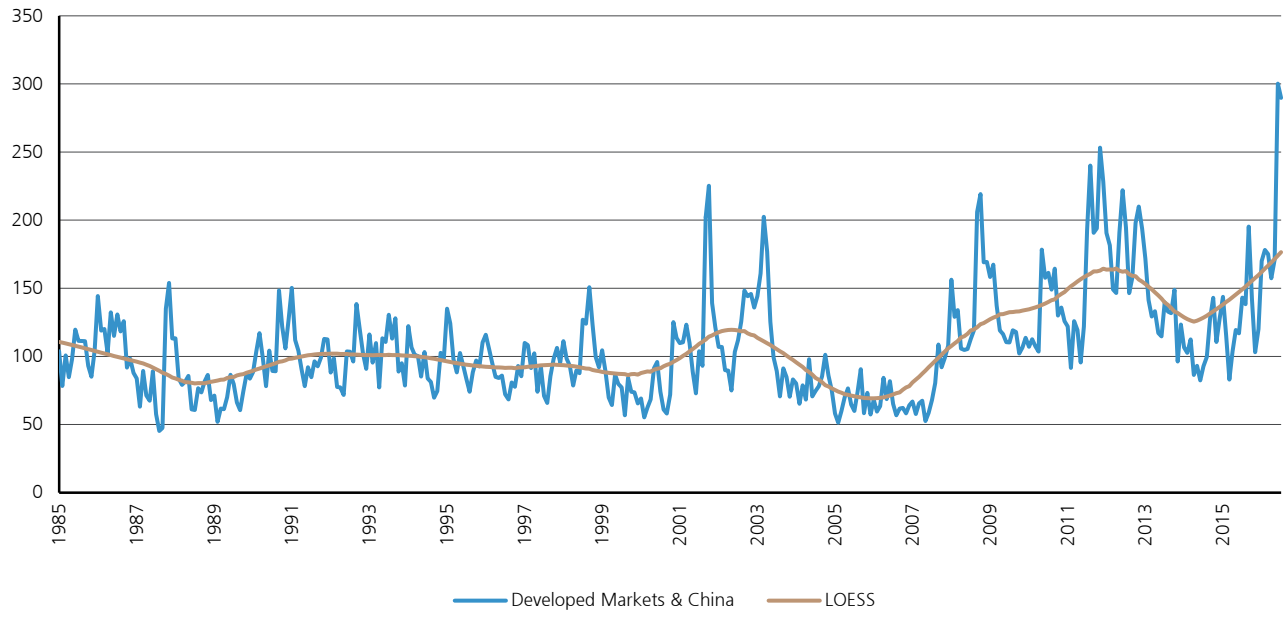
The second principal risk that we seek to understand is economic policy risk. Here, we use data from Economic Policy Uncertainty (www.policyuncertainty.com), a model that has been put together by Scott Baker (Northwestern Universtiy), Nick Bloom (Stanford University), and Steven Davis (University of Chicago).

The indices that they have developed are based on the frequency of economic policy uncertainty coverage.

The methodology is quite intuitive and searches for the trifecta of words pertaining to the economy, uncertainty and policy. They then scale this by the total number of articles in the newspaper and standardise across the newspapers covered and take the monthly average. More detail is available here.

Using firm-level data, they find that policy uncertainty increases stock price volatility and reduces employment and investment in policy-sensitive sectors such as healthcare, infrastructure construction and defence. At a macro level, they find that increases in economic policy uncertainty foreshadow declines in economic growth and employment in subsequent months.

Figure 11: Policy Uncertainty Index (Average across Developed Markets and China)



Source: Policy Uncertainty, UBS Quant. Reproduced with permission from Economic Policy Uncertainty

Conclusion

In a world of heightened macro factor, systemic and economic policy risk, we should expect higher levels of equity market volatility.

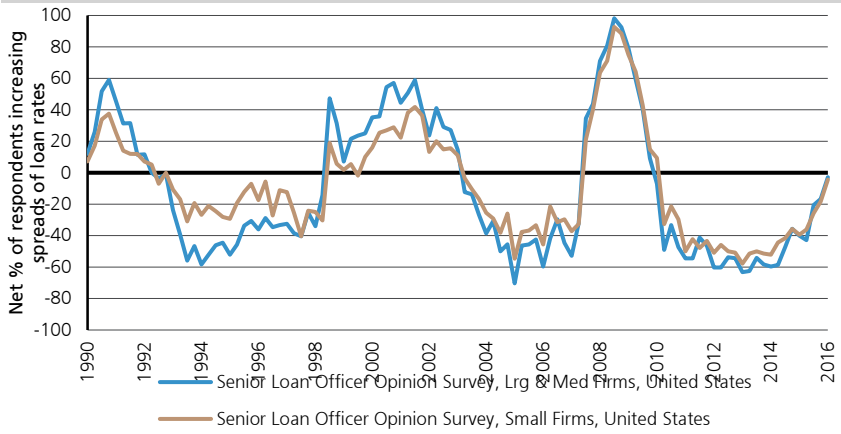
Credit and earnings cycle

Unlike exogenous shocks, which may or may not be anticipated, but by definition are unpredictable, the credit and earnings cycle has been a regular feature of the investment landscape.

Understanding the cycle

In theory, bubbles tend to form during periods of excess liquidity. As a consequence, valuations become stretched and perpetuated through 'rational bubble riding'. However, eventually the competitive landscape increases and cost pressures build, placing pressure on margins and squeezing earnings. At this stage, credit becomes more challenging to raise as lenders (witnessing the tighter environment) increase lending standards (Figure 12).

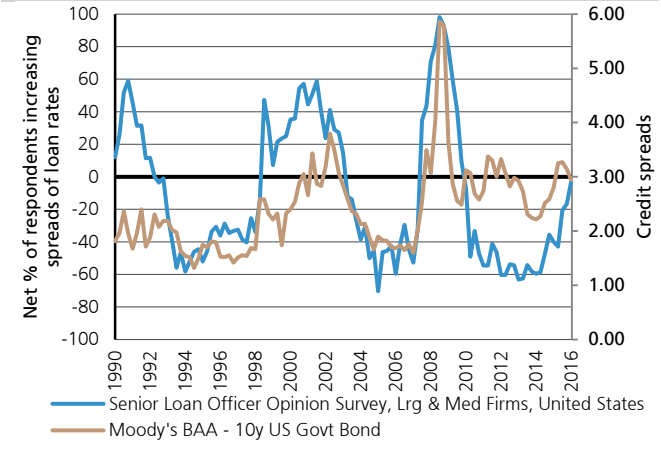
Figure 12: Senior loan officer survey (United States)



Source: Factset, UBS Quant

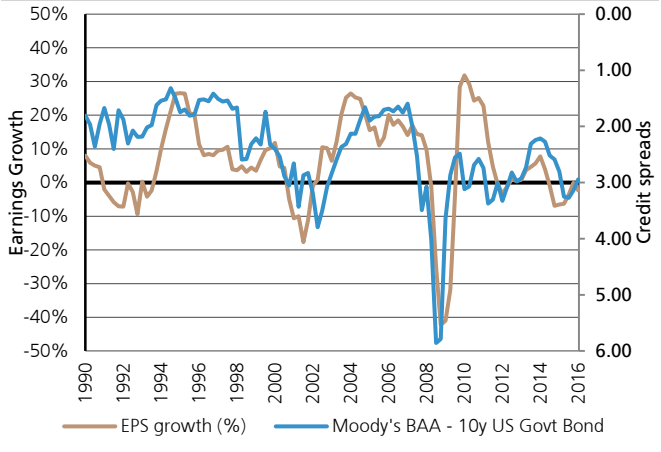
As a consequence, credit spreads increase (Figure 13) and place further pressure on company earnings (Figure 14). The net result is the end of the earnings cycle.

Figure 13: Senior Loan Officer Survey and Credit spreads



Source: Factset, UBS Quant

Figure 14: Credit Spreads and earnings growth rates (%)



Source: Factset, UBS Quant

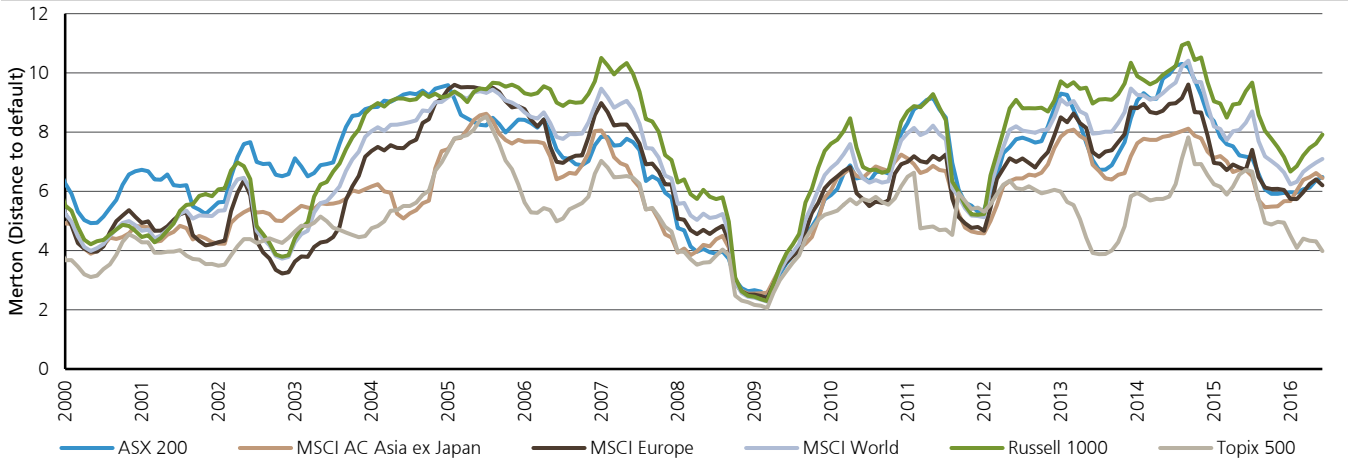
As earnings come under pressure, the stock market starts to drift lower and multiples begin to compress. Given that 77% of stock crashes are driven by earnings announcements (Ak et al 2016), understanding where we are in the earnings cycle is critical. It's at this point that the risk of a market crash increases.

Default risk

Finally, within equities we can estimate the probability of default using the 1974 KMV Merton model. The Model relates each companies' assets, debt and volatility to the distance to default. We find that the KMV Merton model doesn't contain significant information at the stock level until the Distance to Default falls below 5. At which point the probability of negative returns increases significantly.

Below we aggregate the scores by region (Figure 15) and sector (Figure 16) in order to gauge where the likely areas of credit stress are within the equity markets. Overall, we find that the Distance to Default is falling (probability of default is increasing) despite having experienced a short term improvement over the past six months, across all regions with Japan showing the greatest stress.

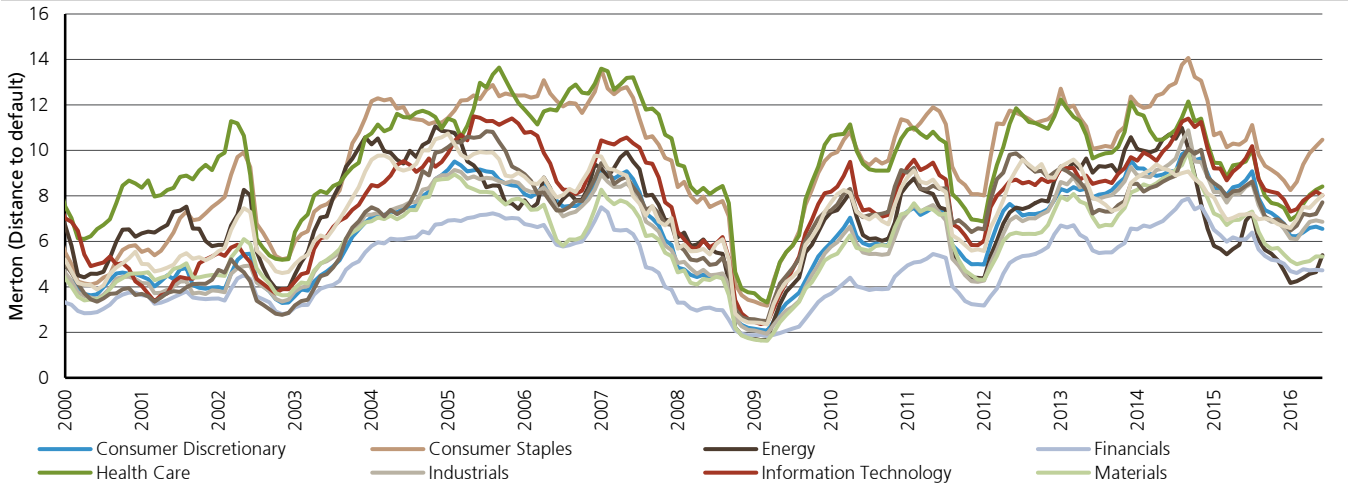
Figure 15: Merton Distance to Default by market (Cap Weighted)



Source: Factset, UBS Quant

Across sectors, we find that the Distance to Default is falling (again, despite having experienced a short term improvement over the past six months) across all sectors with Energy, Materials and Financials showing the greatest stress.

Figure 16: Merton Distance to Default by sector (Cap Weighted)



Source: Factset, UBS Quant

These results are in line with what we are witnessing in credit markets as previously discussed.

Liquidity (crash) risk

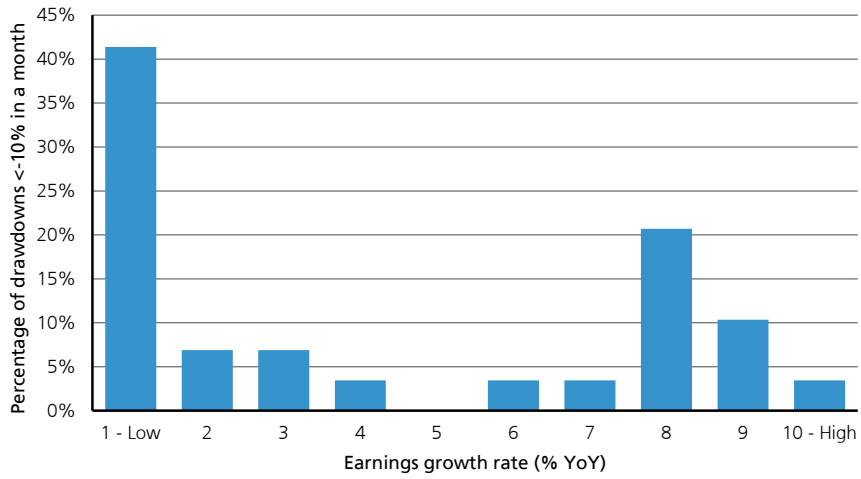
Both exogenous shocks and credit/earnings cycle events lead to stock market drawdowns which in turn lead to liquidity events

Both exogenous shocks and credit/earnings cycle events lead to stock market drawdowns which in turn lead to liquidity events or stock market crashes. This occurs as buyers pull back the prices at which they are prepared to buy stocks and sellers are driven to liquidate positions in a less liquid market. Typically liquidity events are exacerbated by higher levels of margin lending leading to forced selling.

We show that contrary to conventional wisdom, the market does not need to be overvalued in order to correct. In fact, it's more likely that the market suffers a drawdown when earnings growth rates and valuations are low.

Below we examine drawdowns of worse than -10% in a calendar month. Overall, we find that 41% of drawdowns occur in the bottom 10% of earnings growth rates (largely when earnings growth rates are negative).

Figure 17: Subsequent returns worse than -10% by earnings growth (S&P 500, 1871 – 2016)



Source: Factset, UBS Quant

This makes intuitive sense as negative earnings growth rates drive higher risk premia to be demanded by buyers (Figure 3, and Figure 4 on page 5). As a consequence, falling earnings will cause buyers to lower their entry prices, spreads to widen, and liquidity risk to increase.

Kyle's Lambda

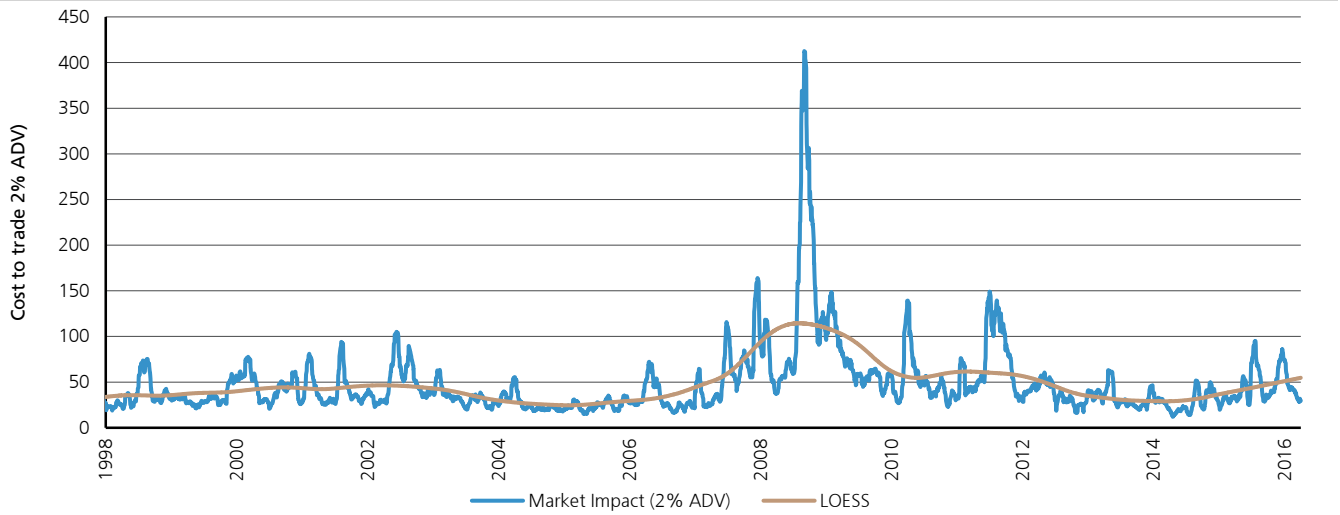
We measure the level of liquidity risk using Pete Kyle's market impact model (Kyle 2016). The intuition behind using a market impact model is that 'business time' passes more rapidly in actively traded stocks/markets than in inactive markets. Once we've adjusted for the rate of 'business time' passing, market properties with respect to the dollar rate at which gains and losses are generated are constant across stocks/markets. Trades of a given percentage of ADV in indices are equivalent to trading the same percentage of volume over multiple days in individual stocks. As a consequence these index trades exhibit a significantly greater impact than trades of the same magnitude at a stock level. In this manner,

the invariance principle implies that there are far greater market impacts for large sales of indices than conventional wisdom suggests.

As a consequence, when liquidity typically dries up, market impact increases significantly more than expected. This by definition is required to occur for the market to correct.

Note, the original Kyle model evaluates the dollar cost of trading a single stock, we have adapted it to an index aggregate, in our interpretation we examine the basis point impact of a trade of 2% of the average daily traded volume (ADV). In this way, we can compare the cost of accessing liquidity at any point in time from 1929 through to today regardless of changes in market structure.

Figure 18: Market impact of a 2% ADV order in bps. (MSCI World)



Source: Factset, UBS Quant

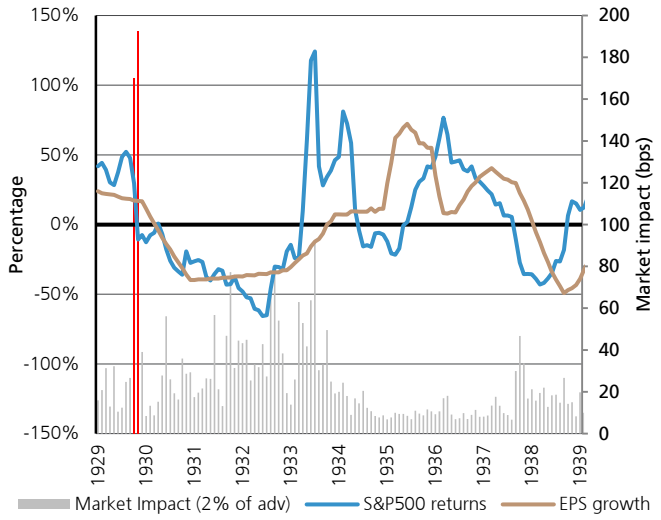
What does Kyle's model show us?

Since 1929 we have witnessed a number of stock market downturns. However, we have only witnessed a few liquidity 'crashes'. As a consequence we highlight the significant crashes that we have observed and assess the model from an empirical perspective.

1. The start of the Great Depression (October 1929)
2. Black Monday (October 1987)
3. The Tech Wreck (2000 – 2003)
4. The Global Financial Crisis (2007-2009)

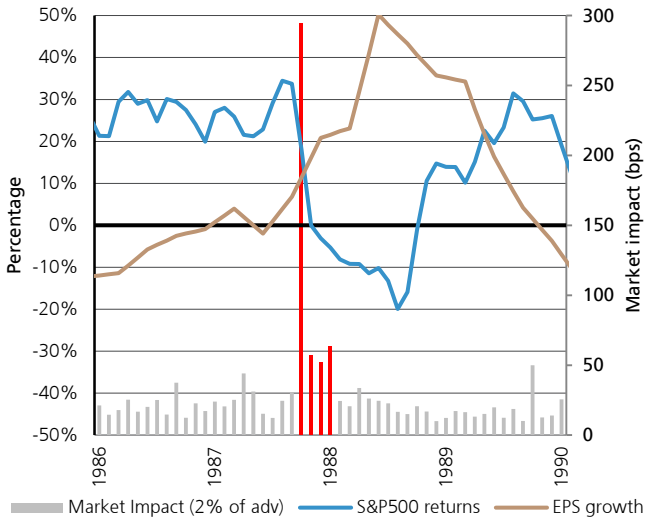
In each case market impact (as measured by the Kyle model) increased significantly prior to the correction

Figure 19: The Great Depression



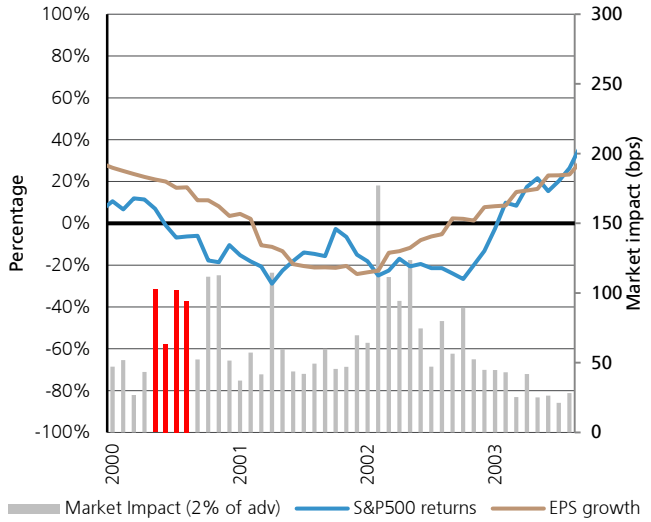
Source: Factset, UBS Quant

Figure 20: Black Monday 1987



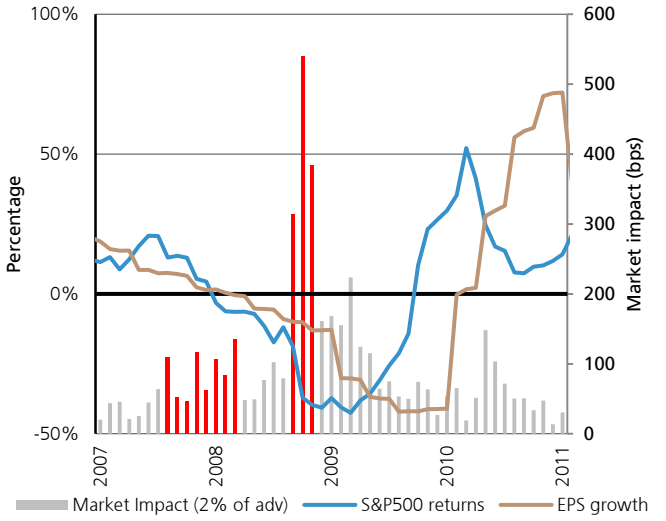
Source: Factset, UBS Quant

Figure 21: The Tech Wreck



Source: Factset, UBS Quant

Figure 22: The Global Financial Crisis



Source: Factset, UBS Quant

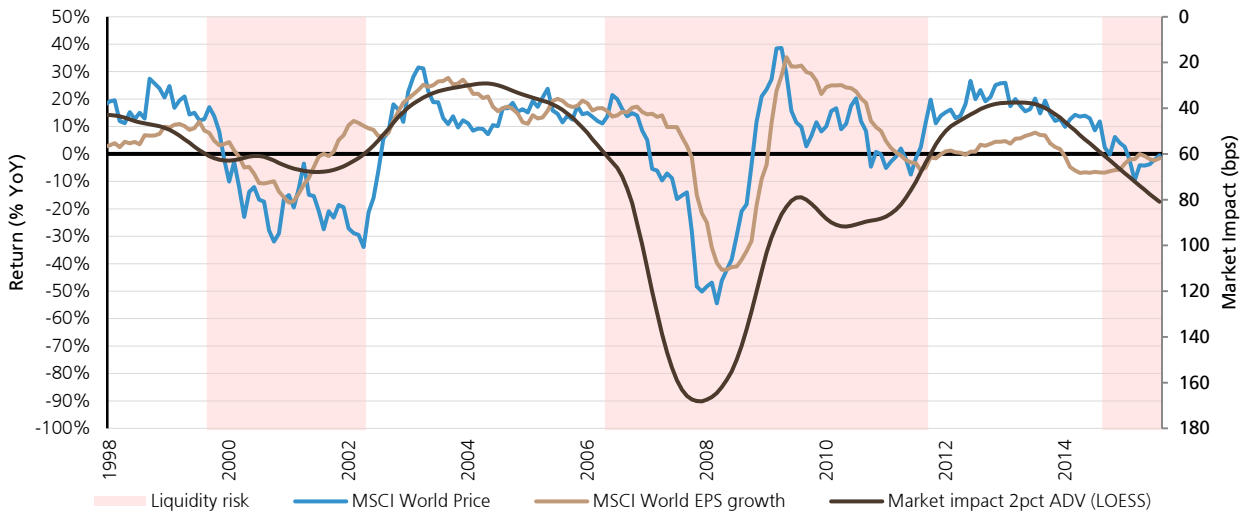
Below, we examine the earnings growth rate, price return and market impact of a 2% ADV order against the MSCI World index. Overall, we find that Kyle's Lambda seems to be a robust model for assessing market impact, and, as hypothesised, liquidity seems to dry up and market impact increase prior to negative market returns.

Where are we now?

Whilst we cannot tell you exactly when the market might correct, we will produce a weekly dashboard to highlight the macro, systemic and market impact risk which will highlight to readers when a correction seems more likely.

The Kyle model is highlighting that whilst we have not suffered a significant drawdown in the market, the market impact has certainly increased, in our view increasing the risk of a stock market 'crash'.

Figure 23: Market returns (MSCI World) and market impact (inverted RHS)



Source: Kyle, Factset, UBS Quant

Where are we in the cycle and where is the risk?

We are currently witnessing the end of the credit cycle. The Senior Loan Officer Survey is pointing to credit conditions tightening, credit spreads have been increasing, global earnings growth rates are in aggregate flat, the Distance to Default is declining, and market impact has been increasing. As a consequence the risk of a stock market correction would appear to be increasing.

We identify two key risks:

1. **The Equity Risk Premium**: Developed world earnings growth rates are currently running at -1.5%, bond yields at 0.5%, and earnings yields at 4.8%. Thus the equity risk premium is trading at 4.3%. Given that earnings growth rates are currently running at -1.5% per annum, we should expect a volatility differential of 11% and as a consequence an equity risk premium of around 6%.

   Where could we be wrong? Our model is fitted based on the historical relationship between earnings growth, volatility and risk premia in the US market. This relationship may change in a world of negative bond yields and it may be that historical US investor preferences may not hold for global markets.

2. **Low volatility equities**: We have shown that low volatility assets are generally more highly geared than higher volatility stocks. As a consequence, they tend to have a high residual beta to credit. As lending standards tighten and credit spreads increase, we think it is likely highly geared stocks underperform regardless of their historical volatility.

   Where could we be wrong? In the event of a financial crisis it is likely that policy makers would 'do whatever it takes' to ensure financial stability, as a consequence of which 'low volatility' as a strategy would probably continue to perform well. However, we think it is likely that there is short term risk in highly geared, low volatility stocks.

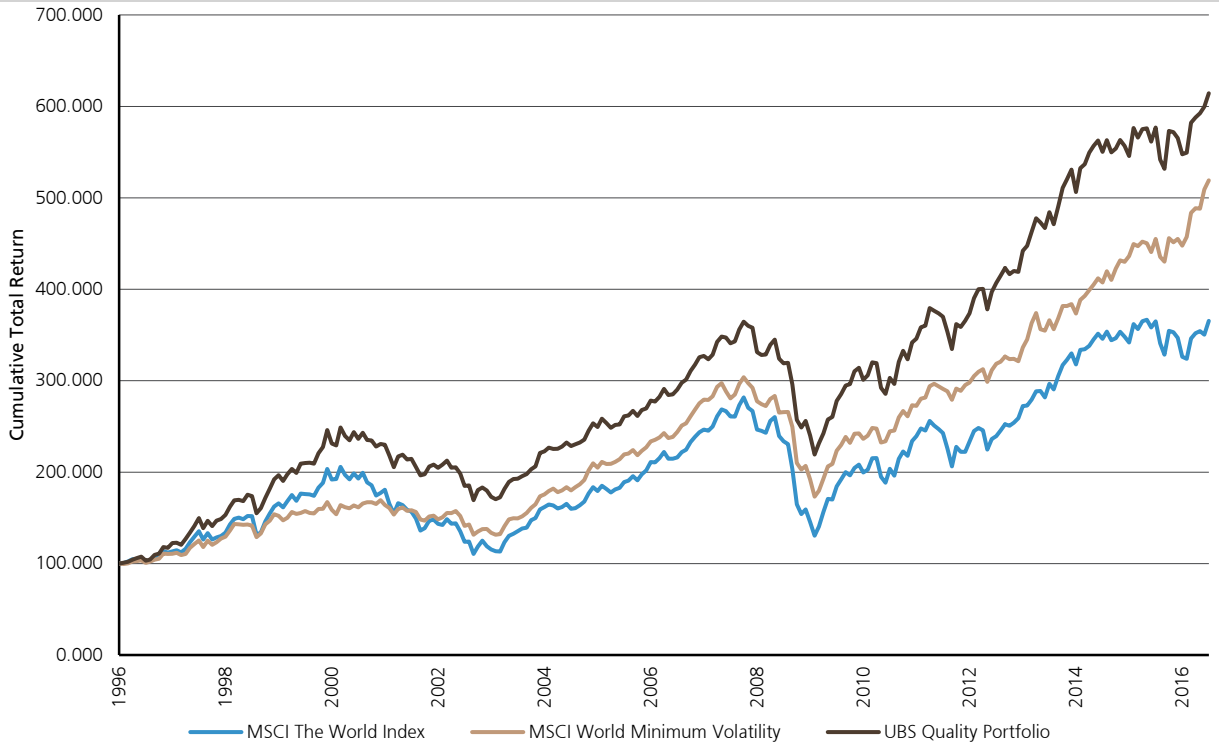
Please contact us if you would like to receive our monthly 'Crash Risk Monitor'.

What to invest in?

As a result of the compression in bond yields, investors have piled into high quality bond-like equities. Given where we are in the credit cycle, we think the risk is that we are heading into a market downturn with High Quality already expensive and Low Quality already cheap. However, it is unlikely that in a Bear market Low Quality underperforms High Quality. As a consequence, we still prefer High Quality stocks. So what is likely to differentiate stocks in the event of a market downturn? The answer lies in the driver of the downturn. If this is indeed the end of the credit cycle, High Quality stocks with improving fundamentals and a sustainable level of gearing is critical to outperformance.

Our recommendation: Buy high quality with improving fundamentals and sustainable gearing. For more information on our methodology, please see our note on Investing in Quality.

Figure 24: UBS Quality, MSCI World Minimum Volatility and MSCI World



Source: Factset, UBS Quant

Figure 25: UBS Quality Index performance metrics

	UBS Quality Portfolio	MSCI World Minimum Volatility	MSCI The World Index
Annualised Return	9.7%	8.7%	7.5%
Volatility	12.5%	11.0%	15.4%
IR	0.77	0.79	0.49
T-Stat	3.50	3.56	2.22

Source: Factset, UBS Quant

Figure 26: UBS Quality stock list

Ticker	Sedol	Company	Country	Sector	Merton decile	Volatility %	Market Cap USD million	Absolute Quality	Delta Quality	Risk Alert
United States										
GOOGL-US	BYVY8G0	Alphabet Inc. Class A	US	Information Technology	10	24.7%	543,475	3:HighQuality	3:ImprovingQuality	3:Safe
JNJ-US	2475833	Johnson & Johnson	US	Health Care	10	15.9%	344,596	3:HighQuality	3:ImprovingQuality	3:Safe
PG-US	2704407	Procter & Gamble Company	US	Consumer Staples	10	16.3%	227,828	3:HighQuality	3:ImprovingQuality	3:Safe
HD-US	2434209	Home Depot, Inc.	US	Consumer Discretionary	10	20.7%	172,109	3:HighQuality	3:ImprovingQuality	3:Safe
PEP-US	2681511	PepsiCo, Inc.	US	Consumer Staples	10	15.3%	156,954	3:HighQuality	3:ImprovingQuality	3:Safe
MO-US	2692632	Altria Group, Inc.	US	Consumer Staples	10	17.0%	132,450	3:HighQuality	3:ImprovingQuality	3:Safe
MCD-US	2550707	McDonald's Corporation	US	Consumer Discretionary	10	19.0%	103,280	3:HighQuality	3:ImprovingQuality	3:Safe
UPS-US	2517382	United Parcel Service, Inc. Class B	US	Industrials	10	16.3%	95,560	3:HighQuality	3:ImprovingQuality	3:Safe
HON-US	2020459	Honeywell International Inc.	US	Industrials	9	20.9%	88,513	3:HighQuality	3:ImprovingQuality	3:Safe
SBUX-US	2842255	Starbucks Corporation	US	Consumer Discretionary	10	24.3%	85,125	3:HighQuality	3:ImprovingQuality	3:Safe
Europe										
NESN-CH	7123870	Nestle S.A.	CH	Consumer Staples	10	18.4%	247,986	3:HighQuality	3:ImprovingQuality	3:Safe
ULVR-GB	B10RZP7	Unilever PLC	GB	Consumer Staples	9	21.5%	133,178	3:HighQuality	3:ImprovingQuality	3:Safe
ITX-ES	BP9DL90	Industria de Diseno Textil, S.A.	ES	Consumer Discretionary	10	28.1%	107,832	3:HighQuality	3:ImprovingQuality	3:Safe
OR-FR	4057808	L'Oreal SA	FR	Consumer Staples	10	26.1%	106,453	3:HighQuality	3:ImprovingQuality	3:Safe
SAP-DE	4846288	SAP SE	DE	Information Technology	9	24.6%	105,061	3:HighQuality	3:ImprovingQuality	3:Safe
DGE-GB	237400	Diageo plc	GB	Consumer Staples	10	19.6%	72,618	3:HighQuality	3:ImprovingQuality	3:Safe
RB-GB	B24CGK7	Reckitt Benckiser Group plc	GB	Consumer Staples	10	20.3%	68,544	3:HighQuality	3:ImprovingQuality	3:Safe
BN-FR	B1Y9TB3	Danone SA	FR	Consumer Staples	9	23.6%	47,388	3:HighQuality	3:ImprovingQuality	3:Safe
HEN-DE	5002465	Henkel AG & Co. KGaA	DE	Consumer Staples	10	24.2%	47,155	3:HighQuality	3:ImprovingQuality	3:Safe
ABBN-CH	7108899	ABB Ltd.	CH	Industrials	8	23.5%	45,337	3:HighQuality	3:ImprovingQuality	3:Safe
Japan										
9437-JP	6129277	NTT DoCoMo, Inc.	JP	Telecommunication Services	9	36.6%	101,411	3:HighQuality	3:ImprovingQuality	3:Safe
9432-JP	6641373	Nippon Telegraph and Telephone Corporation	JP	Telecommunication Services	8	34.2%	98,075	3:HighQuality	3:ImprovingQuality	3:Safe
6861-JP	6490995	Keyence Corporation	JP	Information Technology	10	37.5%	40,867	3:HighQuality	3:ImprovingQuality	3:Safe
4503-JP	6985383	Astellas Pharma Inc.	JP	Health Care	10	34.1%	33,141	3:HighQuality	3:ImprovingQuality	3:Safe
4452-JP	6483809	Kao Corp.	JP	Consumer Staples	10	32.3%	28,989	3:HighQuality	3:ImprovingQuality	3:Safe
7741-JP	6441506	HOYA CORPORATION	JP	Health Care	10	35.7%	14,049	3:HighQuality	3:ImprovingQuality	3:Safe
9843-JP	6644800	Nitori Holdings Co., Ltd.	JP	Consumer Discretionary	10	36.3%	13,325	3:HighQuality	3:ImprovingQuality	3:Safe
1878-JP	6250508	Daito Trust Construction Co., Ltd.	JP	Financials	10	27.0%	12,508	3:HighQuality	3:ImprovingQuality	3:Safe
4508-JP	6870984	Mitsubishi Tanabe Pharma Corporation	JP	Health Care	10	31.3%	10,078	3:HighQuality	3:ImprovingQuality	3:Safe
4581-JP	B3QX5G4	Taisho Pharmaceutical Holdings Co., Ltd.	JP	Health Care	10	32.4%	8,787	3:HighQuality	3:ImprovingQuality	3:Safe

Source: Factset, UBS Quant

Figure 27: UBS Quality stock list

Ticker	Sedol	Company	Country	Sector	Merton decile	Volatility %	Market Cap USD million	Absolute Quality	Delta Quality	Risk Alert
Asia ex-Japan										
941-HK	6073556	China Mobile Limited	HK	Telecommunication Services	8	25.3%	233,973	3:HighQuality	3:ImprovingQuality	3:Safe
005930-KR	6771720	Samsung Electronics Co., Ltd.	KR	Information Technology	9	25.7%	177,477	3:HighQuality	3:ImprovingQuality	3:Safe
532540-IN	B01NPJ1	Tata Consultancy Services Limited	IN	Information Technology	10	20.6%	744,67	3:HighQuality	3:ImprovingQuality	3:Safe
TLKM-ID	BD4T6W7	PT Telekomunikasi Indonesia, Tbk Class B	ID	Telecommunication Services	9	27.2%	29580	3:HighQuality	3:ImprovingQuality	3:Safe
2412-TW	6287841	Chunghwa Telecom Co., Ltd	TW	Telecommunication Services	10	12.4%	28,015	3:HighQuality	3:ImprovingQuality	3:Safe
UNVR-ID	6687184	PT Unilever Indonesia Tbk	ID	Consumer Staples	10	31.7%	26,030	3:HighQuality	3:ImprovingQuality	3:Safe
6505-TW	6718716	Formosa Petrochemical Corp	TW	Energy	9	25.8%	25,838	3:HighQuality	3:ImprovingQuality	3:Safe
532500-IN	6633712	Maruti Suzuki India Limited	IN	Consumer Discretionary	9	28.1%	18,731	3:HighQuality	3:ImprovingQuality	3:Safe
SCC-TH	6609917	Siam Cement Public Co. Ltd.	TH	Materials	8	23.7%	16,255	3:HighQuality	3:ImprovingQuality	3:Safe
AOT-TH	6741187	Airports of Thailand Public Co. Ltd.	TH	Industrials	10	23.8%	15,855	3:HighQuality	3:ImprovingQuality	3:Safe
Australia										
AMC	6066608	Amcor Ltd	AU	Materials	6	17.8%	12,874	3:HighQuality	3:ImprovingQuality	2:Neutral
RMD-AU	6221667	Resmed Inc	AU	Health Care	10	21.0%	8,675	3:HighQuality	3:ImprovingQuality	3:Safe
ASX-AU	6129222	ASX Limited	AU	Financials	8	20.9%	6,590	3:HighQuality	3:ImprovingQuality	3:Safe
DXS	B033YN6	Dexus Property Group	AU	Financials	8	16.6%	6,501	3:HighQuality	3:ImprovingQuality	3:Safe
REA-AU	6198578	REA Group Ltd	AU	Consumer Discretionary	10	24.6%	5,834	3:HighQuality	3:ImprovingQuality	3:Safe
SPK-AU	6881500	Spark New Zealand Limited	AU	Telecommunication Services	7	30.5%	4,626	3:HighQuality	3:ImprovingQuality	3:Safe
FPH-AU	6423968	Fisher & Paykel Healthcare Corporation Limited	AU	Health Care	10	22.1%	4,032	3:HighQuality	3:ImprovingQuality	3:Safe
BLD	6218670	Boral Ltd	AU	Materials	6	17.6%	3,444	3:HighQuality	3:ImprovingQuality	2:Neutral
PPT	6682394	Perpetual Ltd	AU	Financials	7	14.3%	1,426	3:HighQuality	3:ImprovingQuality	2:Neutral
ARB-AU	BWV03W5	ARB Corporation Limited	AU	Consumer Discretionary	10	24.1%	987	3:HighQuality	3:ImprovingQuality	3:Safe

Source: Factset, UBS Quant

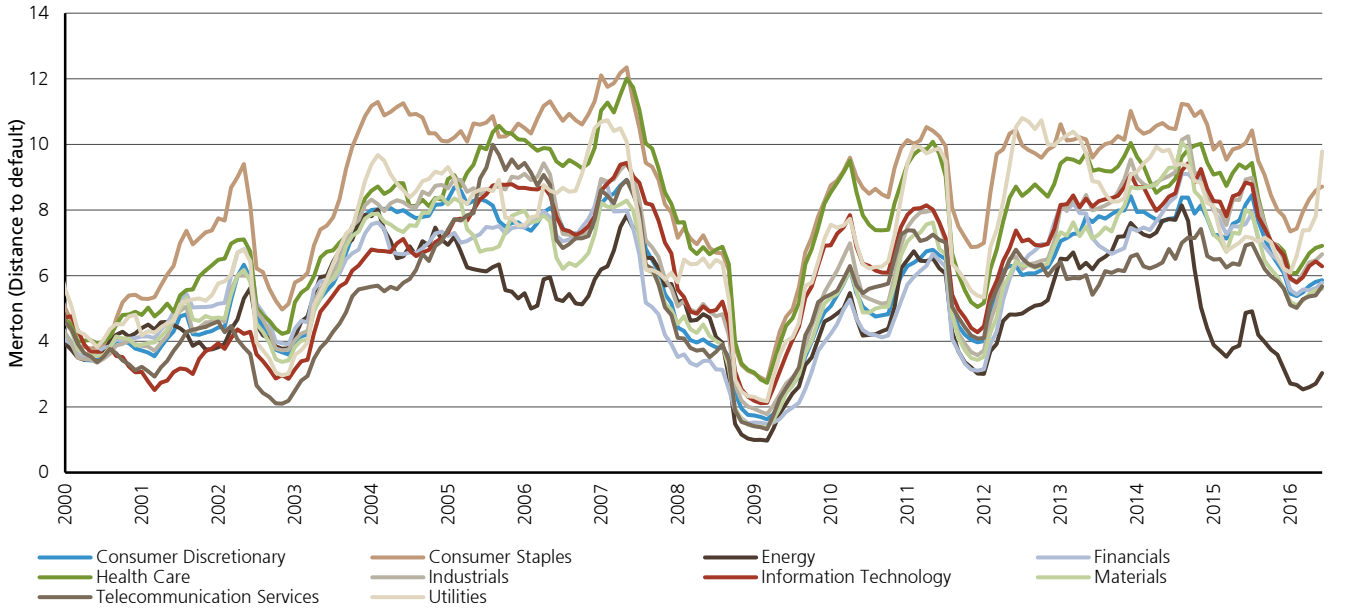
For more information on our methodology, please see our note on Investing in Quality.

Appendix

Regional results

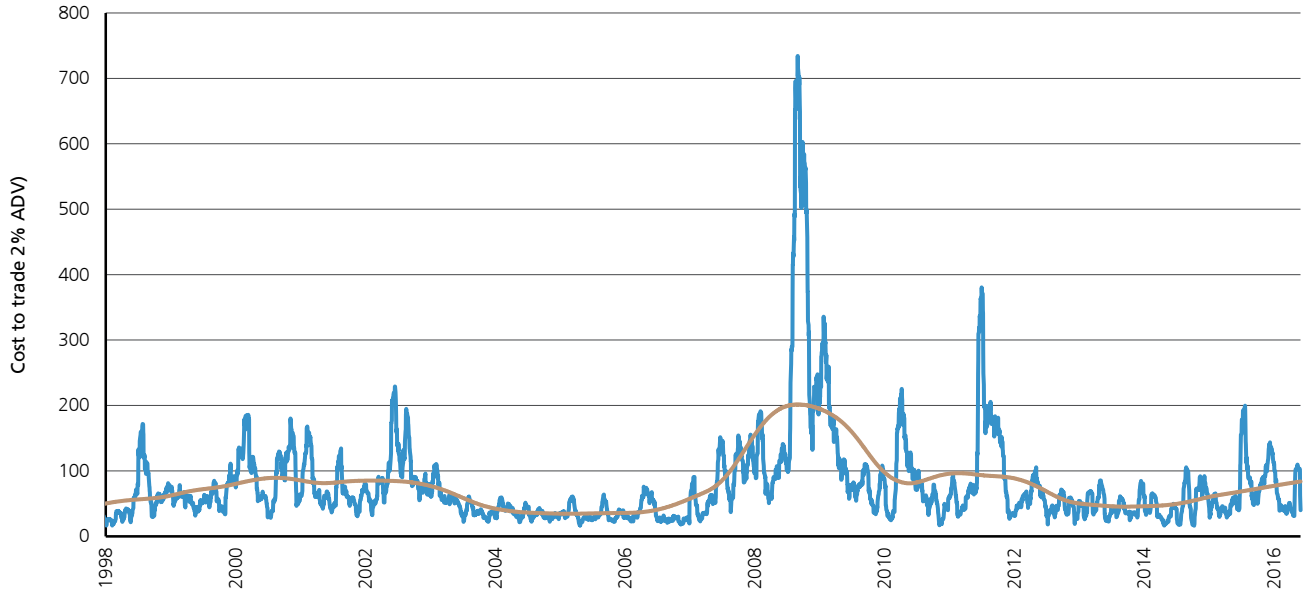
United States

Figure 28: Merton scores by sector



Source: Factset, UBS Quant

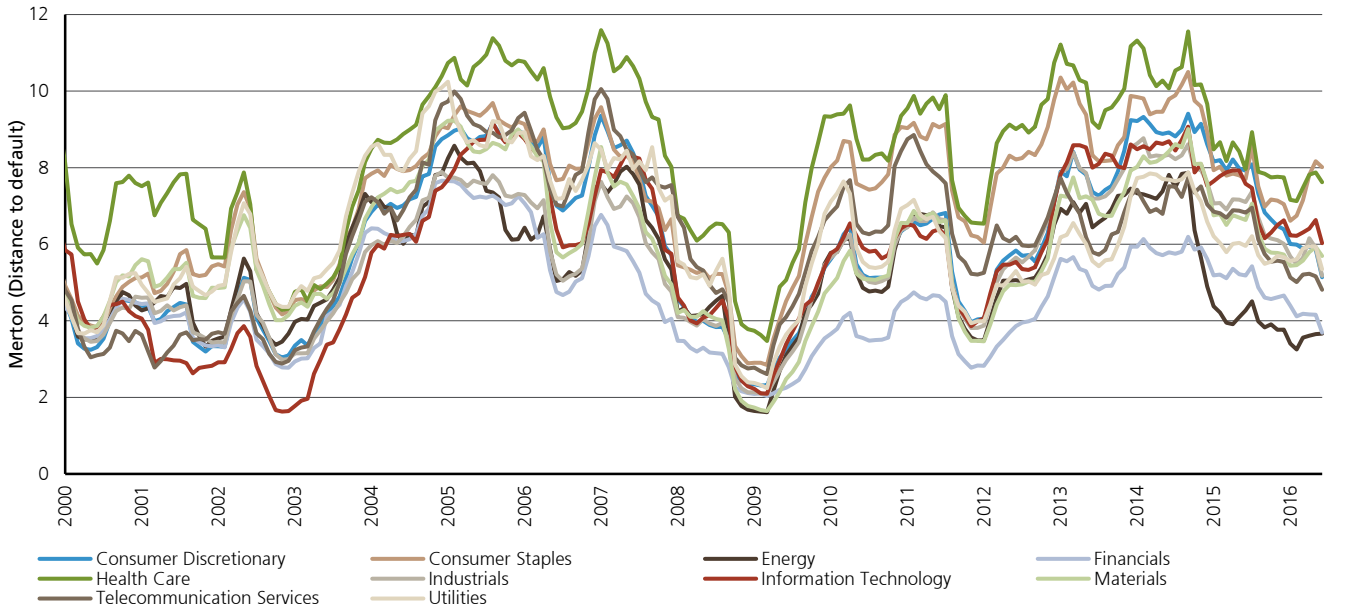
Figure 29: United States: Market Impact



Source: Factset, UBS Quant

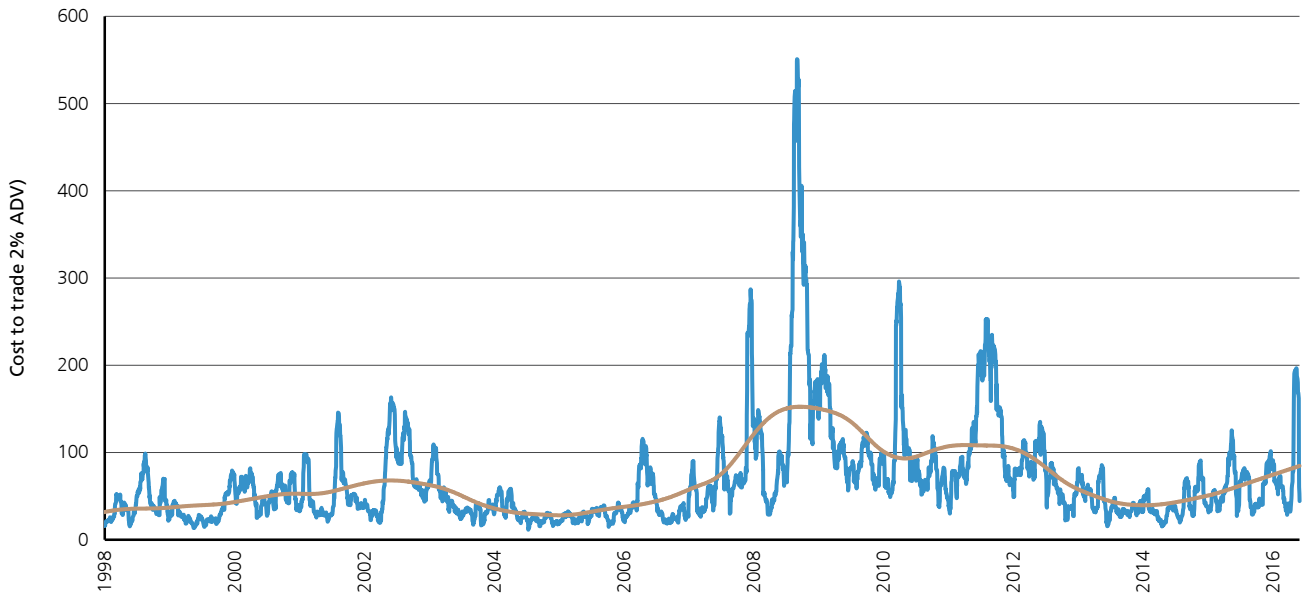
Europe

Figure 30: Merton scores by sector



Source: Factset, UBS Quant

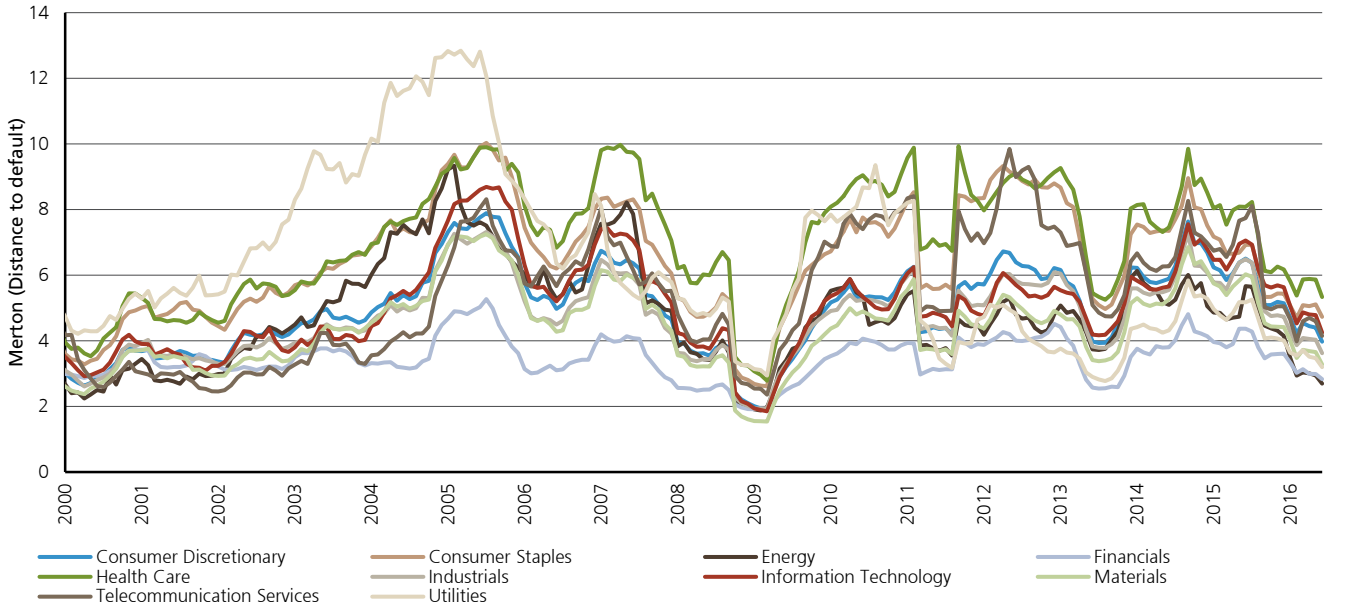
Figure 31: Europe: Market Impact



Source: Factset, UBS Quant

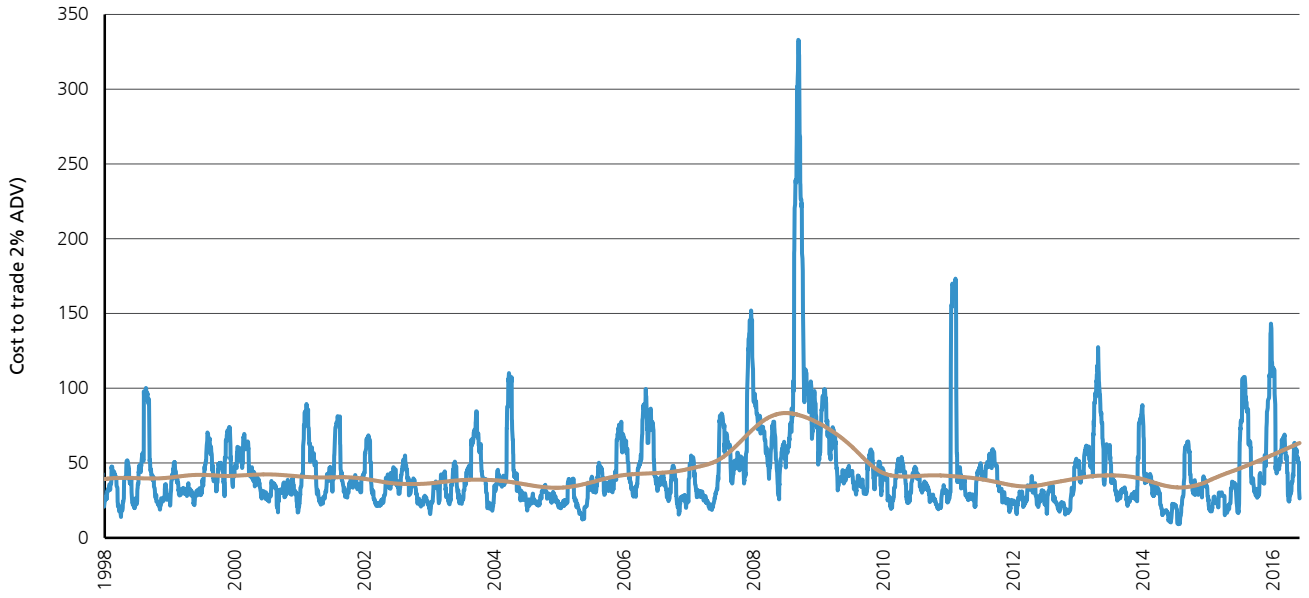
Japan

Figure 32: Merton scores by sector



Source: Factset, UBS Quant

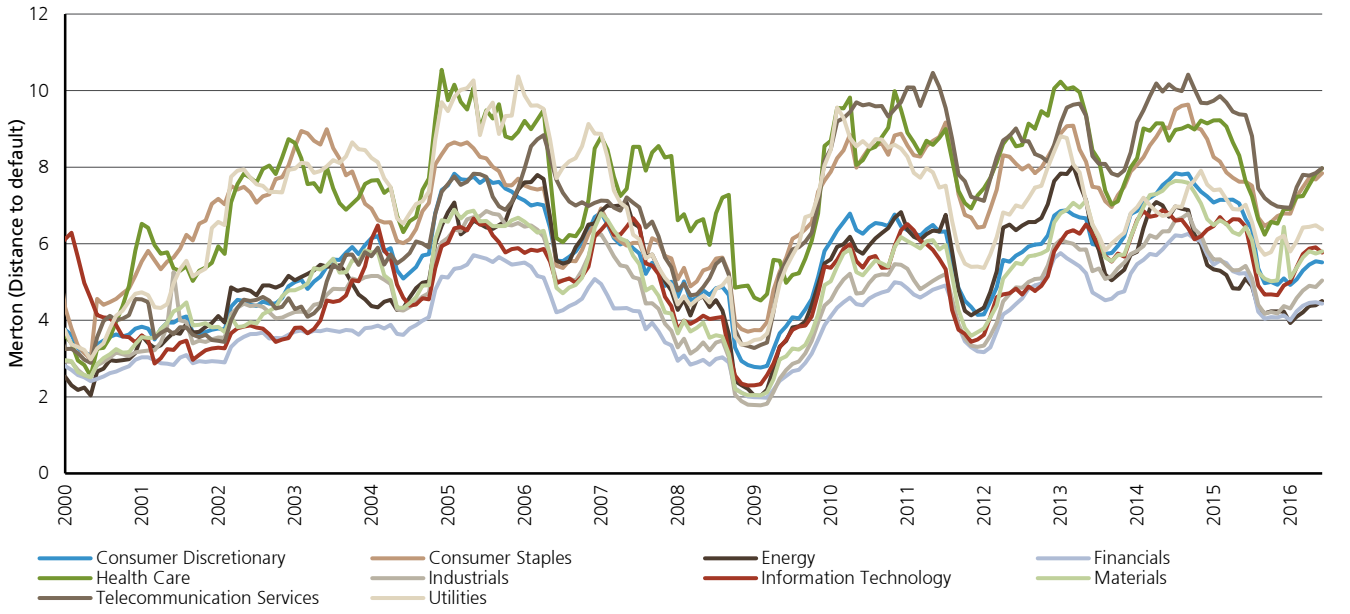
Figure 33: Japan: Market Impact



Source: Factset, UBS Quant

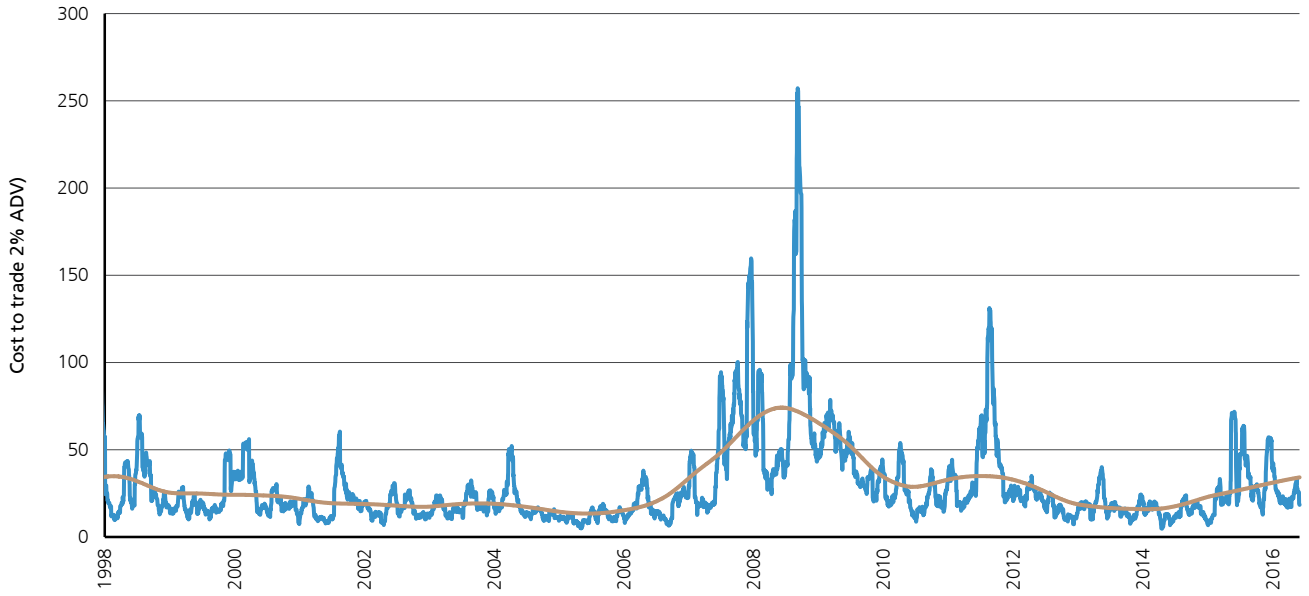
Asia-ex Japan

Figure 34: Merton scores by sector



Source: Factset, UBS Quant

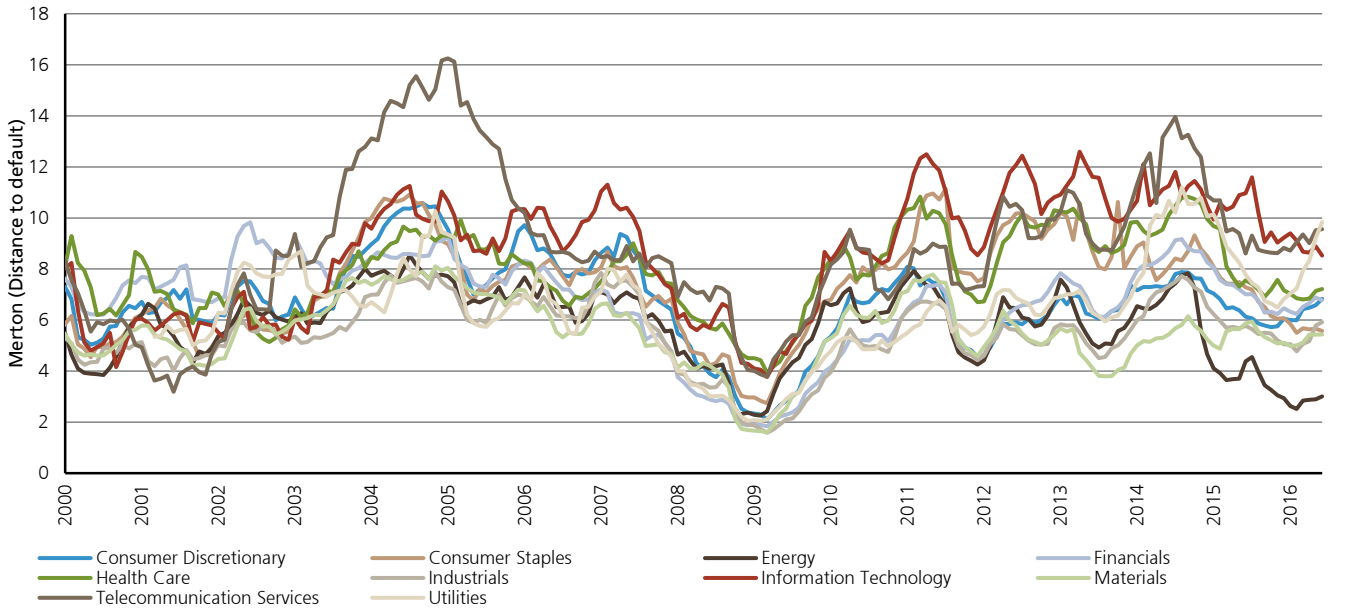
Figure 35: Hong Kong: Market Impact



Source: Factset, UBS Quant

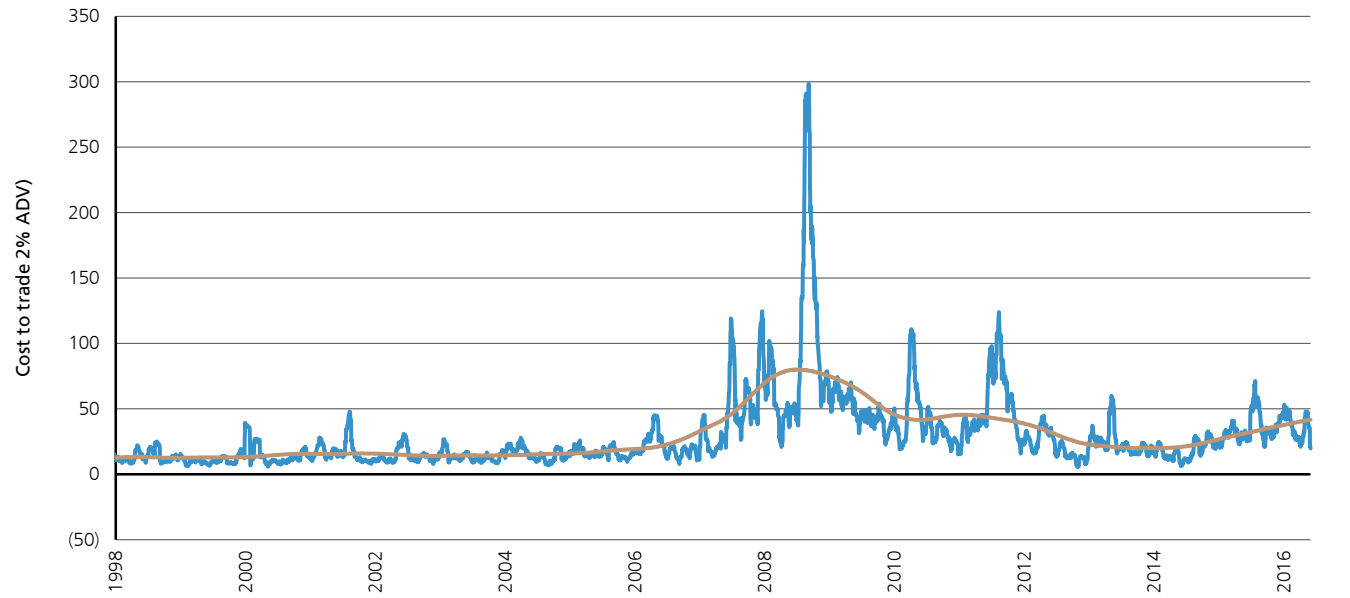
Australia

Figure 36: Merton scores by sector



Source: Factset, UBS Quant

Figure 37: Australia: Market Impact



Source: Factset, UBS Quant

S-Risk

This is a brief summary of the S-Risk calculation.

There are two parts to the S-Risk model: calculation of the long-run marginal expected shortfall (LRMES) score, and calculation of the S-Risk score itself.

LRMES as calculated as:

$$1 - exp^{(\beta * \ln(1-d))}$$

Where in our implementation β is the 1-year price beta calculated by FactSet, and d is the market crisis threshold which is defaulted to 40% as per Brownlees, Engle 2011, S-Risk paper.

S-Risk is the expected capital shortfall in the event of a crisis, which is calculated as:

$$k * DEBT \ - ((1-k) * EQUITY * (1 - LRMES))$$

Where in our implementation k is the prudential capital requirement (set to 8% for Europe and 5.5% elsewhere), EQUITY is common shareholders' equity and DEBT is defined as total assets minus common equity. Recent and planned changes to banks' capital requirement aim to reduce the systemic risk by reducing the right-hand-side of this equation.

KMV Merton

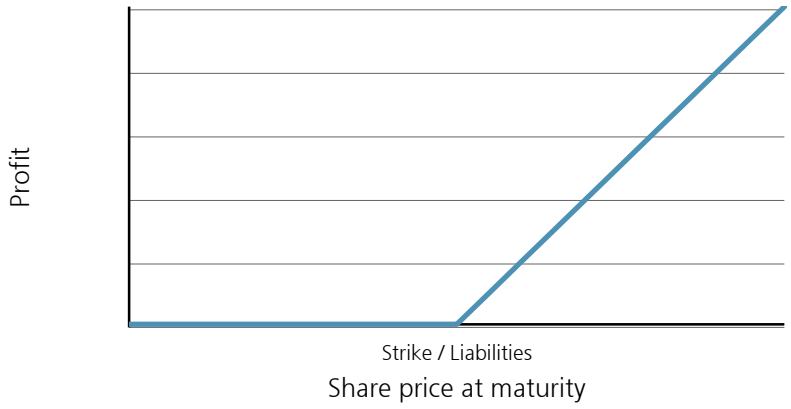
The KMV Merton model was originally developed by Robert Merton in 1974 as a model for assessing the likely credit risk of a company by comparing the company's equity to a European call option on its assets. The probability of default is equal to the probability that the option expires worthless.

We know that:

Assets = Liabilities + Owners Equity

Assuming that the company is wound up at a point in the future, the payoff to shareholders is the same as that of a European call option with the strike set to the value of the firms' liabilities. If at time T the firms' assets are greater than the liabilities, the shareholder will receive the value of the assets less the liabilities. If, however, the value of the assets is less than that of the liabilities, the shareholder receives nothing.

Figure 38: Equity holders payoff



Source: Robert Merton, 1974, On the pricing of corporate debt: The risk structure of interest rates

The Merton model calculates the distance to default using the below equation:

$$DD = \frac{\ln(V/F) + (r - 0.5\sigma_V^2)T}{\sigma_V \sqrt{T}}$$

Where V is the value of the company's assets, F is the value of the company's debt, σ_V is the asset volatility, T is the time horizon, and r is the risk free rate.

The distance to default corresponds to the number of standard deviations between the assets market value and the point of default.

Equity Value of a firm satisfies:

$$E = V\mathrm{N}(d_1) - e^{-rT}F\mathrm{N}(d_2) \quad (1)$$

where E is market value, V is the firm's asset value, F is value of the debt, r is risk-free rate, N() is the cumulative standard normal distribution and d1 is:

$$d_1 = \frac{\ln(V/F) + (r + 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}$$

and d2 is:

$$d_2 = d_1 - \sigma_V\sqrt{T}$$

The volatilities of a firm's equity:

$$\sigma_E = \left(\frac{V}{E}\right)\mathrm{N}(d_1)\sigma_V \quad (2)$$

Equations (1) and (2) can be solved simultaneously for V and σ_V. Distance to default (DD) is:

$$DD = \frac{\ln(V/F) + (r - 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}$$

Assumptions:

The firms debt is a zero coupon bond maturing in one year. We use all current and half of non-current liabilities.

Interest rates are 6 month bank bills

The value of the assets follows a Geometric Brownian Motion

Reference: Robert Merton, 1974, On the pricing of corporate debt: The risk structure of interest rates.

Kyle's Lambda

This is a brief summary of the log-linear version of the linear price impact model from Kyle and Obizhaeva (2016).

We implement the model using daily price returns data (in US$) from FactSet (for global stocks) and CRSP (for US stocks). The expected price impact of trading X shares of a stock with price P, with expected volume V shares and daily volatility of returns σ is given by:

$$\ln\left(1+\frac{\Delta P(X)}{P}\right)=\frac{\lambda}{10^4}*\left(\frac{P*V}{40*10^6}\right)^{\frac{1}{3}}*\left(\frac{\sigma}{0.02}\right)^{\frac{4}{3}}*\left(\frac{X}{0.01*V}\right)$$

The parameters are calibrated in Kyle and Obizhaeva (2016) which used a benchmark price of $40, benchmark stock volatility of 2% per day and expected volume of 1 million shares – these can be scaled appropriately.

In our implementation we aggregate these costs to produce an index-level estimate and include futures volume.

Related literature

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UBS Equity Quantitative Research publications

Monographs, Keys and Q-Series

Title	Date
Is it easier to be a quant in small cap?	Aug-16
Follow the smart money	Jul-16
How can supply chains improve earnings visibility?	Jul-16
High quality names which pay dividends	Feb-16
Why does increasing volatility matter?	Feb-16
What crowded positions are bubbling up in equity markets	Feb-16
What happened to Value, and when will it return?	Jan-16
Who benefits from automation?	Nov-15
The Spectre of Equity-Bond allocation	Nov-15
Dynamic Asset Allocation	Nov-15
How will demographics shape investing for the next ten years?	Nov-15
Surfing the macro wave	Sep-15
Why blame Risk-parity and CTAs?	Sep-15
Bonds are better: asset allocation in target dated funds	Sep-15
Low-Risk Investing: perhaps not everywhere	Jul-15
Cost efficient trading with time varying alphas	Jul-15
The Madness of Crowds	Jul-15
Lessons from Behavioural Finance	Jul-15
A Closer look at the Trend Factor	Jun-15
Understanding Size Investing	Jun-15
Safe Dividends in Times of Financial Repression	Jun-15
Costs as a Style Factor	Apr-15
Cross-Asset Seasonality	Mar-15
Extending our quality model to financials	Mar-15
Where are the crowded trades?	Jan-15
Stock Selection using Machine Learning	Jan-15
Investing in Growth	Jan-15
Harvesting Cross-Asset Value	Dec-14
How to avoid 'Torpedoes'	Nov-14
What happens when volatility normalises?	Oct-14

Academic Research Monitor

Topic	Date
Portfolio Construction and Overfitting	Jul-16
UBS Equity Markets Conference 2016	Jun-16
European Quantitative Conference 2016 Highlights	Apr-16
Does oil matter for equity markets?	Mar-16
Low Risk Investing	Feb-16
Value Investing	Dec-15
Analyst Forecasts and Measuring Distance	Nov-15
UBS Market Microstructure Conference	Oct-15
Equity Risk Premium Forecasting and Market Timing	Sep-15
Behavioural Investing Patterns	Jul-15
Quality and Size Investing	May-15
European Quantitative Conference 2015 Highlights	Apr-15
Smart Beta, Factors and Style Investing	Feb-15
Momentum-Investing	Jan-15
Investment Strategies & Textual Analysis Signals	Dec-14
Commodity Risk & Institutional Investing Habits	Nov-14
Index Membership, Investor (in)attention to News & Spurious Correlations	Sep-14
Forecasting the Equity Risk Premium	Aug-14
Implied Cost of Capital & Shorting Premium	Jun-14
European Quantitative Conference 2014 Highlights	May-14
Trend Following	Mar-14
Factor investing & Quality	Feb-14
Quality & Gross Profitability	Jan-14
Minimum variance: valuation, concentration and exchange rates	Dec-13
Liquidity & back test overfitting	Oct-13
News and its effect on asset prices	Sep-13
Asset pricing & skewness	Aug-13
Timing momentum & risk parity	Jul-13

Valuation Method and Risk Statement

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12-Month Rating	Definition	Coverage[1]	IB Services[2]
Buy	FSR is > 6% above the MRA.	47%	32%
Neutral	FSR is between -6% and 6% of the MRA.	38%	25%
Sell	FSR is > 6% below the MRA.	15%	21%
Short-Term Rating	**Definition**	**Coverage[3]**	**IB Services[4]**
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 30 June 2016.
1:Percentage of companies under coverage globally within the 12-month rating category.
2:Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.
3:Percentage of companies under coverage globally within the Short-Term rating category.
4:Percentage of companies within the Short-Term rating category for which investment banking (IB) services were provided within the past 12 months.

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Company Name	Reuters	12-month rating	Short-term rating	Price	Price date
Alphabet Inc.[6a, 6b, 7, 16b, 22]	GOOG.O	Buy	N/A	US$769.54	26 Aug 2016
Amcor Limited[4, 7]	AMC.AX	Neutral	N/A	A$16.38	26 Aug 2016
China Mobile (HK) Ltd[4, 16a, 16b]	0941.HK	Buy	N/A	HK$96.25	26 Aug 2016
Nestlé[4, 5, 6a, 6b, 7]	NESN.S	Neutral	N/A	CHF77.85	26 Aug 2016
NTT DOCOMO[16b]	9437.T	Not Rated	N/A	¥2,639.0	26 Aug 2016

Source: UBS. All prices as of local market close.
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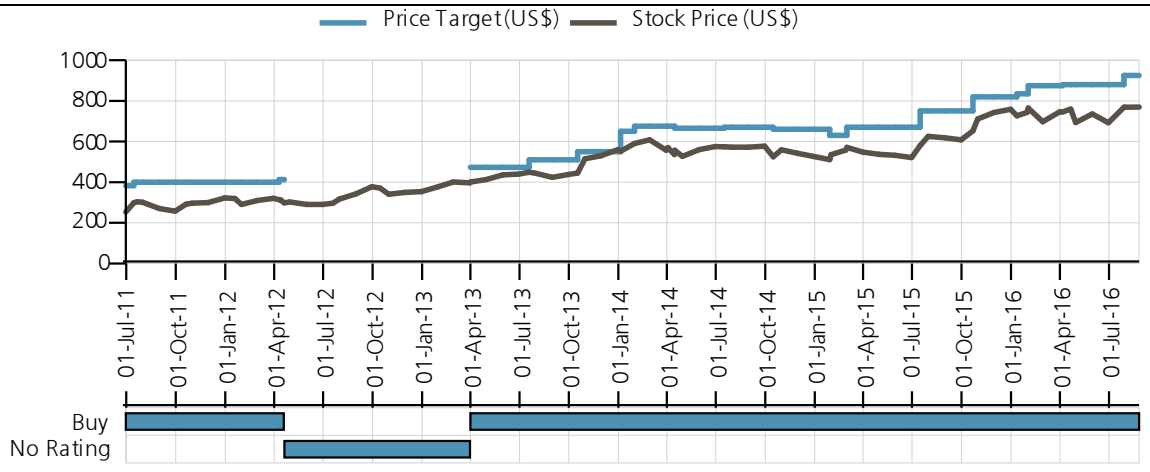
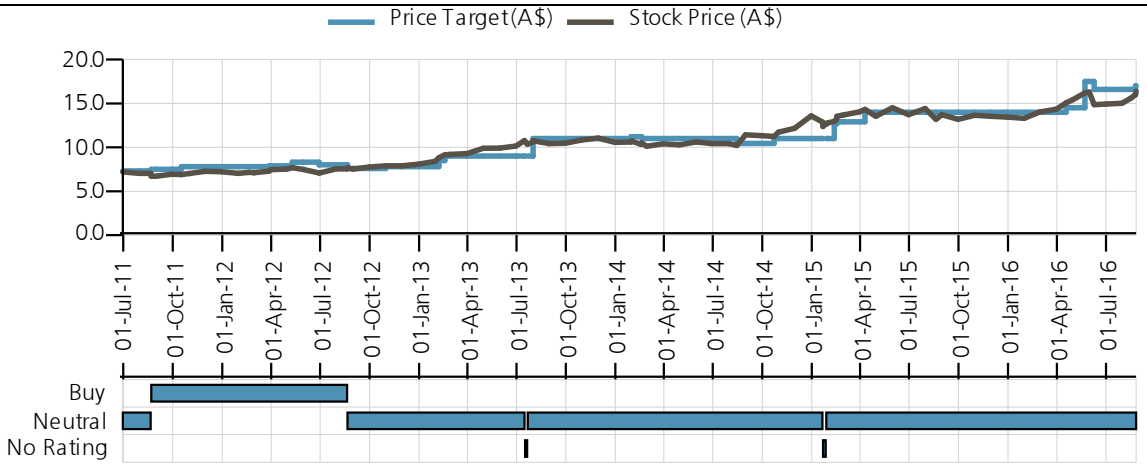


Source: UBS; as of 26 Aug 2016

Amcor Limited (A$)



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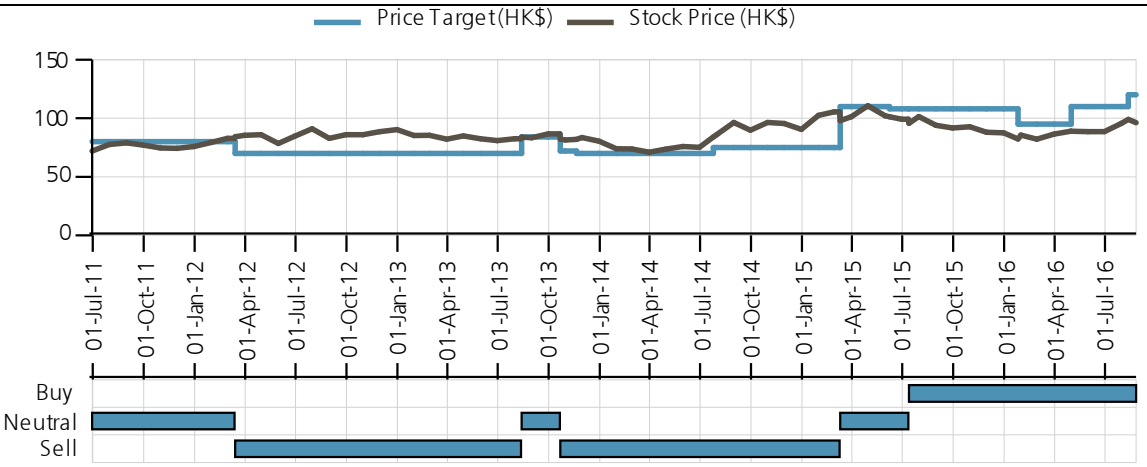
China Mobile (HK) Ltd (HK$)



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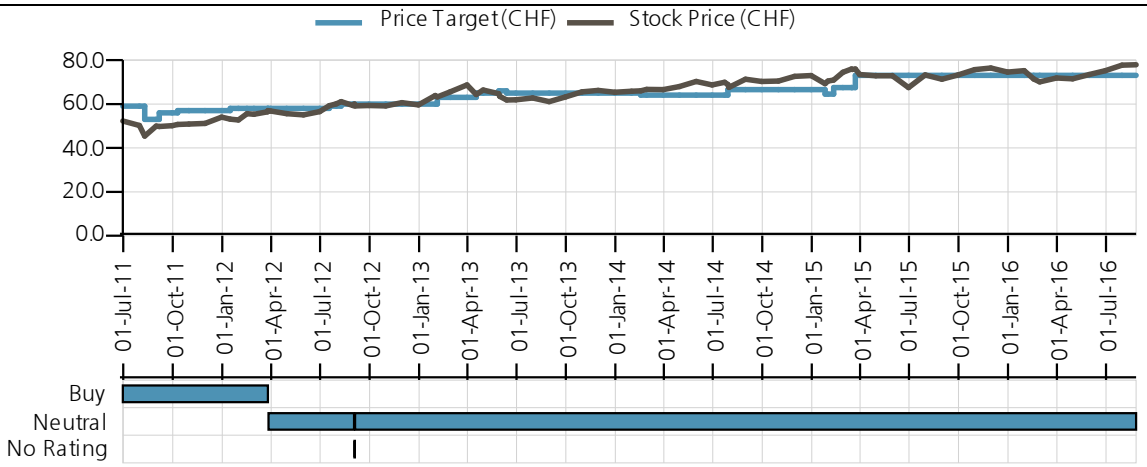
Nestlé (CHF)



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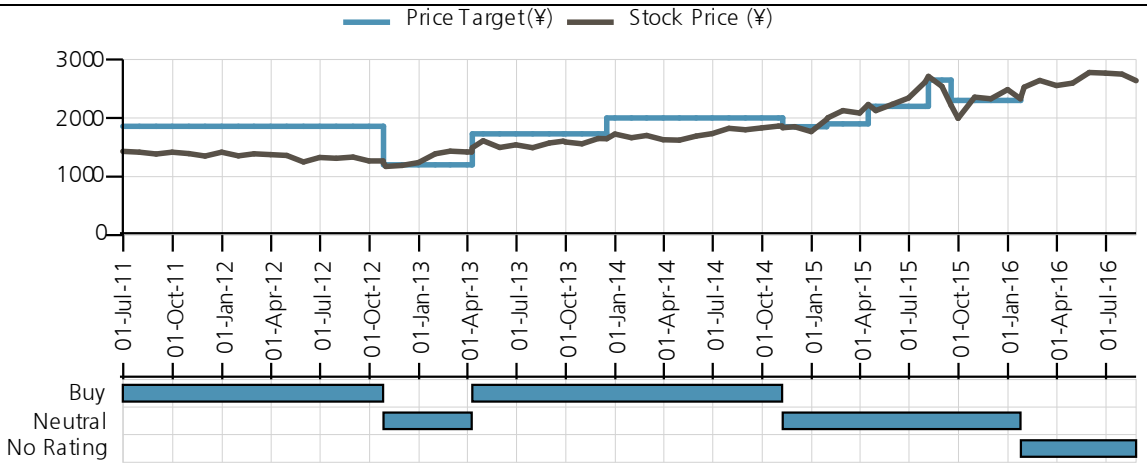
NTT DOCOMO (¥)



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