Correlation and Volatility in International Markets

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IN the 1996 Financial Analysis Journal, Bruno Solnik and his peers examine correlation between the US and international markets, paying special attention to correlation’s relationship to volatility. While diversification is a key strategy to reduce portfolio risk, the authors found that correlation increases in periods of high market volatility, diminishing the usefulness of international diversification. In theory, then, a major financial crisis in the US could have a negative impact on European, Chinese, or Japanese securities. In this study, I examine how correlation has developed further since the authors’ contribution, including the potential effects of globalisation and systemic risk. I have also included a Hong Kong index in this study to observe the behaviour of the broader Asian market (excluding Japan) over time. I found a marked upward trend in correlation over the period from 1971 through 2014, led by Europe and Hong Kong. Further, major international crises drive higher volatility and – in turn – higher correlation between international markets and the US. These findings affirm that international diversification may not save money managers from declining equity prices in the US.

Portfolio managers operate under the assumption that international markets are not highly correlated. This suggests implicitly that a bear market in the United States would not necessarily lead to a bear market in Japan or the United Kingdom. This is an important motivator for portfolio managers that diversify their investments across the globe – diversify, conventional wisdom says, and reduce risk. In this study, I will seek to answer the following questions:

- **How has correlation between the US and international markets evolved?** Importantly, I will compare correlation in the Asia ex-Japan market to that of Europe and Japan.
- **Has the effect of volatility on correlation changed over time?** We want to discern whether the benefits of holding international stocks during crises have increased or diminished over time.

This study compares markets in Europe, Japan, and Hong Kong to the US, using the normalised monthly returns of MSCI regional indices. These markets account for the vast majority of global market capitalisation, giving us a broad perspective. All of this data is expressed in USD, controlling for the effects of local currency (especially across regions with many different national currencies). Keep in mind that correlation and volatility are calculated on the last 12 months of data.
Output

European and US Markets

Hong Kong and US Markets

Japan and US Markets
International Correlation in Equities

Correlation broadly increased in equity markets from January of 1971 through November of 2014. All least-squares lines have a positive slope, with particular increases in Europe and Hong Kong. While correlation data is volatile and noisy, a clear uptrend is visible for both Europe and Hong Kong. Importantly, Europe has a high mean correlation with the US market overall, so continued increases in correlation over the long-term would make for a market very close to the US.

Summary Statistics

<table>
<thead>
<tr>
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<th>Correlation</th>
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<tr>
<td></td>
<td>Mean</td>
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<tr>
<td>Europe</td>
<td>0.6162</td>
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<tr>
<td>Hong Kong</td>
<td>0.4529</td>
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<tr>
<td>Japan</td>
<td>0.3500</td>
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Using a least-squares line, we find that Europe has the highest slope at 0.00112. This implies a yearly increase in correlation of 1.34%, which results in a nearly 58% increase in correlation over the observed time period. The Hong Kong series has a slope of 0.0009, implying a yearly increase of 1.18%, or roughly 51% over the observed time period. Because Hong Kong has a lower mean correlation overall, this pace of increase reflects the market’s growing international exposure. Finally, Japan’s least squares line had a slope of just 0.00054, reflecting a relatively-modest 28% increase in correlation over the time period seen.

While Japan has an export-oriented economy and is quite exposed to international demand, the country’s stocks are curiously uncorrelated to the US equity market relative to Hong Kong and Europe. This may be due to the country’s asynchronous business cycle, which has led Japan to feel the effects of global economic shocks earlier and later than other countries (Solnik et al). Monetary policy has also played some role in the market’s divergence. The Nikkei 225 languished for some time after the 2008 crisis, and only began to pick up in 2012, after the Bank of Japan introduced monetary easing.

Volatility and Correlation

Equity markets in Europe and Hong Kong appear to correlate more closely with the United States market in times of high volatility. This is reflected in the relatively high $R^2$ for the plots, at 0.185 for Europe and 0.100 for Hong Kong. Considering the myriad variables that affect correlation, this study sheds some light on the importance of volatility. The Japanese market, on the other hand, appears to have a very weak link between volatility and correlation. The least-squares line appears almost flat and in fact has a negative slope.
Europe

\[ y = 0.028x + 0.029 \]
\[ R^2 = 0.185 \]

Hong Kong

\[ y = 0.025x + 0.034 \]
\[ R^2 = 0.100 \]

Japan

\[ y = -0.007x + 0.087 \]
\[ R^2 = 0.001 \]
Financial Crises

Times of elevated market volatility allow us to observe the relationship between volatility and correlation. I found that during financial crises, correlation tends to spike along with volatility. In all cases, correlation went over 0.6, with some situations pushing correlation above 0.9. The effects of major financial crises have been similar for the past four decades.

1971-1973 Financial Crisis

[Graph showing correlation and volatility over time with notable events marked]

Black Monday – 1987

[Graph showing correlation and volatility over time with a specific event highlighted]

Correlation spikes to over 0.80 after Black Monday on 19 October 1987
Conclusions

Correlation has exhibited an upward trend from January of 1971 through November of 2014. European and Hong Kong equity markets have especially become more correlated with the US over time, possibly a consequence of increasing international exposure, systemic risk, and globalisation in these economies. Furthermore, volatility continues to drive correlation – especially during economic crises. This means money managers must find less-correlated markets (e.g. Japan) if they want to reduce overall portfolio risk.

Our results build on the work of Dr. Solnik and his peers, and I find that international correlation in the equity market has accelerated since the authors’ study was published.