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## **The Domino Effect in Industries: Why Equity Correlation Surges Are Now So Severe**

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Equity correlations world-wide have dropped significantly after soaring to all-time highs between March and July 2010. The speed with which correlations surged and fell, as well as the fact that the swing could not be easily attributed to specific market events perplexed many market observers. The surge of 2010 prompted some to wonder if the new highs represented a permanent change in the market that might fundamentally alter approaches to portfolio management. Or was it merely a short-term “bubble” that would revert relatively quickly to lower correlation levels? The recent sharp decline back to pre-crisis correlation levels would seem to support the latter view.





## **The Domino Effect in Industries: Why Equity Correlation Surges Are Now So Severe**

**By Anthony Renshaw, PhD and Anureet Saxena, PhD**

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### **1. Introduction**

Equity correlations world-wide have dropped significantly after soaring to all-time highs between March and July 2010. The speed with which correlations surged and fell, as well as the fact that the swing could not be easily attributed to specific market events perplexed many market observers. The surge of 2010 prompted some to wonder if the new highs represented a permanent change in the market that might fundamentally alter approaches to portfolio management. Or was it merely a short-term “bubble” that would revert relatively quickly to lower correlation levels? The recent sharp decline back to pre-crisis correlation levels would seem to support the latter view.

An analysis of the correlation surge using Axioma’s Robust Risk Models suggests that such surges may be the new market norm, at least in the US equity market<sup>1</sup>. Axioma’s risk models indicate that the primary driver of this past year’s correlation surge was a short-lived increase in industry volatility and, in particular, the volatility of the Insurance industry. The contribution of Insurance volatility to the asset-asset correlation surge was at least twice that of any other industry. However, during the surge, *all* industry volatility changes contributed towards increased asset-asset correlation. There was not a single industry volatility change that decreased asset-asset correlation.

Industry- industry correlations have been at record highs since the fall of 2008. Furthermore, the minimum industry-industry correlation among all 68 GICS® Industries has risen from -0.2 in 2007 to +0.5 currently, with no evidence that this trend towards tightly correlated industries is changing. *Currently, there are no uncorrelated US industries.* This explains why increasing volatility in one industry can have a contagion effect leading to an overall increase in equity

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<sup>1</sup> For a more in depth analysis of the correlation market, visit [http://axioma.com/research\\_papers.htm](http://axioma.com/research_papers.htm).

correlations. The opposite phenomenon happens in periods of declining volatilities. Once one industry moves (in this case, Insurance, most likely), the returns to equities in other industries follow, just as one domino falling causes the next domino to fall.

Historically, the US equities market experienced a series of industry volatility surges between 2000 and 2002 of magnitude equal to the one in 2010 but without sharp surges in realized asset correlations. We believe the primary difference between then and now is industry correlation. To demonstrate this, we simulated asset correlations using three different risk models: an up-to-date risk model, a risk model with factor correlations from 9/30/2002, and a risk model with factor correlations from 7/30/2010. Apart from changing the factor correlations, these latter two risk models use up-to-date data. The results confirm that current high levels of factor correlations exacerbate the effect of increasing factor volatilities, leading to larger magnitude asset correlation surges such as those of the past year.

At the moment, asset correlations have returned to pre-crisis levels. However, industry-industry correlations remain high, which suggests that the market conditions lend themselves to short-lived, rapid changes. We suggest that investors should be careful avoid over-reaction to market changes that may, in reality, be driven by a fairly small subset of market factors contaminating the rest of the market.

## **2. Cross-Sectional Asset-Asset Correlations Have Declined Sharply**

Cross-sectional equity correlations climbed to all time highs in all markets last year. Observers wondered if these new highs represented a permanent change in the market — one that might fundamentally alter approaches to portfolio management — or if we were simply witnessing a short-term “bubble” that would revert relatively quickly to lower correlation levels. In a November 2010 research piece<sup>2</sup>, Axioma noted that the high levels of correlation were consistent with a longer term trend of steadily increasing equity correlations that had been taking place for years.

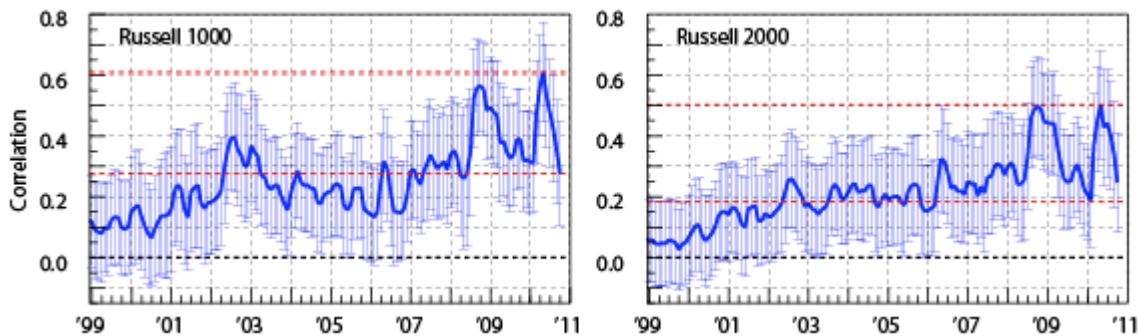
Cross-sectional correlations have dropped significantly in all markets since September 2010, and current cross-sectional correlations are currently very low. Fig. 1 reports historical realized, asset-asset correlations for index constituents for two US equities markets, the Russell 1000 Index (large cap) and the Russell 2000 Index (small cap). For each month and each market, we compute all possible asset-asset, 60-day, forward realized return correlations. For example, if an Index has 1000 assets, then there are  $1000 \times 999 / 2 = 499,500$  possible asset-asset pairs. We compute all of these correlations, and then calculate the average correlation for each day and market. The light blue error bars indicate plus/minus one standard deviation. The two dashed red lines indicate the all-time highest realized correlation and the lowest correlation since August

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<sup>2</sup> “Is This An Equity Correlation Bubble”, available at [http://axioma.com/downloads/EquityCorrelations\\_20101116.pdf](http://axioma.com/downloads/EquityCorrelations_20101116.pdf).

2008. These lines provide a visual reference for comparing recent highs and lows against historical values.

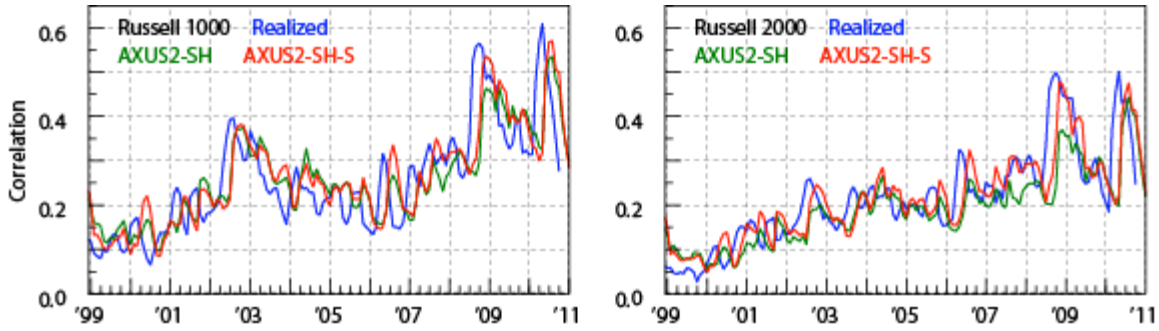
Since we report 60-day forward realized correlations, the last data point shown on these graphs is 9/30/2010, which utilizes the realized returns through market close on 12/30/2010. 60-day correlations have not risen in the four weeks since then.



**Figure 1.** The average asset-asset 60-day forward return correlation for two US markets: the Russell 1000 Index (left), and the Russell 2000 Index (right). The red lines indicate all-time high and post-crisis low correlations.

### 3. Industry Volatility Drove the Correlation Surge

We analyze the drivers of the recent asset correlation surge using Axioma’s Robust Factor Risk Models. Axioma’s factor risk models have tracked the recent changes in asset-asset correlation well, and, therefore, provide a reliable basis for identifying the drivers of the surge. For example, Fig. 2 compares the average realized 60-day forward asset-asset correlations against the predictions of Axioma’s two short horizon US risk models for the Russell 1000 and Russell 2000 universes. Note that the realized correlations are forward correlations so that they utilize return data occurring after the date plotted, while the risk model predictions use return data that occurs entirely before the date plotted. As a result, there is a natural and expected lag between the realized plot and the predicted plots.

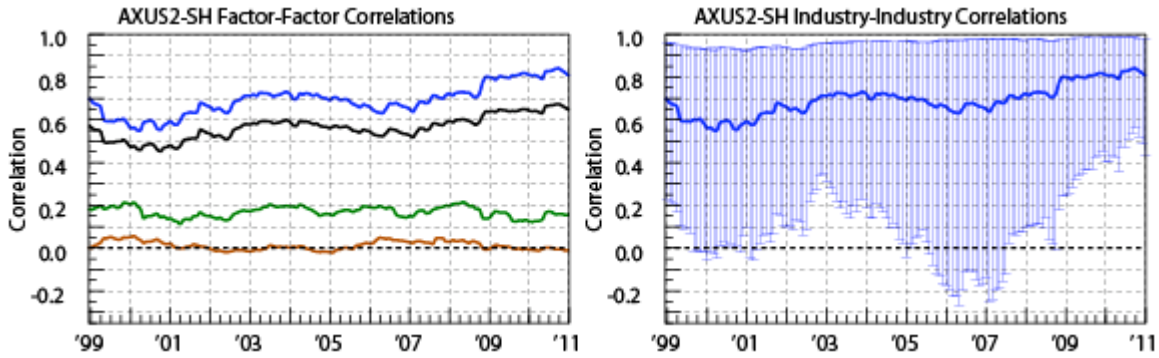


**Figure 2.** Comparison of the realized cross-sectional correlation (blue) with that predicted by two Axioma risk models for the Russell 1000 (left) and Russell 2000 (right) markets. AXUS2-SH (green), is the short horizon, US fundamental factor risk model; AXUS2-SH-S (red), is the short horizon, US statistical factor risk model.

Apart from the expected lag, both models closely tracked the full decline in correlation for both universes, starting from all time highs in mid-2010 and then declining rapidly over the second half of 2010. The slopes of the declines in realized and predicted correlations are nearly identical.

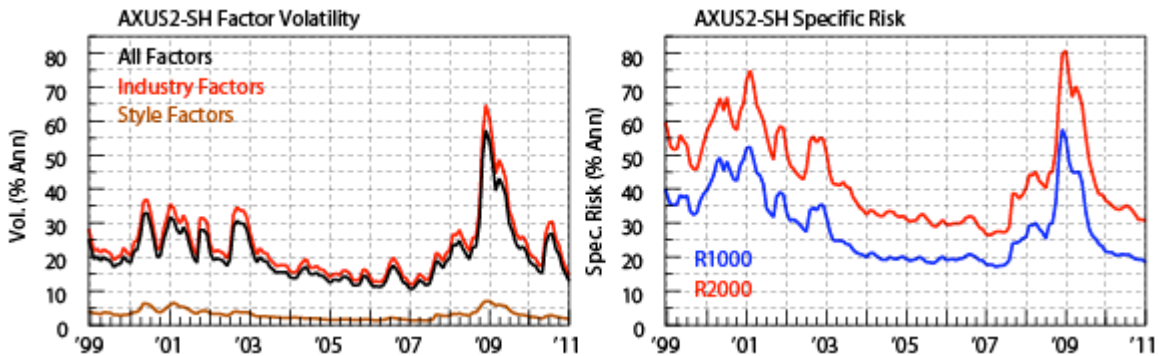
One might expect that the components of these risk models that have changed the most recently may provide insight into the forces that drove equity asset correlations. Fig. 3 shows the average factor-factor correlations for AXUS2-SH broken down into separate factor groups: all factors (black), industry factors (blue), style risk factors (brown), and industry-style (green) risk factor pairs. Also shown at right are the maximum and minimum industry-industry correlations.

Average industry-industry correlations increased substantially in late 2008, and have remained high for the past two years at an average value of 0.81. There was a small increase in industry-industry correlation in mid 2010, to about 0.84, which then dropped back to 0.81. This small increase coincides with the increase in asset-asset correlations, but its magnitude is small. On the other hand, the minimum industry-industry correlation among all 68 GICS Industries has steadily risen for the past four years. Since 2007, the minimum industry-industry correlation has increased from -0.2 in 2007 to +0.5 today. *Currently, no US industries are uncorrelated.*



**Figure 3.** Left: average factor-factor correlations of AXUS2-SH for all factors (black), industry factors (blue), style risk factors (brown) and style-industry factor pairs (green). Right: average industry-industry correlation with error bars indicating the maximum and minimum industry-industry correlation across all 68 GICS industries.

Fig. 4 shows the average factor volatilities for AXUS2-SH broken down into separate factor groups: all factors (black), industry factors (blue), and style risk factors (brown). Also shown at right are the average specific risk predicted by AXUS2-SH for the Russell 1000 (blue) and Russell 2000 (red) universes.



**Figure 4.** Left: average factor volatility of AXUS2-SH for all factors (black), industry factors (red), and style risk factors (brown). Right: average specific risk predicted by AXUS2-SH for the Russell 1000 (blue) and Russell 2000 (red) universes.

The most noticeable recent change in the risk model was the sharp surge in factor volatility and, in particular, industry volatility, in mid 2010. Style risk factor volatility and specific risk both have small increases in 2010, but these increases modest. This suggests that asset-asset correlation changes have been driven by changes in factor volatility and not by changes in factor-factor correlations or specific risk.

Since recent market movements have changed so much in such a short period of time, we can use a simple methodology to verify that, in fact, industry volatilities have been the primary driver of the recent changes in asset correlation. We can attribute the change in asset correlation to any subset of factors of a risk model simply by replacing the volatility of those factors with a volatility that is three months out-of-date. The change produced comparing value using the three month old factor volatility and the up-to-date factor volatility provides an estimate of the change attributable to that factor.

Table 1 shows an attribution of the surge in asset correlation between 4/30/2010 and 7/30/2010 broken down by GICS Sectors for both the Russell 1000 and Russell 2000 universes.

Russell 1000		Russell 2000	
Up-To-Date Risk Model	Predicted Asset-Asset Correlation	Up-To-Date Risk Model	Predicted Asset-Asset Correlation
4/30/2010	0.325	4/30/2010	0.198
7/30/2010	0.535	7/30/2010	0.444
Correlation Change	0.210	Correlation Change	0.246
Sector	Contribution To Correlation Change	Sector	Contribution To Correlation Change
Financials	0.051	Financials	0.046
Health Care	0.047	Information Technology	0.040
Information Technology	0.043	Health Care	0.038
Consumer Discretionary	0.039	Industrials	0.032
Consumer Staples	0.035	Consumer Discretionary	0.027
Industrials	0.032	Consumer Staples	0.011
Utilities	0.023	Materials	0.007
Materials	0.017	Utilities	0.006
Energy	0.011	Energy	0.006
Telecommunication Services	0.008	Telecommunication Services	0.003

**Table 1.** An attribution of asset correlation change between 4/30/2010 and 7/30/2010 broken down by GICS Sectors.

Table 2 shows a similar attribution broken down by GICS Industries. In this table, only the 12 largest contributors are shown.

Russell 1000		Russell 2000	
Up-To-Date Risk Model	Predicted Asset-Asset Correlation	Up-To-Date Risk Model	Predicted Asset-Asset Correlation
4/30/2010	0.325	4/30/2010	0.198
7/30/2010	0.535	7/30/2010	0.444
Correlation Change	0.210	Correlation Change	0.246
Industry	Contribution To Correlation Change	Industry	Contribution To Correlation Change
Insurance	0.026	Commercial Banks	0.013
Food Products	0.014	Health Care Equipment & Supplies	0.012
Health Care Equipment & Supplies	0.014	Software	0.011
IT Services	0.012	Biotechnology	0.010
Health Care Providers & Services	0.012	Insurance	0.010
Media	0.011	Health Care Providers & Services	0.009
Electric Utilities	0.011	Real Estate Investment Trusts (REITs)	0.008
Software	0.010	Capital Markets	0.007
Chemicals	0.010	Commercial Services & Supplies	0.007
Pharmaceuticals	0.009	Electronic Equip. Instr. & Comps.	0.007
Oil Gas & Consumable Fuels	0.009	Thrifts & Mortgage Finance	0.006
Multi-Utilities	0.008	Internet Software & Services	0.006

**Table 2** An attribution of asset correlation change between 4/30/2010 and 7/30/2010 broken down by GICS Industries. Only the 12 largest contributors are shown.

This analysis shows that the Financial sector was the primary driver of the surge in asset correlations for both large and small cap universes. The contributions from Health Care and Information Technologies were also large. At the Industry level, Insurance stands out within the large cap universe in that its contribution is almost twice as large as the next largest industry (Food Products). In the small cap universe, Commercial Banks were the largest contributor, but its contribution is about the same size as the next largest contributor (Health Care Equipment & Supplies).

Although not explicitly shown in Table 2, all 68 GICS Industries contributed positively to the asset correlation surge. This, of course, is consistent with the large, positive industry correlations shown in Fig. 3.

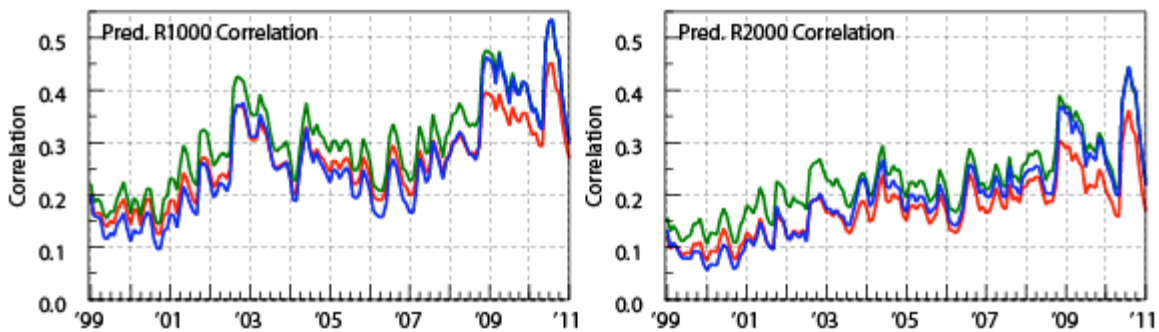
#### 4. Why Was The Asset Correlation Surge So Severe?

The data suggests that industry volatility was the primary driver of the surge in asset correlations. Notice, however, that in Fig. 4 there are series of four industry volatility surges between 2000 and 2002 that are similar to the one that occurred in 2010. The Russell 1000 and Russell 2000

universes experienced only moderate increases in asset-asset correlations during this same time period, mostly for the large cap universe (see Fig. 1).

Why was the recent asset correlation surge so severe while the earlier surges comparatively mild? We believe the primary difference in these events is industry-industry correlation, which is significantly higher now than it was in 2000 and 2002.

We can use Axioma's factor risk models to test this hypothesis by computing the predicted asset-asset correlations using risk models with different factor-factor correlations. Fig. 5 compares the predicted asset correlations for the Russell 1000 and Russell 2000 universes using an up-to-date version of AXUS2-SH; a version of AXUS2-SH with the factor-factor correlations from 9/30/2002; and a version of AXUS2-SH with the factor-factor correlations from 7/30/2010.



**Figure 5.** Predicted asset-asset correlation for three different risk models for the Russell 1000 and Russell 2000 universes. Blue = up-to-date AXUS2-SH risk model; red = AXUS2-SH with factor correlations taken from 9/30/2002; green = AXUS2-SH with factor correlations taken from 7/30/2010.

The results indicate that the changes in factor-factor correlation from 2002 to 2010 account for a difference in predicted asset-asset correlations of approximately 0.05 in 2002 and 0.10 in 2010, given identical increases in factor volatility. That is, the predicted 2010 surge in asset-asset correlations would have peaked at 0.45 and 0.36 for the Russell 1000 and Russell 2000 universes respectively, rather 0.54 and 0.44 if the factor-factor correlations had not changed since 2002. This is an asset correlation reduction of nearly 0.1 in both cases. Conversely, if we replace the actually 2002 factor correlations with those of 2010, the predicted asset correlation rises during 2002 from 0.37 to 0.42 and 0.20 to 0.27 for the Russell 1000 and Russell 2000 universes respectively.

## 5. The New Market Norm

An analysis of asset-asset correlations using Axioma's Robust Risk Models indicate that the recent surge in asset correlations was driven primarily by a short-lived rise in industry volatilities and exacerbated by the current high levels of industry-industry correlation. The high industry

correlations mean that one industry can easily contaminate others, leading to unexpectedly large market changes in asset correlation.

Although asset correlations are once again at pre-crisis levels, industry correlations remain high. This suggests that the market may be especially susceptible to rapid changes in asset correlations. This is not without historical precedent. In 2006, correlations in the European markets whip-sawed from all-time highs in the first half of the year to historically low levels in the second half, before rebounding to relatively high levels by the start of 2007. So asset correlations may head back up, and—as noted in our November 2010 article—such a pattern would be consistent with the longer term trend of steadily rising correlations.

However, as seen this past year, market moves can be surprisingly short-lived. Investors may be rewarded for not over-reacting to market movements, as the high levels of industry correlation may drive relatively short-lived market changes.

Regardless of what happens in 2011, the decrease in equity correlations over the last six months is a welcome sign for the vast majority of equity investors. Many of the commonly used investment equity strategies, including hedging, diversification and alpha generation, generally perform better when asset returns are less correlated.

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