

# The Black Swan in Quantitative Equity

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## Abstract

What happened to market-neutral quantitative equity portfolios in the summer of 2007? First, their returns were much more volatile than past results would suggest likely. In particular, August 8th and 9th generated huge losses while the 10th and 13th produced a positive, albeit weaker, snapback. Second, poor results internationally followed after losses in the US. Third, results from portfolios which operate on different time scales (and which are usually uncorrelated) moved in sync, with correlations increasing to over 80%. A dramatic reduction in holdings, caused by both de-leveraging and panic-selling, led to these losses and the resulting rebound. This “crowd risk” — the tendency of quant portfolios to hold similar names and be easily spooked into exiting together — is now an unavoidable feature of the quantitative equity space. Volatility forecasts need to account for it.

## Volatility

Returns of market-neutral quantitative equity portfolios were amazingly volatile in the summer of 2007. In particular, August 8th and 9th generated huge losses while the 10th and 13th produced similar, although weaker, positive returns. Start with Figure 1.

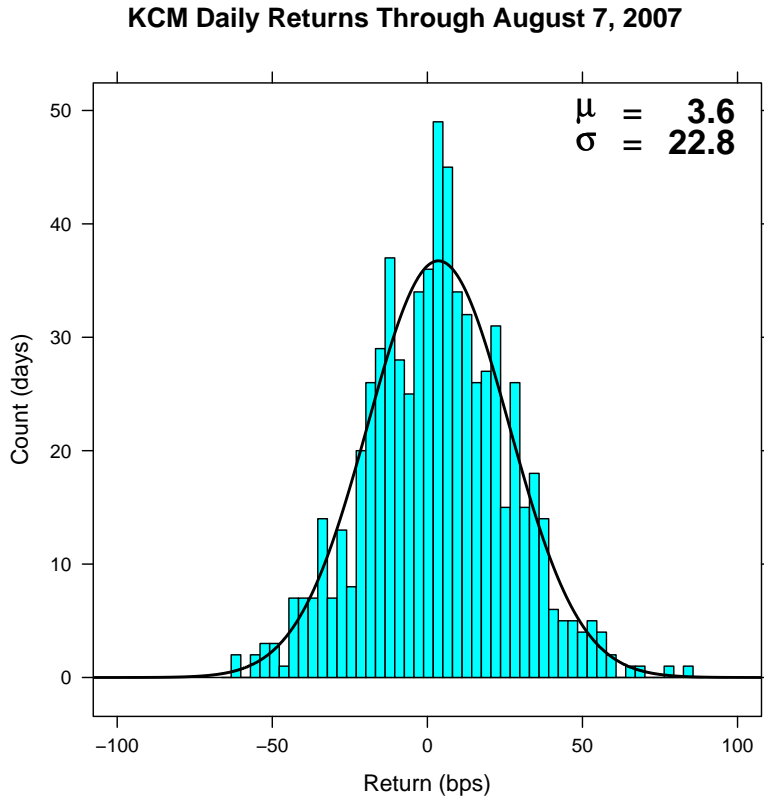


Figure 1: Histogram of KCM daily returns in bps from January 3, 2005 through August 7, 2007. Returns are gross of trade costs and financing. Over this period there are 676 observations with mean 3.6 bps and standard deviation 22.8 bps, for an annualized volatility of 3.6%. A normal distribution with this mean and standard deviation is superimposed on the histogram.

These well-behaved daily returns from January 2005 through early August 2007 are similar to what quant equity managers have seen for years. While individual stocks are not normally distributed, diversified portfolios with hundreds of names and no country/sector exposures are very stable. Although our portfolio does show slightly fat tails, there was nothing in the previous  $2\frac{1}{2}$  years worth of data to suggest that an extreme result was likely. Then came August 8, 2007. Consider Figure 2.

The portfolio was down 4% on both August 8th and 9th. The “quant bloodbath” was global. No country or sector was spared. Similar results

### KCM Daily Returns Through August 15, 2007

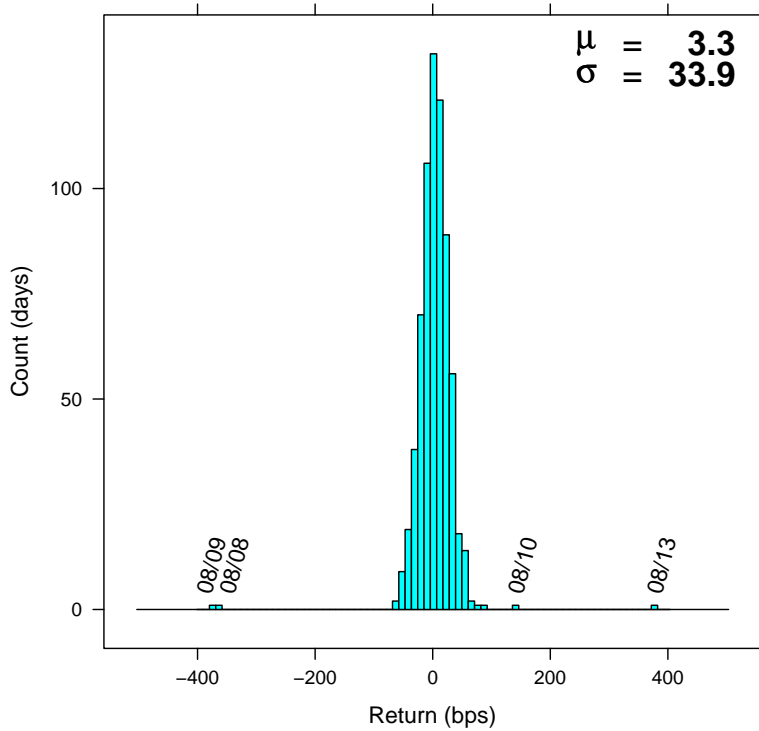


Figure 2: Histogram of KCM daily returns from January 3, 2005 through August 15, 2007, in bps. Returns are gross of trade costs and financing. Over this period there are 682 observations with mean 3.3 bps and standard deviation 33.9 bps, for an annualized volatility of 5.4%. The extreme results are more than 6 times larger than the best and worst days from the previous  $2\frac{1}{2}$  years.

were seen for all holding periods. The only thing which could cause such coordinated losses is wide-spread selling. Although quant A's portfolio is not identical to quant B's portfolio and neither is the same as quant C's, the global "quant book" overlaps with each of them. Even the best quant in the world has many, many positions which are held by other quants. So, when every quant decreases his portfolio size by 10% — a modest, prudent cut, consistent with reducing one's risk exposure in the face of volatile markets — every quant is crushed.

The snapback which followed on Friday, August 10 and Monday, August 13 was caused by two things. First, some quants recognized that this was a bottom, that it was the greatest quant buying opportunity of the last ten years. Once the US opened flat and Europe strengthened on Friday morning, it was clear that the carnage was over. Second, and more importantly, fundamental managers stopped getting out of the way. They had watched while a seemingly random collection of stocks had either plunged or spiked *on no news*. Press reports made clear that this had something to do with quant funds, so there was no reason to act immediately. But, after two days, the prices just became too attractive.

## US Versus International

Looking at cumulative returns over the year, as in Figure 3, we can see that the poor performance started in the US, as early as April. It is not clear if it was this poor performance, perhaps also seen in the shorter holding period portfolios, which led multi-strategy funds to cut down on their exposure or if the need to raise capital as a result of subprime losses was the primary cause. Whichever butterfly initially flapped her wings, the selling soon created a momentum of its own. Sales/covers by quant funds led to losses for other quant funds, leading to more sales/covers. Stat arb funds started to withdraw from the market, making prices even more sensitive to unwinds.

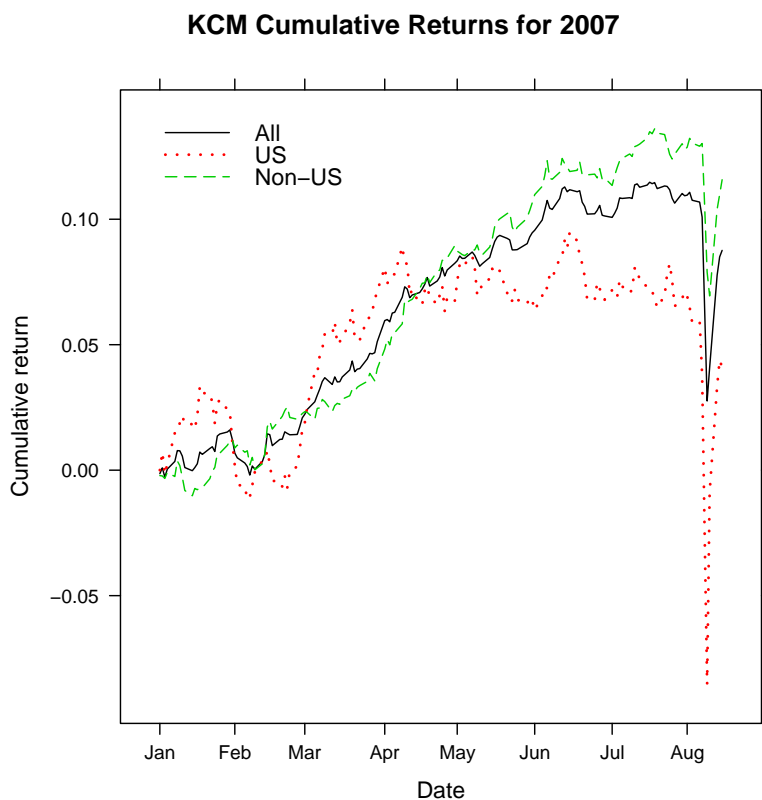


Figure 3: KCM cumulative returns from January 2, 2007 through August 15, 2007 for all holdings, US holdings, and non-US holdings. Returns are gross of trade costs and financing.

## Correlations

The most disconcerting aspect of the downturn was the change in correlations among different sorts of quant funds. Figure 4 shows the scatter plot of the returns of our portfolio and a hypothetical short-term stat arb fund based on 3-day reversal.<sup>1</sup> The correlation during 2007 was only 18% prior to August. There was no particular reason to think that a horrible day for our portfolio will be associated with either a very good or very bad day for 3-day reversal.

<sup>1</sup>These stat arb results are very rough and involve all sorts of unreasonable assumptions. The point is to capture the flavor of what happened.

The lack of correlation between stat arb portfolios and longer holding period quant strategies has been a staple of the quant equity world for at least a decade.

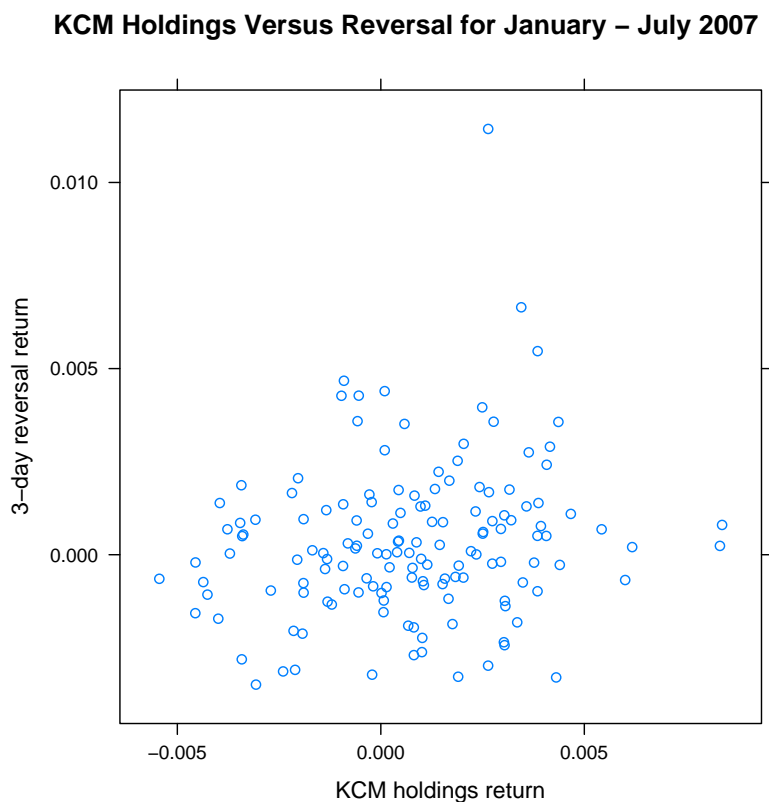


Figure 4: Scatter plot of KCM holdings return versus a 3-day reversal portfolio from January 3, 2007 to July 31, 2007. Reversal portfolio return consists of equal weighted US and non-US portfolios, with universe of the 1,000 biggest companies in each region. Each sub-portfolio return is the equal weighted quintile spread return of a 3-day reversal signal. The signal comprises oppositely signed prior 3-day return, adjusted for country, industry, and sector. Correlation of these returns is 18%, which is barely statistically significant.

All that changed in August. As Figure 5 shows, the correlation increased dramatically this month, to more than 80%.

Just at the moment where, one would hope, poor performance in our

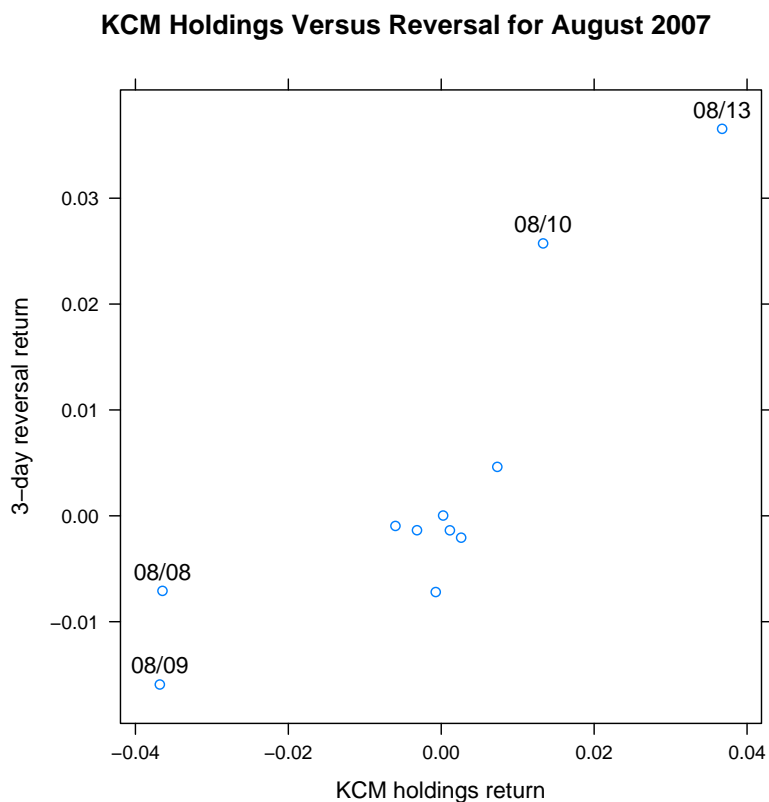


Figure 5: Scatter plot of KCM holdings return versus a 3-day reversal portfolio from August 1, 2007 to August 15, 2007, constructed in the same way as in Figure 4. Correlation of these returns is 84%.

portfolio would be made up for by good performance among the stat arb strategies, those short term strategies also suffered, and then bounced back on the same days.

The black swan which appeared among quantitative equity portfolios — around the globe and for all holdings periods — started in the US. It produced unheard of volatility and high correlations. Panic and simultaneous unwinds among quant managers were the fundamental causes. Knowing these risks, quant managers will be more eager to be the first one through the exit door

the next time. Yet, billions of dollars have left the strategy and few investors seemed inclined to put more money to work. Perhaps the best analogy is to convert arb funds, another crowded trade which suffered an extreme shake out in 2005 but has been a profitable strategy since then. We think that the same will be true for quant equity over the next few years. Yet “crowd risk” means that wise managers should ensure access to adequate capital during times of stress.