



*Black Swans, Real Estate, and Financial Stocks*

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The decline in the real estate and mortgage markets in 2007 has much to teach investors. Real estate has taken a bit hit after rallying for years. Banks that are active in the mortgage markets have also suffered substantial declines in their stock prices due to what is now perceived as indiscriminate lending practices. Major REIT indices are down 20% for the year and a range of bank stocks have double-digit declines. Many investors have lost a lot of money (at least on paper) from their holdings in even blue-chip banks like Citigroup and Bank of America. The question that most investors really need to understand is whether this mortgage and real estate meltdown was unpredictable (a lightning bolt from the blue) or whether there were ways to anticipate and manage the probability of such an event.

**The Economist** has suggested that the scale of declines in the real estate and mortgage markets in 2007 was essentially a ‘black swan event’:

*Although many anticipated a fall in American house prices for 2007, for example, few expected the scale of the ramifications for financial markets, as a whole system of structured finance appeared to unravel and the banking system was plunged into crisis.*

*In one of the defining phrases of 2007, the author and investor Nassim Taleb has called these occurrences “black swans”—unexpected events that have enormous consequences. These are, by definition, very hard to forecast.*

[http://www.economist.com/finance/displaystory.cfm?story\\_id=10339398](http://www.economist.com/finance/displaystory.cfm?story_id=10339398)

Nassim Taleb defines ‘black swan events’ in the following way:

*A black swan is an outlier, an event that lies beyond the realm of normal expectations. Most people expect all swans to be white because that's what their experience tells them; a black swan is by definition a surprise.*

Nassim Taleb ([http://www.edge.org/3rd\\_culture/taleb04/taleb\\_indexx.html](http://www.edge.org/3rd_culture/taleb04/taleb_indexx.html))

If the sub-prime / real estate meltdown was truly a ‘black swan’ event, the probability of it occurring should be estimated to be essentially zero or (at least) vanishingly small by portfolio management tools. There is a very important question here. **Did good statistical models assign a non-trivial probability to the scale of losses that we have**

**seen in financial stocks and real estate prior to the event?** If the answer is no, then perhaps this ‘event’ in 2007 is an example of one of Mr. Taleb’s unpredictable surprises. On the other hand, if good statistical models assigned significant odds to such a decline, there is an entirely different lesson to be drawn. If this scale of decline was predicted at some reasonable probability, who knew and how did they know?

One of the core related themes of Mr. Taleb’s work is that the standards of mathematical finance are too simplistic to capture the risks of extreme events. In fact, he is highly dismissive of quantitative finance as a whole:

*Quantitative economics, particularly finance, has not been a particularly introspective or empirical science....Financial economists built "portfolio theory" that is based on our ability to measure the financial risks. They used the Bell-Shaped (and similar) distribution which proliferated in academia and yielded a handful of Nobel medals...Everything reposes on probabilities being stationary, i.e. not changing after your observe them, assuming what you observed was true. They were all convinced of measuring risks as someone would measure the temperature. It led to series of fiascos, including the blowup of a fund called Long-term Capital Management, co-founded by two Nobel economists. Yet it has not been discredited — they still say "we have nothing better" and teach it in Business Schools. This is what I call the problem of gambling with the wrong dice. Here you have someone who is extremely sophisticated at computing the probabilities on the dice, but guess what? They have no clue what dice they are using and no mental courage to say "I don't know".*

Nassim Taleb ([http://www.edge.org/3rd\\_culture/taleb04/taleb\\_indexx.html](http://www.edge.org/3rd_culture/taleb04/taleb_indexx.html))

Was the sub-prime meltdown a ‘black swan’ event that the quantitative models suggested was impossible? Was everyone playing with ‘the wrong dice’ as Mr. Taleb suggests? I think not—at least based on the evidence before us today. The portfolio theory that Mr. Taleb is so dismissive of is widely in use in banks and on trading floors across the globe. I have worked on these types of models for a decade or so and I think that Mr. Taleb is throwing the baby out with the bath water in his sweeping critique (as above). This is not to deny that the probabilities of some extreme events are essentially totally unknown, but rather that there is a lot of middle ground in which portfolio theory can yield very useful insight into how to invest and manage risk.

Let us begin with a brief discussion of how portfolio theory can be used to estimate the probabilities of events when it is used properly.

The core precept in portfolio theory is that risk and return are coupled. Over long periods of time, asset classes which are more volatile should generate higher average return---and they do. At any given time in a widely traded (i.e. liquid) market for a security, there is a price at which you can buy or sell that security. The price of a security reflects the markets' consensus opinion of the value of the discounted future earnings generated by the company or asset represented by the security. Of course, nobody knows the future earnings from a company or the future value of an asset with a high degree of certainty, so the price moves around as new information becomes available. There are speculative runs (up and down) in which investors become too enthusiastic or pessimistic about a given asset class, etc. Larger swings in price over time suggest that there is more uncertainty as to the future earnings (and vice versa). While investors converge to a price that represents the expected future earnings in the market for a stock, investors also converge to estimates of future volatility in the options markets. Good portfolio models combine market information on risk and return with long-term capital markets data. For the vast majority of investors, it is useful to be able to understand the broad features of risk in a portfolio. Good portfolio models cannot properly estimate the 1-in-10,000 events, but they can estimate risk reasonably well---enough to demonstrate to an investor or portfolio manager whether his or her portfolio is too risky or too conservative.

A good portfolio model is tested to see whether its forecasts of expected return and volatility are borne out in the market. There are a range of standards for stress testing these models. It is certainly true that portfolio models cannot estimate the probability of massive dislocations like 9/11 or the collapse of Enron. On this Mr. Taleb and I agree. On the other hand, there is quite a spectrum of extreme events that good portfolio models can capture---and the current realty/sub-prime meltdown falls into this category, based on available evidence to date. I performed an analysis in which I used our portfolio management software, Quantext Portfolio Planner (QPP), to project the future returns for two financial stocks, Citigroup and Bank of America, and two REIT ETF's (ICF and

RWR). While every portfolio model is somewhat different, QPP's results are broadly consistent with those used in the industry:

<http://www.quantext.com/RiskReturn2.pdf>

I used three years of trailing data through the end of 2006 to drive the model (my standard) and all default settings in QPP. The projections show what a user would have seen—and a number did—at the end of 2006.

The table below shows the percentiles for projected annual return for Citigroup (C) at the end of 2006. At the very bottom of this table, you can see what has actually occurred for 2007 (note this is through Dec 28). Citigroup has dropped 45% in 2007. The projected returns for C suggest that this loss was on the order of 2.5% probability. Things in this probability range (i.e. 1-in-40) are certainly not implausible. One-in-forty events (2.5%) are not like shark bites or getting hit by lightning.

Percentile	Projected Return
1%	-53%
5%	-36%
10%	-25%
15%	-17%
20%	-10%
25%	-6%
30%	0%
2007 Return	-45%

***Projected percentiles for Citigroup (C) at the end of 2006 and actual 2007 return***

Without trying to get down to some estimate of whether the losses at Citi are a 1-in-50 even or a 1-in-30 event, I think that it is clear that this scale of loss is certainly not a 'black swan' kind of event. The whole idea of the 'black swan' is an event that is considered impossible or for which the probability is so small as to be ignorable. If 1-in-40 swans at your local park are black, you would not consider them to be incredibly rare. The 45% drop in Citi over 2007 may have been enormously surprising to many investors, but this does not mean that such an event was beyond a good portfolio model. There is a deep idea here: the market's risk-return data for C carried with it the knowledge that such

a drop was possible at a small but meaningful level. This is not to say that pure historical data provided this estimate, but rather than historical data combined with robust portfolio simulation tools showed that this level of drop was possible at a not-trivial level.

Bank of America (BAC) showed a considerably smaller loss of -19% for 2007, and QPP's projections using data from the end of 2006 suggested that this level of loss would occur at the 10<sup>th</sup> percentile (a 10% chance of at least this level of loss)---see table below.

Percentile	Return
1%	-41%
5%	-28%
10%	-19%
15%	-13%
20%	-8%
25%	-4%
30%	0%
2007 Return	-19%

***Projected percentiles for Bank of America (BAC) and actual 2007 return***

The REIT market has also had a rough year in 2007, with 20% declines for the broad indices. The two tables below show the same QPP projections for ICF and RWR, two major REIT ETF's, using data available through the end of 2006:

Percentile	Return
1%	-34%
5%	-23%
10%	-16%
15%	-10%
20%	-6%
25%	-3%
30%	0%
2007 Return	-18%

***Projected percentiles for RWR and actual 2007 return***

Percentile	Return
1%	-33%
5%	-22%
10%	-15%
15%	-10%
20%	-6%
25%	-3%
30%	0%
2007 Return	-20%

***Projected percentiles for ICF and actual 2007 return***

Both ICF and RWR suffered about 20% declines in 2007, and QPP projected that these losses would occur at between the 5<sup>th</sup> and 10<sup>th</sup> percentiles. Things that occur at between 1-in-10 (10<sup>th</sup> percentile) and 1-in-20 (5<sup>th</sup> percentile) are far from ‘black swan’ events, if we use the definition that a black swan event is beyond the realm of normal expectations.

Now, let’s pull things together. It is true that there are events that are simply beyond our capacity to calculate the odds---9/11 being an example. There are plenty of them in history. One response to such outliers in the investing world is to simply discount portfolio analysis---and this is what Mr. Taleb would suggest. If he is correct that portfolio theory is based on completely ill-founded models, then it is irrational for investors to try to compute risk or to try to discriminate between risky investments. If our capital markets are predicated on investors using their knowledge to establish a balance between risk and return, but our estimates of risk are without value, then the entire edifice is a pure random process. That is an extreme supposition, indeed.

On the other hand, there is an enormous amount of evidence that investors are consistently more highly rewarded for taking on riskier assets over less risky assets (in a statistical sense). While we cannot quantitatively estimate the odds of a 9/11-like event, portfolio theory actually provides an enormous amount of useful insight when used properly. Using data available at the end of 2006, QPP projected outcomes for financial stocks (like C and BAC) and REIT indices (like ICF and RWR) in which the events that occurred in 2007 were estimated to occur with non-vanishing probability. If I am looking

at a stock with a 1-in-20 chances of losing 36% in the next year (as C was projected to do), I would be very careful about how I would include it in my portfolio. I would combine C with other assets that are not highly correlated to it, in order to manage the risks of a major decline as we have experienced this year. I own BAC—and its decline has not caused me any lost sleep. I have other things in my portfolio that have done disproportionately well even as BAC has done very poorly---and this was by design.

Now, I assume that Mr. Taleb would say that the 45% decline in C or the 20% declines in ICF and RWR are not ‘black swan’ events, precisely because a standard portfolio model like QPP calculated that they could occur at non-vanishing probability. The ability to estimate the relative risk in investments is very useful to investors, but Mr. Taleb completely dismisses portfolio theory as worthless and its practitioners as intellectually lazy. This argument is ultimately a philosophical debate rather than a practical one. Mr. Taleb is saying, in effect, that he would rather have no model at all rather than attempt to use an imperfect model. At its core, this is a circular argument. If a portfolio model estimates that something is possible, the event is (by Mr. Taleb’s definition) not a ‘black swan.’ If portfolio theory estimates that the odds of something happening are vanishingly small, and it occurs, it is (by definition) a ‘black swan’ and represents a failure of portfolio theory. How can portfolio theory ever be validated under this sort of scoring?

While the models are far from perfect, and our ability to compute the odds of extremely improbable events is almost nil, the use of portfolio analysis to capture the broad features of the risk in a portfolio is extremely valuable. While *The Economist* article cited earlier suggests that the scale of the sub-prime mortgage meltdown in 2007 was something of a ‘black swan,’ our results show that an investor or portfolio manager with a good portfolio tool could see that declines that we have experienced this year in real estate and financial stocks were well within the range of the possible.

*Quantext Portfolio Planner* is a portfolio management tool. Extensive case studies, as well as access to a free extended trial, are available at <http://www.quantext.com>

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