



Max Darnell  
Partner  
Chief Investment Officer

## Piloting Quantitative Investment Strategies

A lot of ink was spent on quants in August and early September. Much of what was written is likely to leave readers with the impression that in quant shops, computers and mathematical algorithms are making investment decisions rather than people. There was much discussion about how computers, or how the computers' models got it wrong – at least for a moment. The term “black box” was used frequently, implying that what goes on within the confines of the CPU are a mystery to all of us, and those poor servants to the black boxes, the quant managers, were in some cases mystified and confused by the fact that their models didn't work. “Gosh, if it was working yesterday, how could it fail to work today,” we can imagine these poor, misled souls saying to themselves while nervously staring at their shoes.

There are many different kinds of quants, and the caricature that was painted of quants does – as caricatures usually do – hold some modicum of truth. Computers and mathematical algorithms are, of course, *used* to make decisions, and no honest investor of any type can tell you that they haven't been taken by surprise by market events or even been found initially lacking an explanation as to what exactly triggered significant events within their portfolios. Where the caricature falls short, however, is that for most quantitative strategies, human judgment is responsible for the decisions being made, not computers and algorithms which are merely *tools* being used by those investors.

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Those invested in such quantitative strategies already know that human judgment is the decisive factor in designing and shaping the strategies employed. What is sometimes less well understood is the role that judgment plays in the on-going management, or “piloting,” of these strategies. Since the early days of quantitative investing, it has often been said that a key advantage of quantitative investing lies in stripping emotion out of the investment process. That sounds on the surface as though we humans, emotional beings that we are, best step aside and let the machines conduct their work without interruption from us error-prone beings. That's not what it means. Humans also

bring thought to the equation. If we allow *both* emotion and thought to be put aside, then yes, we may indeed be flying on autopilot, wholly reliant upon the machinery. When it comes to navigating the financial markets, that's a flight we'd rather not be on.

### Hierarchy of Quantitative Approaches

Human judgment is often the centerpiece, the very foundation, of a quantitative investment process. Does that surprise you? That's true at our shop. Speaking generally, judgment, if and when exercised, plays a role in two separate stages of the process. Judgment can be decisive in constructing the investment process in the first place by choosing which strategies to employ and by defin-

ing those strategies. Second, it may be decisive in choosing the circumstances under which those strategies should be employed. In quantitative investment products, therefore, human judgment may design and detail the investment decision making process, using quantitative *tools* to aid them in that design, and then, in addition, human judgment may govern the application or execution of that process.

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Such involvement should not be confused with the involvement that human judgment may have in so-called “blended approaches” where quantitative judgments are blended with the subjective judgments of fundamental managers. Such blending means that the decisions about what to buy and sell, and about when to buy and sell, are driven by a combination of objective and subjective decision making. That is not what we’re speaking about here. What we’re speaking about here involves a clear separation of decision making domains. The investment strategies are themselves never disturbed or adjusted based upon subjective views.

First we must understand the hierarchy of quantitative approaches involved in creating the strategy in the first place. The hierarchy is related to the degree and quality of human judgment involved and has the following three levels:

**Statistical/Technical Approach:**

At the bottom of the hierarchy lies a purely statistical approach to designing and defining investment strategy. Here, mathematical algorithms are the brains behind the operation. The best of those who operate these algorithms tend to be very sophisticated in their understanding of the algorithms – they can run circles around most investors when it comes to math, but their understanding of the financial markets is relatively unimportant as the judgments they make are either wholly or principally concerned with the algorithms they chose to employ. If the term “black box” pertains to any form of quant, then it is this category of quant to which it most applies. To those operating the algorithms, however, there is no mystery: they understand how and why the algorithms develop the strategies they develop.

**Judgmental Overlay on Statistical Approach:**

The next level up the hierarchy involves a modest degree of additional human judgment. The algorithms remain the source of ideas as they scan historical data in search of statistical relationships that have, in the past, yielded superior investment returns, but these ideas are scrutinized by people whose goal is to separate those statistical relationships which make sense to them as investors from those which don’t. Any statistical scan of historical data (any “data-mining” exercise) is sure to uncover both relationships that only falsely appear to exist, and therefore won’t work in the future, and relationships that actually exist, and therefore will work in the future. The goal of the judgmental overlay then is to improve the odds of choosing actually existing relationships under the assumption

that if they somehow make sense to someone, they are more likely to be real rather than spurious and therefore reliable in the future.

**Scientific Method:**

Rather than scanning historical data to “discover” statistical relationships that would have led to past profits, the foundation for some quantitative approaches (ours, for example) is to start with a set of beliefs about what drives market returns, and/or what behavioral mistakes investors are likely to make. Sounds like we’ve just described a fundamental investment manager, right? This quant manager differs from the fundamental manager by taking these ideas, examining their validity empirically by seeing whether these ideas would have generated attractive risk adjusted returns historically, and then building a system for tracking the data underlying these relationships in the future. The use of an empirical filter for one’s ideas allows one’s preferences for investment strategies to be dictated by fact rather than emotion, personal bias, or by more limited personal experience. This approach, clearly, is founded upon conceptual, human judgment, not upon data. Those at this level of the hierarchy are likely to think of themselves as investors who use quantitative tools rather than thinking of themselves as quants per se.

Few quantitative investors fit neatly into just one category, so this hierarchy is useful for gauging the degree to which the investment process is founded in human judgment versus historical data. Those hypotheses owned by those who apply the scientific method will unmistakably be influenced by history which means they bear some resemblance to those whose ideas derived purely from the

historical data. Those whose ideas are derived from the data are rarely ignorant of financial and economic theory, so they will bear some resemblance to those whose ideas are based mostly in theory. This is no less true for traditional or fundamental managers who are most certainly influenced both by history or at least their own experience and by financial theory. The dividing lines are grey.

### Piloting Quantitative Strategies

Once the quantitative manager has identified the strategies he wishes to employ, can he just set the machine running and focus on efficiency of execution? Many will assume the answer is yes based upon the assumption that it is important to protect the purity of the quantitative process from potential interference from subjective judgments that are most likely to drag emotion and human error back into a process that was designed to be fully objective, and which had already been fully vetted by human judgment.

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While the sentiment is correct, the answer is not. Our commitment to protecting the objectivity of the process remains firm, but we take a more granular view of the decisions that are made in the execution phase, and we have delineated between decisions which should remain wholly determined by the quantitative models, and decisions which require on-going subjective oversight. *It remains critical that subjective oversight not be allowed*

to influence decisions in the quantitative models' own area of expertise, but there are decisions that fall outside their area of expertise where judgment should, in fact, play an important role.

It is in those areas that stand outside the expertise of the models where piloting is required. The reason we all feel more comfortable with having a pilot in the cockpit of the plane we're riding on is that there's someone there to potentially deal with situations that may not be programmed into the autopilot software. Under normal circumstances we should all prefer to have the autopilot land the plane. When landing in dense fog, for example, the autopilot has the superior skill and should be left to run without interference. That's its area of expertise. Responding to signs of potential mechanical problems, on the other hand, is outside the area of expertise of the autopilot program, and while in the air, the pilot is in a better position to judge such situations and to determine what actions, if any, should be taken.

Those issues that fall outside the purview of quantitative investment models and that require human judgment are issues that *all* investment managers should focus on whether they chose to or not. The issues fall broadly into three categories: issues related to opportunity, risk, and relevance.

- **Opportunity:** because alpha is in limited supply, and because alpha harvesting is subject to competition, opportunity in the future may fail to resemble opportunity in the past. Models can only learn this slowly; humans have some greater chance of identifying such change early on, or at least earlier.
- **Risk:** by our very entry into the marketplace to harvest alpha we change not only the opportunity associated with that alpha, but

we are likely to change the risks associated with it. Judgment is required in navigating such risks.

- **Relevance:** deviations from "normal" market circumstances may cause temporary fractures or disruptions to exist in the behavior of normal market relationships. Understanding whether an investment strategy remains relevant or material in such periods is a matter of human judgment.

We make no claim that any of these issues are easily dealt with by human judgment, but only argue that these are issues that all managers must confront, and that quantitative managers must typically seek to confront *outside* their models (although not necessarily outside in all cases – a point we'll leave to the side for now).

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With respect to opportunity, the principal concern is *alpha depletion*. Harvesting alpha necessarily has an impact upon the available alpha. It is imperative, therefore, that managers take a view on the effect they themselves are having on the on-going productivity of their strategy, and on what effect their competitors are likely to be having. Such judgments are certainly more art than science, as usually one can only hope to find clues as to how the inefficiency and the alpha it yields is being changed by the harvesting of alpha, but one should be always looking for such clues and willing to shift risk taking away from sources of alpha where signs of over-harvesting exist, and to areas where less competition seems to exist.

The clues may come from a wide variety of places. Across the 1990's, for example, it was not difficult to observe long-term degradation in the productivity of earnings revision strategies, and given the increasing number of managers speaking about and presumably pursuing earnings revisions strategies, it made sense to assume that the opportunity set would continue to diminish and to either look for refined versions of the strategy that worked, or to look for other sources of alpha.

A second concern related to opportunity stems from the cyclical nature of market inefficiencies – a matter that we have written about many times before. All market inefficiencies go through periods of expansion and contraction. Expansion means the inefficiencies are growing larger (think “cheap stocks are getting cheaper”), and the strategies meant to exploit them will typically fail during this phase. It is during the contraction in opportunity when those same strategies will reap their best rewards. The point is that one doesn't want to be exposed to the strategy when the rewards have all been harvested, i.e., when the opportunity is most narrow.

Measures of opportunity can, in some cases, be an integral component of the strategy itself, but typically isn't. In some cases, human oversight will be required to manage the allocation of risk and to shift risk away from strategies where the opportunity has been exhausted. Furthermore, human judgment will be required to take a view on whether poor strategy returns are simply the result of a building inefficiency, i.e., part of the normal cycle, versus when poor returns are an indication of long-term alpha depletion. Judging when to stick with a failing strategy and when to walk away from it is, therefore, important – not easy, and subject to error and disagreement, but important.

In the months leading up to the summer of 2007, to take a recent example, we had seen the yield spreads between high and low price to book, price-to-earnings, price-to-sales and dividend discount model-based measures narrow considerably. Relative value had been a spectacular source of alpha for a very long time, and as we observed compression in the opportunity set, we took the view that the opportunity in relative value was at a cyclical low, and reduced the risk that we were taking in many of our models in this area. With hindsight, we regret not having been aggressive enough to have removed all of our exposure to this area, but as other managers have pointed out, the magnitude and speed of the reversal in this opportunity was unusually large. One can reasonably defend the position that there was still opportunity left: we can only say that from the specific manner in which we measure these opportunities, they had shrunk considerably.

There are also risks in alpha harvesting that must be monitored outside of the investment process. One must guard against being too large or too domi-

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nant a player in any individual market or in the taking on of any individual risk. Long Term Capital Management and Amaranth both put themselves in positions where they held outsized portions of the active risk in a market they traded in, and both were vulnerable to exploitation by competitors

who knew that they had become too large a percentage of the market to move about freely. While being the 800 pound gorilla may be advantageous in certain types of activities, it is rarely, if ever, an advantageous position to be in when pursuing active investment returns. Guarding against this risk requires oversight that falls outside of the investment strategy itself.

Alternatively, one must be on-guard against *stampede risk*. Stampedes occur when individuals begin to move together in such a fashion that they become dependent upon the continued movement of the whole. When one member of a stampede tries to behave as an individual by stopping or trying to change direction, the herd will stumble all over itself unable to adjust to the change. The important subtlety here is that for a stampede to be a stampede, individual entities must behave in relatively homogeneous fashion. The danger in the financial markets then is when you have one group of investors, either homogeneous in nature or homogeneous in objective, all piled up on the same side of the same trade.

At the end of the 1920's, you had a large group of investors all borrowing to leverage up their long stock positions – all on the same side of the trade, if you will. When falling stock prices led to margin calls, this caused some to sell, prices were driven further down by that selling, and the herd began to fall all over itself trying to reverse direction. Portfolio insurance suffered the same problem in 1987 – too many entities were all trying to do the same thing at the same time. Relative value players in US equities experienced a similar stampede this August, many investors were all seeking to exit similar positions at the same time. In some cases, the consequences of such stampedes may only be short-run as liquidity dries up and

prices undergo a short-term shock. In other cases, the expected gains may simply not materialize because those gains depended upon an investor's ability to trade just when liquidity dried up (as happened with portfolio insurance). The risks of stampede need to be evaluated on a case by case basis.

The rapid growth in derivatives of late and the leverage that implies has caused some investors to ask whether we are concerned about this, sometimes drawing a parallel with the large build up of leverage in the 1920's. With respect to stock and bond futures, the parallel does not hold. The important point of differentiation is that even relatively homogeneous active investors (take the group of global macro managers, for example) are holding relatively heterogeneous long and short positions. At the same time, large investors who are using bond futures to manage liability risk are passive in orientation, and won't react in stampede fashion to market fluctuations. This means that the basis for a stampede of the type that we saw at the end of the 1920's or in 1987 with portfolio insurance doesn't exist.

Finally, and most challengingly, investors must always be on guard against circumstances that may temporarily render their strategies irrelevant. Within individual market segments or within individual markets, one should find such occasions to be quite rare, but the frequency with which they appear in one or another market or market segment, while still rare, should be less rare. For example, when California-based utilities were facing bankruptcy in the 1990's, we took steps to

neutralize our exposures on the assumption that issues well outside the skill set of our models would dominate price behavior for some period of time. When it became clear to us in early 2007 that issues related to sub-

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prime were likely to loom very large, we eliminated overweight active exposures to subprime. In neither case were we taking a subjective bet. We were simply shifting risk elsewhere. Furthermore, in neither case were we trying to time the strategy. We were simply giving recognition to the fact that the usual market dynamics would temporarily be disrupted as price movement was dominated by an issue which our models are not accustomed to seeing.

### **In Short**

Managers with substantial breadth of inputs have a material advantage in piloting their strategies. It's easier to neutralize exposures to risks – or to turn models off for certain markets or market segments – when you have a large number of other potential sources of alpha. Why continue to take active risk in an area where your expectation is that the risk of your strategy in that area has just gone up substantially? On the other hand, managers must make sure they only base such decisions on assumptions of market disruption, not upon a personal or subjective view of

market direction. Allowing the latter would allow judgment to second guess the skill of the strategy rather than the relevance of the strategy given unusual, surrounding circumstances.

Managers with a top-down or more macro orientation also have an advantage in piloting their strategies. Managers who only see the trees – managers who focus on individual stocks to the exclusion of broader trends – will have more difficulty treating their decisions as strategies and taking a view on the changing opportunities, risks and relevance of their strategies. Being able to take a big-picture view of the risks that one is exploiting is nearly a prerequisite to piloting through these issues.

Computers are not running quantitative investment strategies. People are. People may choose to have greater or lesser input into the selection of strategies as they choose to be higher or lower on the hierarchy we've described, but for our competitors and ourselves we can say that human judgment plays a very strong hand in the development of and selection of investment strategies. Those systematic managers who fly with a pilot in the cockpit are the managers that we think one should choose to have one's money entrusted with. We think you'll find this to be a common trait amongst the best quant managers whether they got it right in late July and August or not.



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First Quadrant, L.P.  
800 E. Colorado Boulevard, Suite 900, Pasadena, California 91101  
626.683.4223  
Marketing Services: [FQ\\_Updates@firstquadrant.com](mailto:FQ_Updates@firstquadrant.com)  
[www.firstquadrant.com](http://www.firstquadrant.com)

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