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Don't fear the Quants (but fear some Quants)

An Introduction to Quantitative Global Macro Investing

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Quantitative investing has received much negative publicity in recent years, as seemingly every negative market event has been accompanied by accusations of out-of-control computer models and rogue mathematicians. The generalization is unfortunate but probably a natural result of the fear of the unknown, or at least the poorly understood.

Merely the phrase Quant Trading conjures up images of ectomorph-filled cubicles and large server rooms stacked with computers running at breakneck speeds – a not entirely inaccurate description, actually. Yes, Quants are good at math; yes, Quants tend to think with scientific rigor; and yes, Quants can make computers do amazing things. The combination of these skills is quite valuable and arguably necessary in modern portfolio management, but there exists a significant informational gap between the people who employ these methods and would-be investors. Explaining mathematical concepts in straightforward terms (to other human beings) is often neither a strength nor particular area of comfort for the quantitatively inclined.

"Invest in what you understand" is an oft-repeated mantra in the asset management business – with versions of its torch carried vocally by investors from Warren Buffett to Peter Lynch. The fact that such a simple concept is often used as an excuse not to consider quantitative strategies is *not* the fault of investors, it is the clear fault of the quantitative community for not describing their investment processes in understandable terms.

Investors in traditional long-only equity mandates, for example, need to understand a manager's strategy and style at a high level, but have no particular knowledge of the precise way a fundamental analyst will weigh different financial statement ratios and footnotes against each other in the decision-making process. Similarly, investors in a quantitative strategy don't need to be able to replicate the detailed mathematics behind any particular portion of the investment process, but they need to understand how the strategy endeavors to make money, how it is likely to behave in different types of environments, and how it

might fit into a diversified portfolio – *in short, an investor simply needs to understand what he is investing in!* You feel comfortable getting on an airplane because you understand that if you move scrap metal fast enough, air resistance will provide lift and keep you afloat – *not* because you understand the specific details of the fluid dynamics and optimal wing design (if you did, you would build airplanes for a living).

What is Quantitative Investing?

Quantitative investing, in the context of Global Macro investing, refers to nothing other than being systematic – that is, being *rigorously objective* – in one's approach to (i) research, (ii) implementation, (iii) portfolio management, and (iv) risk management. The universe of Global Macro funds can be thought of as being divided into two broad approaches: discretionary and systematic. In one important and high-level respect, these two styles are very similar – they both endeavor to profit by expressing investment ideas in liquid global markets. In fact, many hedge fund style indices do not distinguish returns from discretionary and systematic strategies, instead preferring to divide their indices along lines of the tradable assets themselves. From the perspective of the quantitative investor, we'll argue that having a systematic investment process compared to and judged against that of discretionary peers is not such a bad proposition, as we discuss below.

Research

Setting aside the true computer-learning/data-mining strategies for the scope of this piece, it's fair to say that the *process of idea generation* for systematic and discretionary strategies is identical, and by the way, performed by humans in either case. Both types of firms source trade ideas through many avenues, among these reading academic/trade articles, attending industry events, analyzing economic and political environments, and just generally being involved in and immersed in the markets in which they trade. Trade idea sourcing is perhaps the area of greatest similarity between Quants and non-Quants; indeed, the creativity of the human mind is of unquestioned value.

However, idea sourcing is only one part of the research process, and the scientific rigor that quantitative investors bring to the table in a systematic back-testing process can be invaluable in a financial environment where we're surrounded by rule-of-thumb trading advice from various sources of questionable wisdom. Your father knows all of these rules. So does his mechanic. Don't sell your winners, buy after the markets dip 10%, buy the rumor/sell the news, etc. Do these actually work? With which types of assets do they work? In what kinds of environments do they *not* work? Very few media or socially propagated trading tips are accompanied by hard facts backing up the claim; perhaps some of these ideas actually have value, but by and large they tend to be based on limited anecdotal evidence rather than tested rigorously. Quantitative back-testing provides a method of testing such claims in the context of costs and constraints for historical merit and (when designed correctly) potential future profit.

Forcing oneself to explain a trade idea in the form of an equation is a necessary part of the systematic back-testing process and, importantly, demands a rigorous validation of the idea

at a conceptual level. Very simply, a trade idea is the sequential combination of two actions: recognizing a signal and taking a position (or positions) in a tradable asset(s). That's it. Some trade ideas can be very simple: "buy bonds when the FOMC lowers interest rates." The signal (FOMC announces a rate cut) and action (buy US Treasury bonds) are clear. Most trade ideas are more complex, but if I cannot explain the signal and action of my trade well enough to write them down, then do I really even have an idea? Consider the following slightly more complicated example to illustrate this point:

- *Buy low and sell high?* Sounds great, but it's not a particularly useful trade idea. Neither a signal nor an action has been defined.
- *Buy cheap stock indices and sell expensive ones?* How do you define/recognize cheapness?
- *Buy low price/earnings stock indices and sell high price/earnings indices?* What counts as a low or high P/E ratio?
- *Buy stock indices when their P/E ratios are below 10 and sell when they're above 30?* We're getting closer, but while 10 might signal cheapness for an index with an average P/E ratio of 20, would it still signal cheapness for one with a long term average of 12?
- *Buy a stock index when its P/E ratio is one standard deviation below its long-term average and sell when the ratio moves one standard deviation above its long term average?* How do you define long term average, and over what time frame are you computing the standard deviation?
- *Buy a stock index when its P/E ratio is lower than one standard deviation (computed by 3-month trailing daily returns) below its 20 year average; sell the index when the P/E ratio is higher than one standard deviation (of 3-month trailing daily returns) above the 20-year average.* NOW we have a trade idea. Will this trade idea make money? Who knows…but the idea is now specified to the point that it can be clearly expressed in mathematical terms and tested to see if it would have worked in the past and if desired, can be implemented systematically for live trading in the future.

An important realization in quantitative trading is that research is not merely a first step but rather an ongoing process. Trades that work well currently are likely to be crowded out at some point in the future. The ongoing success of a systematic trading program lies in the ability of the manager to innovate – to retire models as their effectiveness wanes and to continually uncover new sources of trading profits.

Recent advances in computing and networking technology have vastly increased the potential for systematic investors to test profitable trade ideas and should foster increased innovation. For example, the idea that thousands of microprocessors in a cloud-computing platform can be simultaneously and cheaply accessed to run computationally intensive back-tests facilitates a shortening and broadening of the model development process. Not surprisingly, Quant investors tend to enjoy a much clearer benefit from technological advances than their discretionary counterparts.

Incidentally, the area of quantitative research is fraught with peril. Data-mining (the process of analyzing data to uncover hidden relationships) can easily lead to data-snooping (a harmful bias, where spurious, nonsensical relationships are confused with meaningful correlations). A research platform should rigorously minimize the opportunity for back-testing shenanigans, and should be designed carefully and intelligently to allow for unbiased model calibration and out of sample testing – prior to live trading. An intelligent method of

mitigating such a destructive bias lies in formulating fundamentally sound ideas prior to testing, rather than uncovering interesting relationships and attempting to apply a rational explanation after the fact.

Intelligent concepts and dangers in model development and back-testing warrant a much deeper discussion than the scope of this piece allows. For now, suffice it to say a model can only be calibrated in past environments – thus the utility of any particular model is then limited to future environments that are well represented by the past.

Implementation

Despite the clear value of creativity in trade idea inception, we humans are often not particularly well-suited to implement our own ideas. If a researcher in any type of a fund discovers a particular trade idea that leads more often than not to a tradable gain, he naturally will want to profit from it. A discretionary trader will look for the appropriate signals, and when he recognizes them will put on this trade in a size he deems an appropriate risk. This methodology can sell his ideas short and shortchanges investors as well. If you discover a signal that forecasts a high probability of a profitable trade, why would you want to limit yourself to execute this trade whenever you happened to notice or recognize the signal? You would want to make this trade in many different markets, in many different instruments, on many different global exchanges, at all hours of the day. Simply said, if the idea is robust and profitable, wouldn't you want to attempt to profit from such a signal *every single time it happened*?

In one sense, this idea is what quantitative global macro trading is really all about: *systematically applying fundamentally sound trade ideas.* Computers are far superior in objectively applying human ideas than humans are themselves, not only from the breadth standpoint discussed above, but also from the perspective of objective diagnosis. Humans often misidentify signals, and even an incomplete signal diagnosis can lead to a suboptimal action. To extend the stock index example in the previous section, perhaps your research uncovered the notion that the value realized by buying low P/E indices and selling high P/E equity indices only manifests itself in high volatility environments, but in low volatility environments the opposite trade is more likely to be profitable. A human noticing an exceptionally low P/E index conceivably could buy the index, forgetting the low volatility environment should be signaling him to sell instead – thereby engaging in a trade more likely to lose money. The example is far too simplistic but illustrates an oversight a human could make that a (properly programmed) computer would not.

An entire subset of investment theory has been developed around behavioral finance, with the notion that if we can understand our own human flaws, we can seek to minimize their negative impact. It is a natural reaction to believe individual immunity to the human flaws of our fellow investors (a behavioral flaw itself), but the unfortunate genetic fact is that we all share these flaws. Well, what if we could go further and be so objective that we not only negate these flaws in our own investing behavior, but we also benefit from the presence of those flaws in our fellow investors? Many systematic strategies explicitly profit from this dynamic, whether intending to or not. The objective rigor of systematically applying a well-tested investment concept by its very nature extracts profit from inefficient or behaviorally

flawed counterparties. Human emotions have a nasty habit of causing us to ignore hard facts and make precisely the wrong trade in times of stress, while prudently designed systematic strategies will trade on hard facts/signals. It's not to say that these trades will work every time – they will not, and they don't have to. If for example, a particular trade idea profits one dollar 55% of the time and loses one dollar 45% of the time, isn't this a trade you'd want to do as frequently as you possibly could?

An additional advantage of systematic implementation lies in the area of automated trade execution itself. Even beyond the concept of removing fat-finger human trading (a person making an incorrect mouse click or keystroke), automated execution systems can be quite valuable in scaling in and out of sizeable positions. Automated systems use volume timing algorithms to trade more actively during periods of high liquidity, ensuring efficient execution and favorable pricing, and can simultaneously trade on many global exchanges. In comparison to their human counterparts, computers are tireless, infinitely patient, and more responsive to changing market conditions. One note however, is that these algorithms are only as good as their programmer, and the concept of a computer executing trades unchecked in an environment markedly different than that for which it was designed is dangerous. Therefore, a strict limit of the computer's scope within the trading function is appropriate, and simultaneous human oversight of the execution function is necessary.

Portfolio Construction and Risk Management

Many systematic global macro investors would argue that the greatest advantage they hold over their discretionary counterparts lies in the quantitative approach to portfolio construction and risk management. These two functions can be thought of as distinct, but we group them here due to the advantages of having an embedded risk management process within the portfolio optimization function.

Pragmatically speaking, in a global macro strategy, *portfolio optimization is simply a mechanism of converting theoretical profits from underlying trading models to real profits*. A natural implication being that the degree to which these paper profits can be crystallized for a given level of risk is a solvable maximization problem, albeit a complicated one. This is where Quants shine.

A systematic global macro portfolio typically is comprised of *many* trading ideas running simultaneously, providing considerable portfolio diversification. Successful Quants understand the correlations among various types of trading models (or groups of trading models) as well as those among the various tradable assets used to express trade ideas. More successful Quants understand that these correlations can and do change! Trading in liquid asset classes allows a purposeful and dynamic sizing of risk to various trading models, and as volatility levels and correlations change in various markets, the risk allocation can be easily adjusted to track the intended exposures at any level in the portfolio (assets, models, groups of models, and overall portfolio) by rebalancing frequently. Quantitative portfolio management also provides an opportunity for explicit and transparent performance attribution, and judging the effectiveness of various models in live trading provides a direct feedback loop to facilitate and enhance the research and development process.

By comparison, the level of arbitrariness in position sizing and risk limits in portfolio construction and rebalancing for a discretionary strategy can lead to an artificially poor transfer of theoretical to realized profits. However, one inherent danger in quantitative portfolio construction lies in the trap of over-optimization. Placing too much faith in historical returns, correlations, or volatilities can lead to unstable portfolios, demanding excessive turnover, and transaction costs. Quants have the faculties necessary to perform sophisticated mechanical optimization, but a level of common sense needs to be applied in the design of the optimization and risk management systems. No optimization method is perfect, but employing prudent quantitative methods facilitates an efficient transfer of conceptual wealth from trade ideas to real profits.

Sophisticated quantitative investors will optimize their portfolios with transaction cost aware optimizers, which algorithmically strike a balance between paying the trading costs (commissions, bid-ask spreads, market impact) necessary to shift the portfolio to a more optimal risk-return profile and allowing a portfolio to drift from its optimal level to avoid these costs. The importance of explicitly accounting for such market frictions in the construction of well-diversified portfolios is difficult to overstate.

What type of Quants should be feared?

We've alluded to these throughout this paper, but aggregating here seems appropriate.

- Fear Quants with poor research practices. Academics and scientists have developed sound research practices over many centuries, and financial markets are no place to ignore previously learned lessons.
- Fear Quants whose ideas are not *incepted* in common sense. Generating an economic trading idea, expressing the idea mathematically, and rigorously testing the idea is the proper order. Uncovering a relationship through back-testing, then attempting to attach an economic explanation afterward is a dangerous practice that has led to many money-losing strategies.
- Fear Quants who misidentify the proper functions for humans and machines. There is no substitute for human innovation and creativity; a machine can be a rigorous and objective executor, but is inherently limited by the human who programmed it.
- Fear Quants who place undue faith in models in new environments. A model is a mathematical expression of a human idea, calibrated in a specific set of past environments. If a future environment isn't well represented by the past, then a model calibrated in that past is unlikely to serve its user well.
- Fear Quants who don't see a need for human oversight in machine-based trade execution. Again, a machine only understands the trading environments it was programmed to trade in.
- Fear Quants who over-optimize. Portfolio optimization has distinct limitations, and overreliance on dubious techniques and historical relationships is a recipe for dubious future performance.
- Fear Quants who are not continually innovating. Trade ideas have varying lives – a successful systematic program is based on continual development of new ideas.
- Fear Quants who are unable to explain their methods. Quantitative trading can use very sophisticated techniques to tackle difficult problems, but if someone cannot explain

what he's doing, he arguably doesn't understand it well enough to be doing it successfully.

- Fear Quants who are *unwilling* to explain their methods. Investors don't want secret trading formulas – in fact if a fund manager has proprietary models that have real value, the last thing an investor wants is for these to become public and be crowded away. But in an era of fraud and distrust, an investor needs to have solid grasp of what exactly he's investing in and deserves to be comfortable with the *people* who are designing and implementing the systematic strategies.

Final thoughts

We hope this short paper has provided useful information in explaining some of the basic techniques and potential advantages of quantitative or systematic trading; in reality we have merely scratched the surface. Any investor bias against these strategies stemming from opaqueness and lack of understanding is completely rational and frankly, prudent. The blame lies squarely on the shoulders of the Quants themselves, and increased education for and collaboration with the investment community is the right method for repairing lack of transparency and misconceptions, because both investors and managers stand to benefit from the uncorrelated profit potential systematic strategies can offer. Additionally, we believe our attempt to point out some potential pitfalls of quantitative investing should serve useful to potential investors; these are areas a diligent investor should be inquiring about on their path to becoming more comfortable with both quantitative strategies and the people who conduct them.

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