Why Most Quantitative Investing and Trading Systems Fail

By Baijnath Ramraika and Prashant Trivedi

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"Invert, Always Invert." – Carl Gustav Jacob Jacobi, German Mathematician

"Hundreds of studies have shown that wherever we have *sufficient* information to build a model, it will perform better than most people." – Daniel Kahneman (as you read this statement, don't forget to consider the implication of the word "sufficient")

"Roger Federer plays tennis using Wilson racquets. I use Wilson racquets. Does that make me Roger Federer?" – Paraphrasing a friend of ours.

In an interesting post, the fund manager Dominique Dassault talked about a time when he was fascinated with quantitative black box trading systems. As he was talking to a leading quantitative portfolio manager about quantitative systems, the portfolio manager said something that surprised Dassault: While quantitative algorithms may work for a while, even for a long while, eventually, they all just completely blow up. When asked about the reasons for the blow up, here is what the he had to say:

> Because despite what we all want to believe about our own intellectual uniqueness, at its core, we are all doing the same thing. And when that occurs a lot of trades get too crowded...and when we all want to liquidate (these similar trades) at the same time…that's when it gets very ugly.

Dominique went on to offer a good summary of what quantitative managers are doing, including low-enforced back-test volatility, high leverage and increased concentration of risk. All have a very logical rationale.

However, at the core of this problem is a much more basic issue: logical fallacy.

Defining quality – The quantitative way

Most, if not all, quantitative systems are designed by selecting factors that were present in successful investments/trades over the selected back-test period. Typically, a system developer will pick up a host

of factors and run simulations in order to identify which factors were associated with better investment returns.

To further expound upon this process, let's consider the case of quality as an investment factor. It has received a lot of attention by academics as well as developers of quantitative investment strategies. It is the latest fad in the jungle of investment factors.

Most quantitative strategies that promise to utilize quality as the dominant selection factor employ returns on capital or some variation of it. This is driven by the finding that companies that generated higher returns on capital have been associated with higher subsequent investment returns. Of course, as quantitative managers try to step over each other in an effort to showcase the superiority of their system, most of them gravitate towards significantly more complex systems, introducing a multitude of factors in their models.

The idea that a high-quality business generates higher returns on capital passes the muster of commonsense as well. Let's say that the average return on capital of all businesses is 10%. What this means is that when you invest $100,000 in a business, on average, you will expect to earn US$10,000 from your investment. But what if the business that you invested your $100,000 was earning you $15,000 instead? Most quantitative systems, as they define quality currently, will likely conclude that we have a high-quality business on our hands.

The fallacy of the converse

Clearly, for a business to be considered superior, it needs to generate returns on capital that are greater than the average business. While this statement, if correct, establishes that all high-quality businesses are associated with high returns on capital, it does not follow that all businesses that earn high returns on capital are high quality businesses. But, that's exactly what most quantitative systems are likely to conclude. As high returns on capital are likely to be present in every high-quality business, the quantitative system will likely conclude that every business that earns excess returns on capital is a high-quality business. This argument is not very different from saying that because I play using Wilson racquets, I am Roger Federer!

This kind of an argument construction falls in the trap of fallacy of the converse, also known as affirming the consequent. Consider the following argument form:

1. If Dog, Four Legs (another way of saying that dogs have four legs).
2. Four Legs (I found something with four legs).
3. Therefore, Dog (this thing is a dog).

Obviously, this is an invalid argument. Not everything that has four legs is a dog. Similarly, not every company that is earning returns on capital in excess of cost of capital is a high quality business.

High returns on capital – Necessary but not sufficient condition

As Daniel Kahneman said, wherever we have "sufficient" information to build a model, it will perform better than most people. We posit a key question here: While ability to earn higher returns on capital is a *necessary* condition for the presence of a high-quality business, is it the *sufficient* condition?

Before you jump to a conclusion, we thought it instructive to share with you the business experience of Baijnath's father. Back in the 1970s, in a small town of Northern India, the elder Mr. Ramraika started a business selling clothes. His industry showed up in his business performance, and he was quickly able to earn returns on capital that were well above the cost of capital. The necessary condition of high returns on capital was met. But did he have a high-quality business?

Over the next few years, the business landscape changed. Attracted by the success of businessmen like the elder Ramraika, many more entrepreneurs entered the business, using either their own capital or borrowings. The same town, which had about five such businesses in the seventies, now houses more than 100 such businesses. So while the target customer base increased by a factor of three, the number of competitors increased more than 20-fold! Not surprisingly, the end result of this process was sub-par returns for everyone involved.

What happened? Why did the number of competitors mushroom? The answer lies in the absence of barriers to entry. The barriers to entry, if there were any, were surmountable. It was possible for other entrepreneurs to enter the business. As additional capital flowed in, returns on capital were driven down.

Clearly, it was not a high-quality business. It was a business that was enjoying a temporary competitive advantage that emanated from a demand-supply mismatch. A situation that had an over-rectification as capital flowed to reap the perceived excess rewards.

Avoiding the fallacy of the converse: Invert, always invert

The key issue here is that most quant systems seek out factors that were associated with trades/investments that generated superior investment returns. Such a process ignores Jacobi's insight, "Invert, Always Invert." It is as important, if not more so, to understand those cases that shared the same characteristics but did not work well.

For example, if one were to study the fate of the elder Ramraika's business, it would be abundantly clear that the lack of entry barriers drove returns on capital down. This insight leads to the conclusion that excess returns on capital is not a "sufficient" condition. For the business to be able to sustain the excess returns, barriers to entry need to be present, and they need to be strong.

Conclusion

Be careful before jumping to yet another conclusion. Much like the error with accepting returns on capital as the sufficient condition, if you conclude that barriers to entry is the sufficient condition, you will be falling prey to the same fallacy. If barriers to entry are present, but they do not lead to higher returns on capital, a business is still not high quality. Judging the presence or absence of barriers to entry is best handled by qualitative, human judgement, while judging the superiority of returns on capital is best handled by the machine.

The underlying cause of eventual failure of most quantitative investing and trading strategies has to do with how the factors are identified. Those that apply Jacobi's suggestion and focus on sufficiency of conditions in their model definitions will carry much lower risk of system failure.

Baijnath Ramraika, CFA, is the CEO and CIO at Multi-Act EquiGlobe Limited (MAEG). Contact him at ramraika@gmail.com. He maintains a blog at Symantaka.

Prashant Trivedi, CFA, is the Chairman at MAEG and is the founding chairman of Multi-Act Trade and Investments Pvt. Ltd. MAEG is an investment manager based in Mauritius managing investment funds focused on high quality businesses.