



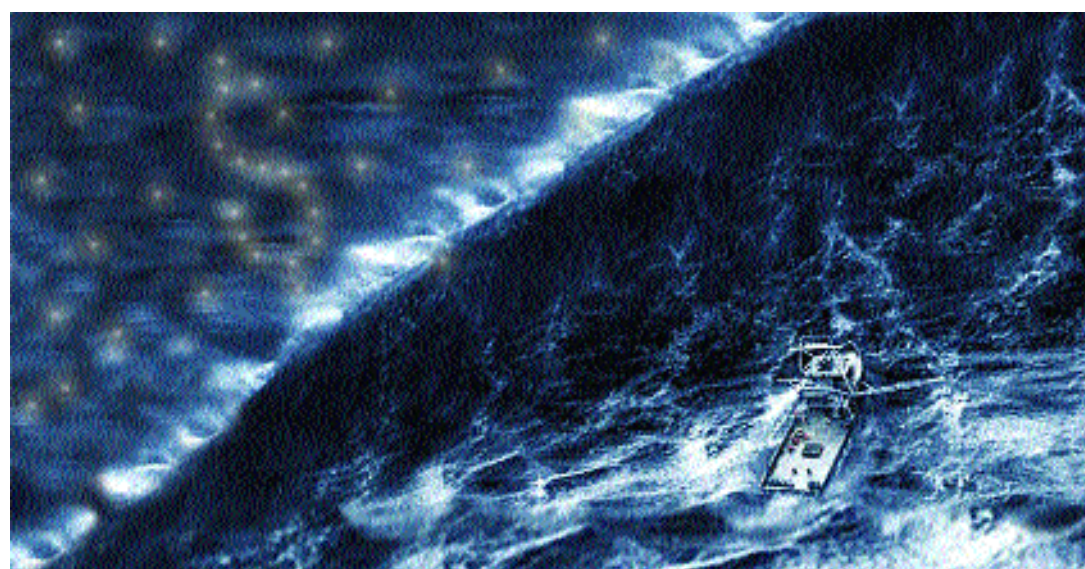
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A MATHEMATICIAN ON WALL STREET

Statistical Arbitrage – Part III

How a STAR was born from CPUs the size of refrigerators, and proved in practice

The Bamberger version of statistical arbitrage was driven by two key ideas. The main source of alpha was the short term reversal effect we had discovered in 1979/80. The main tool for risk reduction was to divide the universe of stocks into industry groups of from two to thirteen stocks and trade each group separately on a dollar-neutral basis. Thus the portfolio reduced risk from the market and various industry factors. To back test the system and to simulate real-time trading, we drew upon Princeton-Newport's 1,100 square foot computer room filled with two million dollars worth of equipment, a domain ordered, organized and overseen by Steve Mizusawa. Inside were banks of gigabyte disk drives the size of washing machines, plus tape drives and CPUs the size of refrigerators. All this sat on a raised floor consisting of removable panels, under which snaked an ordered jungle of cables, wires and other connectors. The room had its own halogen system. In case of fire the room flooded with non-combustible "halogen" gas automatically within 80 seconds. Once this happened the room had too little oxygen for fire to burn or for people to breathe. We drilled on how to get out in time and how to trigger the halogen manually, if necessary. This was high tech in the mid '80s. It has since been obviated by the enormous increase in computer miniaturization, speed, and cheapness. Now, for instance, hard disks the size of a CD can hold several gigabytes. The room was



chilled to a constant 60F by its own cooling system and had sealed doors and dust filters to keep the air clean. Since smokers strongly emit tiny particles for an hour or more afterwards, Gerry agreed, with a lot of good natured kidding, not to go in the computer room.

Our joint venture was funded by Princeton-Newport Partners and run in New York by Bamberger as a turn-key operation. We called it BOSS Partners, for "Bamberger (plus) Oakley Sutton Securities," the latter a broker dealer serving Princeton-Newport Partners and related entities. On capital ranging from 30 to 60 million dollars, BOSS started earning in the 25 to 30 per cent annualized range in 1985. This gradually declined to around 15 per cent or so in 1987. Bamberger then elected to retire a millionaire. He felt that in the booming market of the '80s, a 15 per cent return was not worthwhile, and he wanted to simply enjoy life.

Princeton-Newport was returning 25 per cent or so net of fees to investors in 1987 so the cur-

rent BOSS return of 15 per cent was not compelling. But I had developed another method that I thought would be a substantial improvement. After BOSS closed we programmed it and again earned satisfactory returns when we restarted in January of 1988. By chance, we missed the crash of '87. How would we have done? In October of 1987, market volatility began to rise. On Friday, October 16, the Dow, at 2,300 or so, fell more than 100 points, over 4%. On Monday, October 19 it fell again from about 2,200 to about 1,700, an unthinkable 508 points, or 23%, by far the greatest one day percentage drop in history. Computer simulations showed our new statistical arbitrage product would have had a good day. And the violent volatile days that followed produced excellent returns. This was a ship for riding out storms.

To control risk we replaced the segregation into industry groups by the statistical procedure called factor analysis. Factors are common tendencies shared by several, many, or all compa-

nies. The most important is the market factor. For each stock, this measures the tendency of that stock to mimic or track the market. Using historical prices, the daily returns on any stock can be expressed as the part due to its tendency to follow the market plus what's left over, the residual. Financial theorists and practitioners have identified a large number of such factors that help explain securities prices, to a degree which varies with the stock and the factor. Some factors, like participation in a specified industry group or sector (e.g. oil, financial) mainly affect subgroups of stocks. Other macroeconomic factors like the market itself, short term interest rates, long term interest rates, and inflation, affect nearly all stocks.

The beauty of a statistical arbitrage product is that it can be designed to approximately neutralize as many of these factors as one desires. The portfolio becomes market neutral by zeroing out the market effect: constrain the relation between the long and short portfolios so that the total effect of the market factor on the long side is just offset by the total effect on the short side. The portfolio becomes inflation neutral, oil price neutral, etc., by doing the same thing with each of those factors. Of course, there is a trade-off: the reduction in risk is accompanied by a limitation in the choice of possible portfolios (only ones which are market neutral, inflation neutral, oil price neutral, etc., are now allowed) and, therefore, the attempt to reduce risk tends to reduce return.

We got help applying factor analysis to the model from John Blin, a former professor of probability and statistics, and Steve Bender, a former physicist. Their business, APT, computed and sold their current factor analysis for many traded securities. We called the new method "STAR" for "STatistical ARbitrage." At the request of one of our investors we sent a trading history to BARRA, a world leader in researching and developing financial products. They tested STAR with their factor model E2, which had 55 industry factors and 13 macroeconomic factors. They found that our returns were essentially factor neutral. Our returns did not appear to come from lucky disguised bets on various factors.

If I could predict the performance of factors like the market, inflation, gold, etc., then I

Table 1. Rates of Return for STAR

Date	Capital (millions)	STAR Return	STAR After Fees	S&P 500 w/Dividends
Jan. 1988	10	2.70%	2.16%	4.27%
Feb. 1988	11	4.35%	3.50%	4.70%
Mar. 1988	11	4.00%	3.24%	-3.02%
Apr. 1988	12	1.43%	1.17%	1.12%
May 1988	12	-0.19%	-0.16%	0.87%
Jun. 1988	13	1.91%	1.57%	4.59%
Jul. 1988	18	1.77%	1.45%	-0.37%
Aug. 1988	23	1.32%	1.09%	-3.39%
Sep. 1988	30	2.15%	1.78%	4.22%
Oct. 1988	38	2.34%	1.94%	2.81%
Nov. 1988	46	1.80%	1.50%	-1.37%
Dec. 1988	54	1.13%	0.94%	1.73%
Jan. 1989	26	4.38%	3.50%	7.40%
Feb. 1989	16	2.49%	2.01%	-2.50%
Mar. 1989	38	0.58%	0.47%	2.33%
Apr. 1989	39	1.78%	1.44%	5.19%
May 1989	39	-0.20%	-0.16%	4.13%
Jun. 1989	39	2.30%	1.87%	2.50%
Jul. 1989	40	-0.04%	-0.04%	9.39%
Monthly SD		1.33%	1.07%	3.36%
Annualized SD		4.60%	3.70%	11.65%
Annualized Return		25.13%	20.06%	31.25%
Ann. Sharpe Ratio (Approx.)		3.79	3.34	2.02
Correlation of STAR		-0.04 with S&P 500		

would bet on them instead of neutralizing them in the portfolio.

It was fortunate that we had evolved beyond the Bamberger model because, in simulation, its returns continued to fall. Moreover, after a good 1987, Tartaglia had reportedly expanded statistical arbitrage at Morgan Stanley in 1988 to some \$900 million long and \$900 million short, which had to drive down overall returns for the system. The rumor was that they lost between 6 per cent and 12 per cent, leading to the winding down of the product. If true, this misfortune may have come in part from the decline in performance of the original product and any modified version they might have evolved to, and also to the increasing market impact costs of the much larger trades. Compare the performance of our new approach, shown in Table 1.

Fees have been calculated as 20 per cent of

profits. Expenses of the partnership may affect actual returns. 30 day T-Bill Annualized return was 7.7 per cent.

Along with the decline of statistical arbitrage at Morgan Stanley, people began leaving the quantitative systems group that was in charge of it. Among the departing was David E. Shaw, who in the words of *Time* magazine was "... a former professor of computer science at Columbia University, [who] had been wooed to Wall Street by Morgan Stanley, where he specialized in the arcane field of quantitative analysis - using computers to spot trends in the market." Shaw was looking for \$10 million in start-up capital. Princeton-Newport Partners was interested.

In the spring of 1988, Shaw and I spent the day in my Newport Beach office, along with some of our key people. We discussed his plan to launch an improved statistical arbitrage product, and expand from that base. Princeton-Newport Partners was able to put up the \$10 million he wanted for start-up. We were very favorably impressed by Shaw and his ideas but we decided not to go ahead because we already had a good statistical arbitrage product. Shaw found other backing and created one of the most successful analytic firms on Wall Street. Later Shaw would become a member of the president's science advisory committee. Using statistical arbitrage as a "core" profit center, he expanded into related hedging and arbitrage areas (the Princeton-Newport Partners business plan again), and hired large numbers of very smart well trained quantitative types from academia. One of his smart hires was Jeff Bezos, who, while researching business opportunities in 1994 for Shaw, got the idea for an online bookstore and left to start Amazon.com.

By August of 1988, it was clear that the government's investigation of Jay Regan and others in the Princeton office of Princeton-Newport Partners was likely to be serious, protracted and costly. This led us to phase out our STAR venture with Blin and Bender as well as joint ventures with others. It also probably would have destroyed a venture with D.E. Shaw had we elected to proceed. In fact, one of our limited partners, the "fund of funds" Paloma Partners, picked up the Shaw option.