

Monte Carlo or Bust

We must always be ready to learn from repeatable occurrences however odd they may look at first sight.

—Box on *Quality and Design*, G.E.P. Box

1.1 BEGINNING

In 1985 a small group of quantitatively trained researchers under the tutelage of Nunzio Tartaglia¹ created a program to buy and sell stocks in pair combinations. Morgan Stanley's Black Box was born and quickly earned a reputation and a lot of money. A fifteen-year rise to heroic status for statistical arbitrage (a term uncoined at that time) was begun.

Details of the Black Box were guarded but soon rumor revealed the basic tenets and the name "pairs trading" appeared in the financial lexicon. The premise of pairs trading was blindingly simple: Find a pair of stocks that exhibit similar historical price behavior. When the prices of the stocks diverge, bet on subsequent convergence. Blindingly, beautifully simple. And hugely profitable.

¹In *The Best of Wilmott*, Paul Wilmott states that the MS pairs trading program was initiated by Gerry Bamberger in 1982/1983, that Bamberger departed MS in 1985 for Princeton Newport Partners and retired in 1987. We are unable to confirm whether Bamberger's MS program was distinct from Tartaglia's; others have claimed a group effort and complain that it is unfair to anoint either group head as "the inventor."

Interestingly Wilmott claims that pairs trading was discovered at his firm as early as 1980.

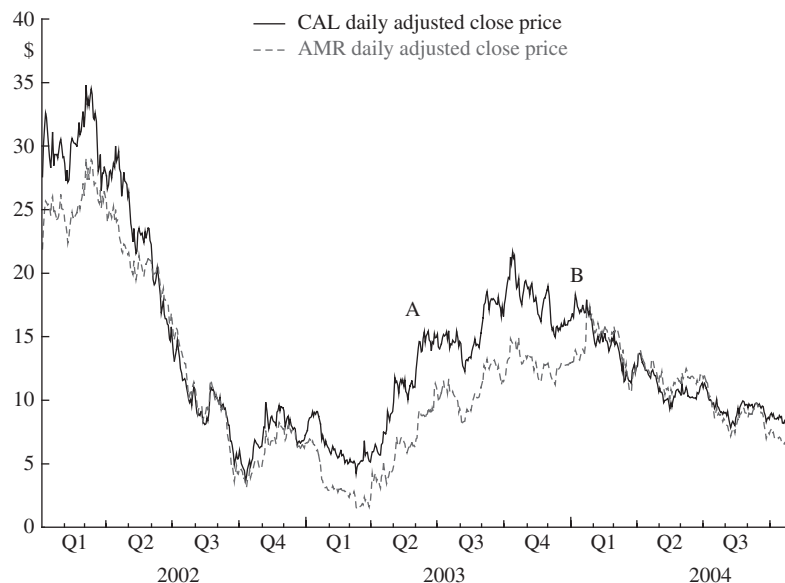


FIGURE 1.1 Daily closing prices, CAL and AMR (2002–2004)

Where did Tartaglia get his insight? As with many stories of invention, necessity was the motivating force. Chartered by management to find a way to hedge the risks routinely incurred through its lucrative activities with block trading, Tartaglia's mathematical training conjured up the notion of selling (short) a stock that exhibited similar trading behavior to the stock being managed by the block desk. Immediately the notion was invented, the more general application of pairs trading was innovated. Very shortly, a new profit center was adding to the bottom line.

Figure 1.1 shows the daily close price of two airline stocks, Continental Airlines (CAL) and American Airlines (AMR). Notice how the spread between the two price traces opens and closes. The pairs trading scheme veritably yells at one: Buy the lower-priced stock and short the higher-priced stock when the spread is “wide” (A), and reverse out those positions when the spread closes (B).

In 1985 computers were not familiar appliances in homes, and daily stock price feeds were the tools of professionals alone. Sheer number crunching power, crucial to serious implementation of a pairs

trading business, required tens of thousands of dollars of hardware. Pairs trading, so beautifully simple in concept and for years now in practice, was born in an era in which investment houses alone could realistically research and deploy it.

Many stories from the era infect the industry, mythologizing the business and the practitioners. Two such stories that have genuine substance and that have continued significance today are the SEC's use of algorithms to detect aberrant price patterns, and the evolution of specialist reaction to the contrarian traders from initial suspicion to eventual embrace.

The SEC was intrigued no less than others by the aura around the Morgan Stanley black box. Upon learning about how the models worked to predict certain stock price motions, it was quickly realized how the technology could be employed to flag some kinds of unusual and potentially illegal price movement, long before neural network technology was employed in this role.

In the late 1980s the NYSE was populated with over 50 independent specialists. Largely family businesses with limited capital, they were highly suspicious when the group at Morgan Stanley began systematically sending orders to "buy weakness" and "sell strength." The greatest concern was that the big house was attempting to game the little specialist. Suspicion gradually evolved into cozy comfort as the pattern of trading a stock was revealed. Eventually, comfort became full embrace such that when the specialist saw Morgan Stanley accumulating a weak stock, the specialist would jump on the bandwagon "knowing" that the stock's price was set to rise.

The early years were enormously lucrative. Success soon spawned independent practitioners including D.E. Shaw and Double Alpha, both created by former acolytes of Tartaglia. In subsequent years other groups created pairs trading businesses, the founders of which can be traced either to the original group at Morgan Stanley or to second-generation shops such as Shaw. As the practice became more widely known, academic interest was piqued; published articles by NBER, among others, made the general precept known to a wide audience and with the rapid increase in power of low cost personal computers, the potential practitioner base exploded. Very quickly, so did the actual practitioner base.

1.2 WHITHER? AND ALLUSIONS

Two decades later, the matured adult statistical arbitrage that grew up from the pair trading infant faces a cataclysmic environmental change. Returns have greatly diminished. Managers are beset by difficulties and are adapting strategies to cope. The financial market environment of the new century poses survival challenges one might liken to those faced by earthly fauna millenia ago when the last ice age dawned. The quick and adaptable survived. The slow and morphologically fixed froze or starved.

Statistical arbitrage's ice age dawned in 2000 and entered full "frigidia" in 2004. Observers proclaimed the investment discipline's demise, investors withdrew funds, and practitioners closed shop. The rout was comprehensive. A pall of defeat enveloped discussion of the business.

This judgment of a terminal moment for statistical arbitrage is premature, I believe. Despite the problems for traditional statistical arbitrage models presented by market structural changes, which are documented and examined in later chapters, there are indications of new opportunities. New patterns of stock price behavior are occurring on at least two high-frequency timescales. Driving forces are identifiable in the interplay of electronic trading entities, the rising future of stock trading in the United States.

The appearance of the new opportunities, admittedly only roughly characterized at this time, suggests significant economic exploitability, and they may be enough to stave off the fate of extinction for statistical arbitrage. The cro magnon man of classic reversion plays will be superseded by the homo sapiens of. . . . That remains to be seen but outlines are drawn in Chapter 11.

I considered titling the book, *The Rise and Fall and Rise? of Statistical Arbitrage*, reflecting the history and the possibilities now emerging. The pattern is explicit in the preceding paragraphs of this chapter and in the structure of the book, which is written almost in the form of an annotated history. To those readers whose interest is borne of the question, "What are the prospects for statistical arbitrage?", the historical setting and theoretical development in Chapters 1 through 7 may seem anachronistic, unworthy of attention. It might be likened to suggesting to a student of applied mathematics that the study of Copernicus' system for the motions of astronomical

bodies is presently utilitarian. I maintain that there is value in the historical study (for the mathematician, too, but that is taking analogy much further than it deserves). Knowing what worked previously in statistical arbitrage, and how and why it did, provides the necessary foundation for understanding why market structural changes have negatively impacted the strategy class. Knowing which changes have had an effect and how those effects were realized illuminates what might be anticipated in the presently congealing environment.

Interpreting the present in the context of the past is hardly a novel notion. It is a sound bedrock of scientific investigation. Most people are familiar with the admonition of political philosophers that those who do not study the past are doomed to repeat its mistakes.² But that is not our reference point. While undoubtedly some arbitrageurs have made their individual errors, there cannot be a verdict that the collective of practitioners has “made a mistake” that ought to be guarded against ever after. Our reference point is the far more compelling scientific view of “standing on the shoulders of giants.” Bereft of value judgments, scientific theories, right or wrong, and no matter how pygmy the contribution, are set forth for scrutiny forever. The promise of the new opportunities may be understood and evaluated in the context of how market changes rendered valueless that which was formerly lucrative.

Let’s be quite clear. There is no claim to a place in history with the work reported here despite allusions to historical scientific genius. Neither is the area of study justifiably on the same shelf as physics, chemistry, and mathematics. It sits more appropriately with economics and sociology because the primal forces are people. We may label an emergent process as “reversion” (in prices), describe temporal patterns, posit mathematical equations to succinctly represent those patterns, and commit ourselves to actions—trading—on

²“Progress, far from consisting in change, depends on retentiveness. When change is absolute there remains no being to improve and no direction is set for possible improvement: and when experience is not retained, as among savages, infancy is perpetual. Those who cannot remember the past are condemned to repeat it. In the first stage of life the mind is frivolous and easily distracted, it misses progress by failing in consecutiveness and persistence. This is the condition of children and barbarians, in which instinct has learned nothing from experience.” *The Life of Reason*, George Santayana.

the output of the same, but the theory, models, and analysis are of an emergent process, not the causal mechanism(s) proper. No matter how impressibly we may describe routines and procedures of the regular players, from analysts (writing their reports) to fund advisors (reading those reports, recommending portfolio changes) to fund managers (making portfolio decisions) to traders (acting on those decisions), the modeling is necessarily once removed from the elemental processes. In that complex universe of interactions, only the result of which is modeled, lies the genesis of the business and now, more fatefully, the rotting root of the fall. Astonishingly, that rotting root is fertilizing the seeds of the rise(?) to be described.

Unlike the study of history or political philosophy, which is necessarily imbued with personal interpretations that change with the discovery of new artifacts or by doubt cast on the authenticity of previously sacred documents, the study of statistical arbitrage benefits from an unalterable, unequivocal, complete data history that any scholar may access. The history of security prices is, like Brahe's celestial observations, fixed. While Brahe's tabulations are subject to the physical limitations of his time³ and uncertainties inherent in current relativistic understanding of nature's physical reality, the history of security prices, being a human construct, is known precisely.

In exhorting the quality of our data, remember that Brahe was measuring the effects of physical reality on the cosmic scale for which scientific theories can be adduced and deduced. Our numbers, records of financial transactions, might be devoid of error but they are measurements of bargains struck between humans. What unchanging physical reality might be appealed to in that? We might build models of price changes but the science is softening as we do so. The data never changes but neither will it be repeated. How does one scientifically validate a theory under those conditions?

³The first Astronomer Royal, John Flamsteed (1646–1719), systematically mapped the observable heavens from the newly established Royal Observatory at Greenwich, compiling 30,000 individual observations, each recorded and confirmed over 40 years of dedicated nightly effort. “The completed star catalogue tripled the number of entries in the sky atlas Tycho Brahe had compiled at Uraniborg in Denmark, and improved the precision of the census by several orders of magnitude.” In *Longitude* by Dava Sobel.

The questions are unanswerable here. One cannot offer a philosophy or sociology of finance. But one can strive for scientific rigor in data analysis, hypothesis positing, model building, and testing. That rigor is the basis of any belief one can claim for the validity of understanding and coherent actions in exploiting emergent properties of components of the financial emporium.

This volume presents a critical analysis of what statistical arbitrage is—a formal theoretical underpinning for the existence of opportunities and quantification thereof, and an explication of the enormous shifts in the structure of the U.S. economy reflected in financial markets with specific attention on the dramatic consequences for arbitrage possibilities.

