

## Applying Science to the Art of Investing

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Successful investors call investing an art but in reality, most apply well established scientific principles to win in the market.

In this short essay, we explore scientific practices and its application (wrong and right) to stock market investing. This is neither prescriptive nor comprehensive in its approach but an attempt to provoke thinking about how we manage portfolios and money.

There are three approaches to science: The approach of observation popularized by Darwin. Darwin observed things around him and came up with the theory of evolution. The approach of experiments which entails conducting experiments to postulate theories. Newton's and Galileo's experiments on behavior of matter is a classic example of the use of experiment to evolve theory. The approach of imagination or thought is a third way to postulate scientific theory. Einstein imagined the theory of relativity - it wasn't until decades later that the science world proved Einstein's theory. In the stock market too, investors and analysts use observation, experiments and imagination to construct portfolios.

How I wish I was tossing a coin: Investment by observation is the most common approach. We use historical data to arrive to conclusions about the future. But this is a faulty approach in our view since the historical distribution of share price returns may have little resemblance with its future distribution unlike the toss of a coin. Yet it is popular because of ease of use as well as the confidence it generates through quantification of likely outcomes.

Market participants know the future in advance: Conducting experiments is difficult in stock markets since live markets are not subject to alteration of factors or inputs like in science experiments. In science, inputs can almost be changed at will to test results in a different environment. Stock markets do not permit this. What we can observe is historical behavior and fit the observations to a proposed experiment. This process is prone to magnified errors since the fitting is usually done to prove a priori conclusions.

Beauty lies in the eye of the beholder but stock returns don't: In contrast, imagination is a powerful tool in stock market investing. That said, ex post proof of imagination is not subject to testing like in physical sciences. This leaves us with a lot of thumb rules which seem to work but proofs remain elusive. A classic example is the PE frown. It postulates that low PE and high PE stocks tend to underperform the market most of the time over longer durations - the sweet spot for PE valuations is in the middle - low PE stocks underperform because the market is efficient and knows that the underlying business is not attractive whereas high PE stocks miss the market since a lot of the future growth is in the price. This theory is very appealing but temporal evidence is missing. Imagining creatively about how businesses can evolve is an edge in stock picking but hardly a guarantee to better returns.

Applying scientific principles: This does not mean that the markets are not subject to scientific principles. These principles straddle areas ranging from biology, mathematics to social sciences. So let us see what we can borrow from the various sciences to apply to stock picking (far from an exhaustive list and certainly not prescriptive):

- a) Evolution theory: Time cooks share price returns. This works both ways but in the end given that the market pays equity risk premium for owning equities over the truly long run, in a portfolio context, time is an investor's friend like it is for a surviving species.
- b) Medicine: Like in medicine, every patient is idiosyncratic, so in stock picking, every investment is unique. Like doctors, avoid generalization traps is the insight from medicine with application to stock picking.
- c) Mathematics: Continuous compounding, which long-term investors are so familiar with, was something that Jacob Bernoulli discovered. His insight was that for an annual interest rate or return of R (expressed as a %) for T years will yield a value of  $e^{RT}$  at the end of T years with continuous compounding. Compounding is the secret of wealth creation and its principle and discovery is rooted in mathematics.
- d) Probability theory: Return distribution is not normal (Bell curve). Stock returns more likely follow a Pareto distribution and non linear path. This means risk management yields superior returns.
- e) Psychology: Making money in stocks is about managing greed, fear, boredom and envy - very basic human emotions. Being aware of them creates two advantages - avoiding mistakes and capitalizing on the crowd's follies.
- f) Physics: Ultimately, Einstein challenged Newton's insights on gravity. What operates at the gross level is different from the finer level even though there is inter dependence. Macro and Micro in stock markets have a similar relationship. Professional stock pickers have a disdain for macro and vice versa. Flexibility is the best tool in this regard.
- g) Decision theory: Path dependence is crucial to stock market investing. Washing a shirt and then ironing it gives a completely different result from first ironing it and then washing it.
- h) Information theory: This made Claude Shannon the father of the Internet but it also inspired John Kelly to engineer the Kelly Criterion which arguably remains the most potent tool for portfolio managers.
- i) Bayes' Theorem: This describes the probability of an event based on prior knowledge of conditions that might be related to the event or essentially when the facts change, the opinion should also change .

In the end we quote Sir Isaac Newton who upon losing a princely sum of 20000 Pounds in the South Sea Bubble in the 18th century said, "I can calculate the motion of heavenly bodies, but not the madness of people".