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Portfolios beyond Finance

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Many researchers in finance, especially as they advance in the profession, start to wonder as to what contribution the field really makes to the broader human endeavor of knowledge. Physicists uncover the truths of the quantum and the cosmos, biologists unlock the secrets of life, computer scientists discover the secrets of artificial intelligence – but what does the finance researcher contribute, if at all? Can one really ever compare talk about ad hoc heuristics like PE or EPS or YTM with discussions about atoms and genes? Among finance academics, this is jokingly described as the mid-life crisis. Yet, many researchers take this question very seriously, and a number of efforts have been made, in recent years, to distill the essence of a "finance way of thinking." In other words, a list of techniques that are unique to finance, which other fields can borrow from us. Presently, the technique that seems to be on top of such lists is the portfolio and factor approach in finance. In fact, academics like MIT's Andrew Lo have started advocating such approaches to distant fields like healthcare and biomedical research.

1. Portfolios everywhere

The origins of the portfolio approach in finance go all the way back to the early 1950s when a young PhD student at Chicago by the name Harry Markowitz decided to take a fresh look at the problem of investing in the markets. Till then, the dominant archetype of investment was old-school understanding of a company's fundamentals: find as many good, solid companies as you can, and then hold all the stocks to earn rich profits. The bible was Graham and Dodd's 'Security Analysis', and most market players were strict believers. When Markowitz presented his new theory, it felt so novel at first that academics simply rejected it. The famous economist Milton Freidman dismissed the work as not real economics, and Markowitz had to spend many years on the sidelines of the profession. Yet, as the years passed, researchers began to recognize the importance of the idea, and nowadays, any basic course in asset pricing begins with the idea of a Markowitz portfolio.

A portfolio is just a collection; what a mathematician would call a non-null set. In Markowitz's case, this collection was of asset prices. Asset prices are variable in nature, so mathematically, this was a collection of random variables. Markowitz represented each random variable by two properties, its mean and standard deviation, and thus created the classical setup of academic asset pricing. How must an investor construct his portfolio so that it was efficient, Markowitz asked; that is, how should one maximize return (mean) while minimizing risk (standard deviation)? Markowitz's key insight was that what mattered was not only individual asset price means and standard deviations, but also collective co-movement among asset prices represented by covariance among the random variables. A well-constructed portfolio minimized the overall risk by looking not just at individual assets, but by choosing assets in unison, such that they did not co-move much with each other. This technique came to be known as diversification.

Later researchers like William Sharpe, Jack Treynor and Stephen Ross refined these ideas further and laid the basis of what are now called factor models, the most famous of which is the Capital Asset Pricing Model, or CAPM. The insight roughly was that even after diversifying away risks by Markowitz's procedure, in any portfolio, there should be some residual risk. These were the risks that affected the entire universe from which the assets were selected – for example, the macroeconomic underlying of a country if one were confined to a particular country's assets. Such risks earned a premium. Further refinement led to the identification of these factors with recognizable asset characteristics – for instance, the size differential of the firms in the available universe, or inherent patterns of trading in the available universe like momentum.

It is not hard to see that the abstract ideas in the portfolio and factor approach are fairly general. Instead of asset prices, the random variables could be the bio-markers produced by a drug in various parts of the body. Or it could be ecosystem signatures of various methods to combat climate change. Or, to take a topical example in the afterglow of Chandrayaan-2, it could be various high impact advanced scientific projects available to a nation. In all these cases, in the end, the decision is about choosing the most efficient portfolio – just like in financial asset pricing. Thus, to a number of researchers in finance, the techniques that we have developed to understand and simplify the portfolio problem constitutes a fundamental contribution. And increasingly, academics in finance are venturing out beyond the narrow confines of financial markets to apply these techniques.

2. The dangers

As much as we'd like to believe in the efficacy of our portfolio and factor solutions, we also have to contend with the competing opinions, put forward by finance academics themselves that point out the shaky foundations of this theory. Among the most well-known is the critique by Richard Roll in the 1970s, which broadly says that the factor models are empirically untestable because it is impossible to observe the universe of all random variables. Many new variations of the critique have been advanced in recent years; for instance, the factor zoo critique, which says that no matter how many factors we add to a model, we can never convincingly accept or reject the model. In fact, finance academics have gradually moved away from conventional factor-based foundations for portfolio analysis to what is called a stochastic discount variable analysis. To maintain continuity, these stochastic discount variables are called stochastic discount factors or SDFs, and the SDFs may be converted to conventional factors; however, the basic approach of SDFs is different from the earlier foundations. All that is taken as given is future payoffs from an asset and current market price of asset, and from these one derives the random variables that balance payoff with price. It is these balancing random variables that then become the atoms of new portfolio theory.

Another litany of dangers in the portfolio and factors for real world approach comes from the absence of learning, in any form, in these techniques. The portfolio problem is essentially a problem of optimization. The asset characteristics are given, the constraints are given, the objective is given; and given all these givens, the approach gives a way to come up with a solution. Even with financial assets, this has been a source of controversy right from the beginning. How does one learn the return and risk characteristics of assets? Past data is the usual answer in finance, but we're never sure about how far in the past constitutes the right solution. Going too far back implies including regimes which may not be relevant for the portfolio optimization, while using only recent data might mean that one is excluding relevant regimes. In finance there is at least past data; in many real-world setups where a portfolio approach is useful, one does not have the luxury of any data at all. Before a mission like Chandrayaan is approved into a portfolio of scientific projects, how would one learn about the risks or returns of the project? When a cancer drug is the first of its kind, how should a pharma company learn its characteristics when deciding if it is a good addition to its portfolio?

3. A Field in Flux

Compared to areas like physics or biology, finance is a recent entrant to the 'serious academic discipline' club. Computers might be recent, but computer science, too, is quite ancient, if one traces the field's origins in logic. As with any impatient child waiting to grow up, finance is trying its best to punch above its weight. After all, few other fields can boast of billions and trillions of dollars as part of their argot. But finance is a field still coming to maturity, still very much in flux.

As we move towards advocating the portfolio approach outside of finance, questions like the ones raised above, have taken on a new tone of urgency. Surprisingly, the answers to such questions are often coming from researchers outside finance. For instance, in recent years, machine learning theorists have developed many new ways to analyze large portfolios. Similarly, operations theorists have developed new tools that go under names like bandit theory to address the question of learning in portfolios. As finance pushes beyond its traditional boundaries, it is often gaining more than contributing in the new exchange of ideas. To many connoisseurs of finance, this is the greatest positive in this climate of advocacy.