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Financial Engineering Versus Cancer

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Financial engineering and its toolkit of derivatives earned a bad reputation during the financial crisis of 2008. Derivatives are just assets whose value depends on the price of other assets, such as futures contracts or options. Along with financial products such as mortgage-backed securities (MBS) and collateralized debt obligations (CDOs), derivatives allowed savers—including pension funds and individuals—to buy payments on mortgage securities from investment banks that purchased the rights to those mortgage payments from mortgage lenders.

Rightly or wrongly, many analysts blamed the housing bubble and/or the severity of the subsequent crisis on the misuse of these financial instruments. Both foes and fans of financial engineering must admit that this discipline, like other tools, multiplies one's power to do good or harm. But financial engineering fundamentally solves financial problems with mathematical techniques, which usually means trading and distributing risk.

If financial engineering can distribute the pecuniary risk of medical research, then it can play a role in curing cancer.

Let's consider the problem of medical research risk. Medical research projects (e.g., investigations to search for cancer treatments) are unusual investments in that they are typically very expensive, often costing hundreds of millions of dollars, and the vast majority of such projects end up earning no money at all. Those projects that do earn money might earn a great deal of money, but the profits will be seen only many years later, typically 10 years or more.

One might think that such a project could sell shares of stock in the venture, but this is generally infeasible; it is far too costly for individual investors to distinguish good projects from bad projects. A large firm could hire experts to evaluate such projects and then invest in the most promising research, but these projects are still very risky investments and a few large failures could bankrupt even established biomedical firms.

But financial engineering may be able to solve such problems. Articles by David Fagnan, José-Maria Fernández, Roger Stein, and Andrew Lo outline financial engineering techniques to facilitate medical research (Fernández, Stein, and Lo, 2012, and Fagnan et al., 2013). These authors propose a large fund with the expertise to evaluate projects and choose a large, diversified group of projects over a long period. The large scale and diversification are keys to success. A $30 billion dollar fund could finance 150 projects, each of which costs $200 million. Investing in a group of risky projects is much less risky than investing in an individual project because some projects will succeed, even if most projects will fail. The average return for such a group is much more predictable than the return on any individual project, just as the average temperature over a season is much less variable than the temperature on a single day. A diverse group of research ideas is important because a group of projects with similar methods might either all succeed or all fail, making the group very risky. It can be difficult, however, to ensure that project methods are dissimilar enough to create unrelated outcomes. Using the historical rates of success for cancer treatment projects, the authors estimate that a portfolio of 150 projects that each have a 5 percent chance of success would have a Sharpe ratio (expected return-to-volatility ratio) roughly comparable to that of the stock market.

Fagnan et al. (2013) argue that such a cancer megafund would differ from a conventional venture capital fund in both size and funding methods. Because a $30 billion cancer research fund would be a substantial fraction of the $176 billion U.S. venture capital market in 2010, much of the funding would need to come from the very large and liquid long-term bond market, especially investment-grade 10- or 20-year bonds. Financial instruments, such as tranching and bond insurance (credit default swaps), could tailor the risk to different types of investors, opening the door to a wider group of investors. Later research from the same authors—that is, Fagnan et al. (2014)—argued that funds for medical research would need much less capital than originally proposed for the cancer megafund if the research projects would tap into traditional funding sources for later stages of development. For example, only $5 billion would be sufficient for a cancer research fund, while a fund for research in "orphan" diseases would need as little as $575 million to achieve an attractive risk-return ratio.

These authors make a compelling case that if financial engineering can distribute the pecuniary risk of medical research, then it can play a role in curing cancer. ■

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