

\$30 Billion Health of Nations BioFund

MIT
LFE

Andrew W. Lo, MIT

Sir Gordon Duff, UID, Pro Vice Chancellor Emeritus
Oxford University

15 October 2021

MIT

Laboratory for
Financial Engineering

\$30 Billion Health of Nations BioFund



Honorary Patron

- Budi Sadikin, Minister of Health of the Republic of Indonesia

Tri Hita Karana Forum on Future Knowledge and Blended Finance

Bali Leaders' Summit G20 2022

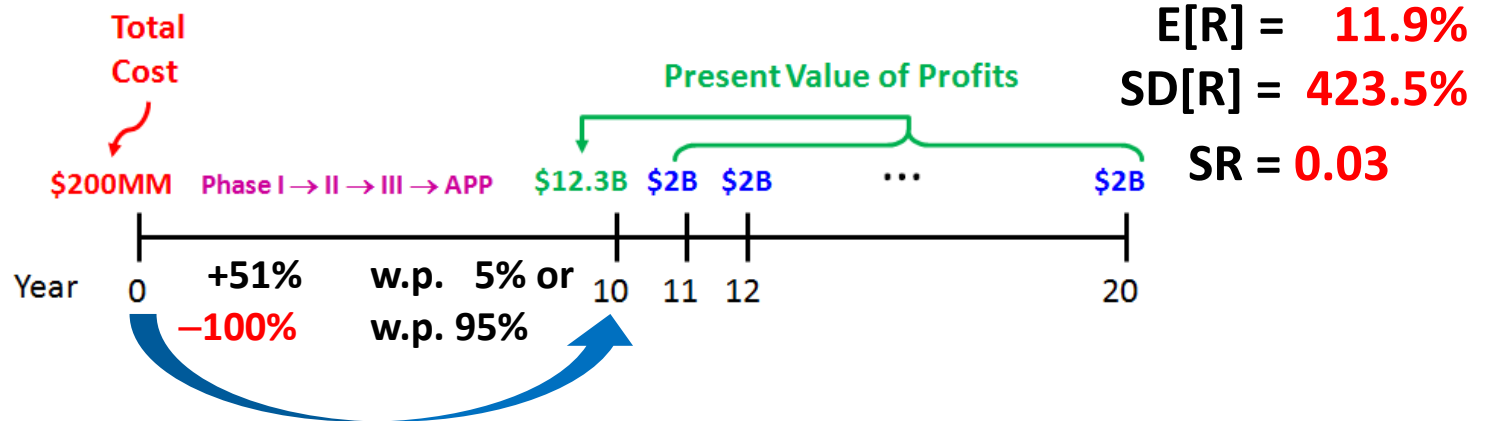
Health of Nations BioFund Council (to be discussed)

- Robert C. Merton, School of Management Distinguished Professor of Finance at MIT Sloan School of Management
- Tarun Khanna, Jorge Paulo Lemann Professor, Harvard Business School, Lancet India Chair
- Joseph Gatto, Chair of Planetary Health Alliance
- Philip Yeo, Chairman of EDIS and Advanced MedTech Singapore
- Alfred Scheidegger, Partner, Founder of Nextech Invest

Risk and Reward

Would You Invest In This Project?

- \$200MM investment, 10-year horizon
- Probability of positive payoff is 5%
- If successful, annual profits of \$2B for 10-year patent



Financial Engineering Can Help

What If We Invest In 150 Programs Simultaneously?:

- Requires \$30B of capital
- Assume programs are IID (can be relaxed)
- Diversification changes the economics of the business:

$$E[R] = 11.9\%$$

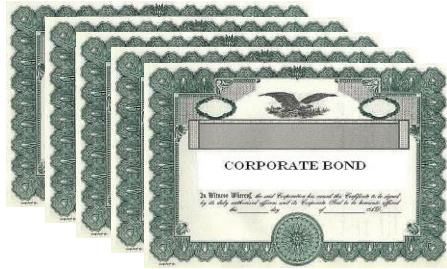
$$SD[R] = 423.5\% / \sqrt{150} = 34.6\% \quad \mathbf{SR = 0.33}$$

- But can we raise \$30B??
- It depends on the portfolio's risk/reward profile (correlations?)

Financial Engineering Can Help

What If We Invest In 150 Programs Simultaneously?:

- With reduced risk, debt-financing is feasible!

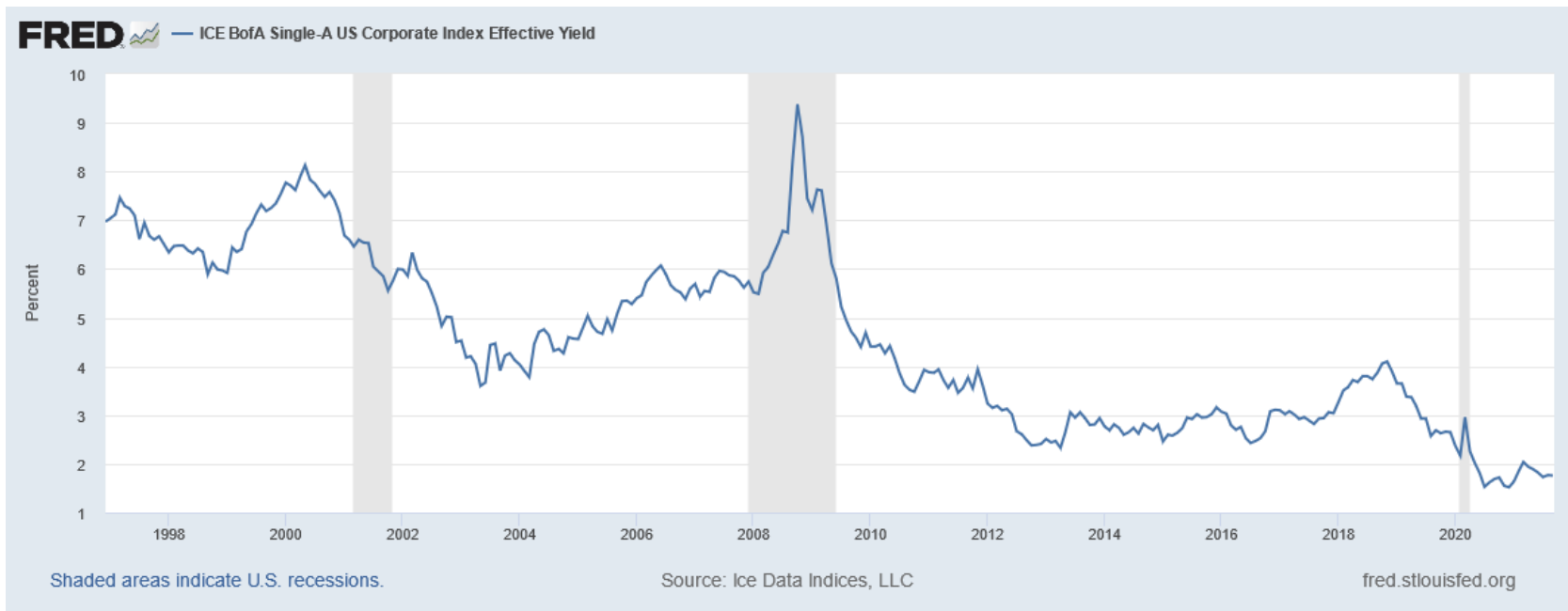


| Event | Probability | Minimum Year-10 NPV | Maximum Year-0 Proceeds at 1.70% (BofAML AA 10-Yr as of 9/9/21) | Maximum Year-0 Proceeds at 1.76% (BofAML A 10-Yr as of 9/9/21) | Maximum Year-0 Proceeds at 2.22% (BofAML BBB 10-Yr as of 9/9/21) |
|------------------|-------------|---------------------|---|--|--|
| At least 1 hit: | 99.95% | \$12,289 | \$10,383 | \$10,322 | \$8,336 |
| At least 2 hits: | 99.59% | \$24,578 | \$20,765 | \$20,643 | \$16,672 |
| At least 3 hits: | 98.18% | \$36,867 | \$31,148 | \$30,965 | \$25,008 |
| At least 4 hits: | 94.52% | \$49,157 | \$41,531 | \$41,287 | \$33,344 |
| At least 5 hits: | 87.44% | \$61,446 | \$51,914 | \$51,608 | \$41,680 |

Financial Engineering Can Help

ICE BofA Single A US Corporate Index Effective Yield

31 Dec 1996 to 9 Sep 2021



Cystic Fibrosis Foundation

Venture Philanthropy: A Case Study of the Cystic Fibrosis Foundation

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ABSTRACT

Advances in biomedical research have created significant opportunities to bring to market a new generation of therapeutics. However, early-stage assets often face a dearth of funding, as they have a high risk of failure and significant development costs. Historically, this has been particularly true for assets intended to treat rare diseases, where market sizes are often too small to attract much attention and funding. Venture philanthropy (VP)—which, for the purpose of this paper, is defined as a model in which nonprofit, mission-driven organizations fund initiatives to advance their objectives and potentially achieve returns that can be reinvested toward their mission—offers an alternative to traditional funding sources like venture capital or the public markets. Here we highlight the Cystic Fibrosis (CF) Foundation, widely considered to be the leading VP organization in biotech, which facilitated the development of Kalydeco, the first disease-modifying therapy approved to treat cystic fibrosis. We evaluate the CF Foundation's example, including its agreement structures and strategy, explore the challenges that other nonprofits may have in adopting this strategy, and draw lessons from the CF Foundation for other applications of VP financing.

- Rare disease – 30K Patients in US, 70K globally
- No cure; until 2012 (Kalydeco), treatments only addressed symptoms
- Progressive, multi-system disease; respiratory failure causes death
- Life expectancy of 28 years in 1986

<https://bit.ly/37rFUHC>

Cystic Fibrosis Foundation

- 1994: Bob Beall became CEO and began investing in drug development
- 1998: Aurora Biosciences (Vertex)
- \$150M from 1998 to 2005
- Ivacaftor discovered in 2005, Kalydeco approved in 2012, Orkambi in 2015, Trikafta in 2019
- CFF sold its royalty interests (~10%) in 2014 and 2020



Cystic Fibrosis Foundation

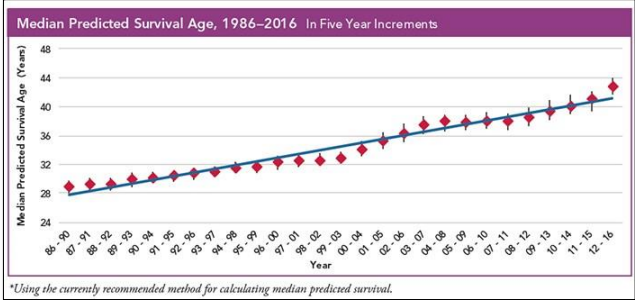
THE WALL STREET JOURNAL
 BUSINESS
 Nov 19, 2016

Royalty Pharma Announces \$3.3 Billion Acquisition of Cystic Fibrosis Foundation

ROYALTY PHARMA

ROYALTY PHARMA ACQUIRES ADDITIONAL ASSETS FROM THE CYSTIC FIBROSIS FOUNDATION

“The mission of the Cystic Fibrosis Foundation is to cure cystic fibrosis and to provide all people with the disease the opportunity to lead full, productive lives by funding research and drug development, promoting individualized treatment and ensuring access to high-quality, specialized care.”



Public (Nasdaq: RPRX) announced today an acquisition of Royalty Pharmaceuticals, Inc.'s cystic fibrosis (CF) assets. The transaction includes an upfront payment of \$575 million. Royalty's Chief Executive Officer, stated, "We are excited to build on our existing portfolio through this initial landmark funding transaction in 2014 to develop and fund lifesaving therapies and improve care for patients with CF through funding the biopharma ecosystem. We will continue to support the CF Foundation's work to fund specialized CF care."

**Finance Does Not
Have To Be A Zero-
Sum Game!**

**Terima
Kasih
Banyak!**