

The Debacle of *Archehos* and Confirmation Bias

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Received: May 23, 2024

Accepted: August 20, 2024

Online Published: August 31, 2024

doi:10.5539/ijef.v16n9p55

URL: <https://doi.org/10.5539/ijef.v16n9p55>

Abstract

The *Archehos* collapse marks an unparalleled debacle in financial history. The individuals at its core, Bill Hwang who managed the fund and the investment bankers who transacted with him, exhibited perplexing behavior. This paper delves into the potential influence of confirmation bias in the fiasco.

Keywords: confirmation bias, Kelly's formula

1. Introduction

Archehos Capital, managed by Bill Hwang (BH), suffered a trading loss exceeding \$20 billion over just a few days during the Spring of 2021. *The Wall Street Journal* (2021) reports that the loss wiped out BH's entire wealth and the investment banks involved also suffered staggering collateral damage totaling several billion dollars. The collapse of *Archehos* stands out as the most spectacular debacle in the history of financial vicissitude.

The catastrophe of *Archeho* indicates that BH failed to consider adequately the risks associated with his speculative trades. It is incomprehensible that BH, a seasoned and successful financial player, would risk more than 100% of his total wealth \$20 billion on his trade positions. A conventional mathematical analysis may be inadequate to elucidate the abrupt demise of *Archehos*. This extraordinary event warrants an equally extraordinary explanation: this paper explores the potential influence of Kahneman (2011)'s cognitive biases.

2. The Optimal Percentage of Wealth at Risk on a Speculative Trade

Imagine that you have a speculative trade with an almost 100% probability of yielding a handsome profit and a negligibly low probability of incurring a loss. It might be very tempting to wager a significant portion of your wealth on such a trade. What if you bet 100% of your wealth? Anyone with a basic sense of self-preservation knows the folly of betting 100% of his wealth on a single trade. Unless the probability of success is 100%, continuously wagering the entirety of your wealth will inevitably lead to financial ruin.

What then is the ideal percentage of your wealth to risk in any speculative trade? Thorp (2006) references Kelly's formula, which advocates for putting a smaller percentage of your wealth on a speculative trade than the probability of that trade turning a profit. Kelly (1956) derived this formula from a straightforward assumption: for a \$1 bet on a speculative trade with two potential outcomes either \$B or \$0 - the probability of getting \$B is P, while the probability of losing the \$1 is (1-P). Under this premise, the optimal percentage of wealth, X, to risk in a

repeated series of such bets is calculated as $P - \frac{(1-p)}{B}$ [i.e., $X = P - \frac{(1-p)}{B}$] (Note 1).

The implication of Kelly's formula is clear: a rational speculator should never risk 100% of their wealth, certainly not more than 100% by leveraging their position, unless the probability of success is 100%. [i.e., $X = P - \frac{(1-p)}{B}$, hence $X < P$].

Any speculative trade, in real-world scenario, involves a spectrum of potential outcomes, not binomial outcomes as in the Kelly's analytical framework, and each outcome with its associated probability distribution. Further, the value of a trade position fluctuates over time, leading to a widening range of potential outcomes. The marked-to-market value of a leveraged trade position has an even wider range (Note 2).

When the marked-to-market value of a speculative trade falls to the maintenance margin level, a margin call is issued. Failure to meet this call forces the trader to liquidate positions at a loss. Even if subsequent market movements would have eventually turned the position profitable, the trader still incurs losses due to premature closure. Therefore, a successful trade hinges not only on predicting the terminal price but also on anticipating the fluctuation of the position's value over time (Note 3).

To safeguard against adverse market movements and potential margin calls, a prudent speculator must maintain a reserve wealth. Thus, even if the trader's prediction of the final price level is entirely accurate (i.e., $P=1$ in Kelly's framework), the optimal percentage of wealth to risk in a leveraged position is significantly less than 100% ($X < 1$).

Consequently, Kelly's formula, $X = P - \frac{(1-p)}{B}$, is an upper bound, overstating the optimal percentage of wealth a speculator should expose to risk in any trade.

3. Why Risk 100% of Wealth on a Speculative Trade?

An average speculator, even one unfamiliar with Kelly's formula, would likely not risk their entire wealth on a speculative trade. BH, given his considerable intelligence evidenced by the substantial profits he amassed over decades, presumably understood Kelly's formula. Moreover, he must have been aware of the inherent risks associated with the financial derivatives used in his leveraged positions, which Warren Buffett famously likened to "weapons of mass financial destruction."

It is baffling, therefore, that BH not only staked his entire wealth on speculative positions but also managed to lose all \$20 billion and more within a few days. This begs the question: Why did he do it?

Two possibilities emerge. Firstly, BH might have been acting out of a suicidal impulse, taking on exceptionally risky bets without concern for the consequences. Such recklessness could lead to self-destruction when faced with a catastrophic loss of \$20 billion. However, as of spring 2024, there is no evidence to support this possibility.

Alternatively, BH might have been driven by an unfathomable psychological compulsion or need. Exploring the depths of Hwang's psyche requires an extraordinary approach. His inexplicable actions pose a significant challenge to understanding his motive. We must delve into the enigmatic realms of his mind to construct a plausible narrative explaining why he took such incomprehensibly risky trading positions, resulting in a swift destruction of his wealth.

4. The Confirmation Bias

Kahneman (2011) highlights the role of preexisting decision rules, or biases, in aiding quick decision-making, crucial for survival, and our capacity to detect patterns which contribute to our ability to thrive. BH's perplexing conduct could stem from his knack for identifying patterns in his experiences, reinforced by confirmatory findings in subsequent encounters.

In the early stage of his financial career, BH, like any trader, sought cause-and-effect explanations for his trading outcomes. What set him apart was his Christian upbringing as the son of a Christian pastor, as reported by Christianity Today (2022), which shaped his worldview. BH may have discerned a pattern linking trading success with his generous contributions to evangelical causes. Initially nebulous, his recognition of this pattern gained strength over three decades, with each success followed by charitable giving.

Drawing on Ivan Pavlov's classical experiment with dogs, wherein a mental link between the ringing of a bell and food triggered a physical response, BH, akin to Pavlov's dogs, established a mental link between trading success and contributions to evangelical causes. This led to a progressive intensification of his confirmation bias, overshadowing rational analysis of trading decisions. Essentially, a sustained streak of profitable trade led BH to attribute his billions in trading profits not to his intelligence or luck, but to divine intervention.

BH's religious conviction propelled him to leverage 100% of his wealth through financial derivatives. By spring 2022, he considered risk management unnecessary in the presence of divine guidance. Consequently, he refused to unwind his trades at a slight loss resulting in a total loss exceeding \$30 billion when he failed to meet margin calls. While others might view his actions as delusional, BH saw them as rational deductions from his experiences repeatedly confirmed over several decades. With confirmation bias, success perpetuated further belief in his convictions.

5. The Psychology of Money

Considering the psychology of money sheds light on BH's seemingly irrational behavior. While many of us pursue wealth in the belief it will bring happiness, Kahneman and Deaton (2010) suggest that beyond a certain income threshold, the marginal utility of additional income diminishes, and further increases do not significantly boost happiness.

If someone found themselves in BH's position, generating tens of millions annually from speculative trades, they might question the necessity of pursuing further speculative positions given their already substantial wealth in tens of billions. However, recognizing that money can buy both extrinsic and intrinsic goods, and understanding that the additional satisfaction gained decreases more rapidly for material possessions compared to personal fulfillment and growth, they might engage in speculative positions to acquire more intrinsic goods.

BH likely valued the intrinsic value of money over its extrinsic value. Rather than seeking greater wealth for personal satisfaction, he may have found fulfillment in contributing to evangelical causes. Believing himself to be an instrument of divine will, he may have derived happiness from redirecting worldly wealth towards a higher purpose. Thus, his seemingly irrational behavior may have been rationally driven by a pursuit of intrinsic happiness (Note 4).

6. The Psychological Trap of Money

The decision of savvy investment bankers to facilitate BH, who risked more than 100% of his wealth through leveraged trade positions, can be attributed two possibilities. Bouveret and Haferkon (2022) suggest the first possibility - the banks may have lacked transparency into BH's exposure, leading them to underestimate the potential consequences. As such, the investment banks were unaware of the true extent of risk BH was undertaking, making them unwitting victims in the collapse of his leveraged transaction. The lawyers (at the Paul, Weiss, Rifkind, Wharton and Garrison) who prepared a report on the Credit Suisse, asserted the investment bankers' ineptitude, yet their accusation lacked persuasiveness, akin to blaming engineers rather than management for ongoing technical issues with Boeing's planes.

Alternatively, the investment bankers may have been victims of a confirmation bias, believing that BH to be an exceptionally successful trader who consistently turned profits. This bias could have been fueled by the significant revenue generated from BH's transactions year after year. Within this psychological trap, many bankers may have viewed BH with an aura of infallibility, a halo effect in action.

The confirmation bias likely led to a lax attitude towards risk management regarding BH's trades. The substantial and dependable fee income generated by BH's transactions may have overshadowed any concerns about potential risks. Thus, the investment banks may have neglected proper risk control measures until the *Archehos* fiasco erupted in Spring 2022, resulting in losses in billions for the banks.

7. The Messages of the *Archehos* Debacle

The *Archehos* debacle serves as a stark reminder of the power of biases over our rational faculties. Confirmation bias, bolstered by a string of substantial financial gains over an extended period, can override even the most intelligent individuals' ability to think rationally. This applies not only to Bill Hwang and the savvy investment bankers but to most of us – we tend to believe what we want to be true.

The *Archehos* fiasco also highlights the peril of risking 100% of one's wealth on speculative trade positions. The analysis presented in this paper indicates that the maximum percentage of one's wealth to put at risk in any speculative position should be significant below what the Kelly's formula prescribes, or the probability of the trade generating a profit.

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Notes

Note 1. The derivation of Kelly's formula:

The Kelly's formula is the portion of wealth at risk, X , that maximizes the growth rate of wealth, where the terminal wealth is A_T and the initial wealth is A_0 , and \$1 bet becomes \$ b with the probability of $\frac{w}{w+l}$ or \$0 with the probability of $\frac{l}{w+l}$.

$$A_T = A_0 (1+bx)^w (1-x)^l$$

$$\text{Max } f(x) = \ln [(1+bx)^p (1-x)^q], \text{ where } p = \frac{w}{w+l}, q = \frac{l}{w+l}, p + q = 1$$

$$f'(x) = 0 = \frac{pb}{1+bx} + \frac{-q}{1-x} \quad x = \frac{pb-q}{b(p+q)} = p - \frac{q}{b} < p$$

$$f''(x) = \frac{-pb^2}{(1+bx)^2} + \frac{-q}{(1-x)^2} < 0$$

Note 2. A confidence interval of the range of price over time can be best visualized by an envelope. If the variance of outcomes over a single period is σ^2 , then the variance of outcomes over t number of periods is t times σ^2 .

Note 3. If the marked-to-market value of a position reaches a certain profit level, the speculator may opt to close immediately the trade securing a profit.

Note 4. A pedantic may quip that the divine Spirit might have noticed that most of the trading profits, exceeding \$20 billion, had not yet reached the ultimate destination of evangelical causes and remained under BH's name.

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