

FINANCIAL RISK MVE220

Black Swans and Antifragility

Applied on the 1987 bank crisis

Authors:

William DANIELSSON *wildan@student.chalmers.se* 941204-6576

Matilda PERSSON *matpe@student.chalmers.se* 951015-6061

Examiner:

Holger ROOTZÉN

Study Period 4, 2018

1 Introduction

Mathematical statistics has become more and more important and widely implemented within several areas. It is useful in bio-medical studies, in machine-learning, for quality control, and not at least within insurance and finance. Statistical tools can be used to map biological phenomena, make predictions from data, ensure evaluate quality parameters, and especially to estimate risks and future trends within finance.

Black Swans and Antifragility are two concepts within financial risk that has have (and will probably continue to have) massive impact on statistical finance. These concepts were founded by Nassim Nicholas Taleb in the beginning of the 21th century and has since grown in popularity.

Short said are Black Swans unforeseen events and Antifragility is about getting stronger from pressures. The ideal scenario within financial statistics is when unforeseen events, Black Swans, make the financial system stronger. For example should financial crisis not hurt the system, but make it stronger.

Specially interesting is to see how a real financial case can apply these two concepts and to investigate what impact these theories can have in the future. To gain a deeper understanding for Black Swans and Antifragility the bank crisis in 1987 has been chosen to be investigated and the concepts are applied to this case.

1.1 Aim

This report aims to give the reader an introduction to Black Swans and Antifragility, it will not be a complete investigation of the subjects but more of a summary. This report also aims to present the course of event of the 1987 bank crisis and apply the two concepts of Black Swans and Antifragility on this real case.

1.2 Method

First, for the authors to get a broad understanding of the subject a small literature search on Google was made. Thereafter, a more thorough literature review was made to fully understand the subjects and the timeline of the bank crisis in 1987. One expert within the area of Black Swans and Antifragility was identified, and this knowledge was used to further dig into the subjects.

Last, some free reflection was done between the authors of this report to make sure all concepts and theories was understood correctly. Some final thoughts of the authors was also generated.

2 Black Swans

A black swan is an event that is unpredictable, has extreme impact and can be explained afterwards to seem less random than it was [1]. There are several historic examples of Black Swans within technology, science, culture and business. But let's start from the beginning.

The concept of Black Swans was, as said, founded by the Professor in Science of Uncertainty Nassim Nicholas Taleb in 2007, when he published the book with the same name [1]. The name, Black Swans, originate from the fact that Europeans thought that all swans were white in the end of the 1600-century. All swans they had seen were white and there was no reason to believe something else existed. After a travel to Australia, though, some experienced black swans. This discovery forced Europeans to change their picture and accept that swans could be both white, and black. Thereof the name of Black Swan.

As mentioned before there are several examples of Black Swans in history. Think about the terrorist attack 9/11. The introduction of computers. The art of printing. Economic crisis. All these are events that were unpredictable, but seem obvious, and perhaps even inevitable, after they happened. They have also had a massive impact and changed how

we view things.

Black Swans are defined by three characteristics defined below [1].

The event is unpredictable. The reason why Black Swan events are not predicted before they occur is, according to Nassim Nicholas Taleb, that humans often focus too much on what we know and forget to take into consideration what we do not know [1]. This is about the subject of scalability. Generally, humans are too quick to scale knowledge without considering the risk with interpolating outside the boundaries.

The event has extreme impact. The second characteristic is that of the large consequences the event has. The consequences can be either positive or negative. Examples of positive Black Swans are the invention of the art of printing or the introduction of computers. Negative Black Swans can be the terrorist attack 9/11 or economic crises.

Explanations describing the event's predictability are developed after the occurrence. All theories are based on experimental data of past events. When a new, unpredicted event (a Black Swan) happens new theories based on this new data are developed. These theories often also find indicators that the event was to happen, and that the event should have been predicted.

What is then the effect of Black Swans? It depends on if in "mediocristan" or in "extremistan" [1]. When in "mediocristan" if one measure is added to a large sample of experimental data, it will not significantly change the total. This is true for most evolutionary phenomena, such as human weight. If one person's weight is added to a large sum of weight (even if adding the heaviest person on earth) it will not significantly change the sum of weights. If in "extremistan", looking at extremes, one measure can in fact change the total. For example, if studying the worth of a sample of people and add the worth of the wealthiest person on the earth, he/she will represent a large portion of the total wealth. It is within extremistan we find Black Swans;

this is where an event can have significant impact.

Black Swans can not be predicted. Unexpected events, both positive and negative, will continue to happen and change our perception of the world. New theories will continuously evolve when new data is available. The beauty with this concept is that the future can not be estimated to full and therefore Black Swans will continue to pop-up.

3 Antifragility

Consider a daily situation; a package with fragile items are sent. Such a package is naturally handled with caution, to avoid damage to items. What is the exact opposite of such a situation? At first thought, words like resilient or robust come to mind. However, that is akin to calling the opposite of positive neutral. Instead, an antonym to fragile, it is expected that, in addition to being unbreakable, it should benefit from shocks, stress and a wide array of trauma. In lack of an existing word describing the phenomenon of reverse-fragility, we may call it 'antifragile'. A concept introduced and widely discussed in [2].

Antifragile things benefit from shocks; when exposed to volatility, randomness, disorders, and stressors they thrive and grow [2]. In comparison to simply resilience; the resilient resists shocks and stays the same - the antifragile gets better. The antifragile embraces randomness, uncertainty, and gain when exposed to errors. Aside from, as an example, the economic systems, the human body, which may benefit from stressors and volatility, there are human-made objects like financial contracts designed to benefit from market volatility.

The antifragility of some comes necessarily at the expense of the fragility of others [2]. Antifragility can be examined from a collective perspective, e.g. a natural organism with many parts or a global economy divided into several local economies. In a collective, the fragility of some parts is often necessary for

the well-being of the system as a whole or others. The benefits from a failure of a fragile part are usually transferred to the others, rather than the fragile part itself. If a local restaurant shuts down in a local region, the rest of the restaurants in the region may benefit: not only in reduced competition but also the opportunity to learn from the errors of the "sacrificed" local restaurant.

The antifragile is not completely oblivious to errors [2]. For the antifragile, the harm from errors should be less than the benefits. Errors should not be of such degree that it completely destroys the system or unit, but instead can help prevent larger calamities in the future. Worthy of note is that an economic system is not necessarily antifragile. Consider globalized economic systems that operate as one, this means that errors can spread and compound throughout the whole system rather being confined to a single unit.

Illustrating a case of gaining from disorder,

"...Sweden and other Nordic countries experienced a severe recession at the end of the cold war, around 1990, to which they responded admirably with a policy of fiscal toughness, thus effectively shielding them from the severe financial crisis that took place about two decades later."

- Nassim Nicholas Taleb
[2, Chapter 7, Sweden and the Large State]

Sweden experienced a housing bubble that deflated during 1991 and 1992, with subsequent policy of fiscal toughness implemented by the Swedish government, see e.g. [3].

The concept of antifragility can be applied in the world of entrepreneurship. Starting a business is a risk endeavor, with the potential of failure. However, alluding to previous discussions about fragile and antifragile parts in a collective, the failure of some businesses facilitates knowledge and expertise for others. What did not work? What can be learned

from this as to avoid it happening again? The antifragility of some parts at the expense of fragility of others.

Similarly, antifragility and fragility can also be seen in a company itself. Whether a company tries a new product for the market, decides to scale into a new territory, or anything else of risky nature, there is prone to be some failures. Failures that may result in severe costs, such as cash and time. However, it also facilitates the company with knowledge of what did not work, and why it did not work - to avoid future, similar mistakes.

4 The crash 1987

The market crash of 1987 occurred on the 19th of October 1987, with key-events leading up to the market crash happening in the week before. The crash led to a major economic systemic shock. Prices of many financial assets tumbled, and market functioning was impaired. The crash exposed weaknesses in the trading systems. Several, major factors have been attributed to the crash: difficulty in gathering critical information for investors, record high margin calls, and program trading strategies. The Federal Reserve bolstered marketing conditions by liquidity support. A main source of inspiration for the events surrounding the crash of 1987 is given by [4], due to its objectivity and claims, discussions supported by references.

Leading up to the market crash, there had been rising interest rates globally, with growing U.S. trade deficit, and a decline in the value of the dollar. There were concerns about inflation and higher interest rates in the U.S. as well. In addition, there were indications of an overvalued market due to price increases outpacing earnings growth [5]. The financial market also saw an increase in program trading strategies, especially with portfolio insurance and index arbitrage strategies. Roughly, program trading strategies were a computer program set up to quickly execute trades of a number of stocks, e.g. of a stock index, when certain conditions were met.

In the week before the crash, a couple of major events took place. Due to a legislation regarding the elimination of tax benefits with financial mergers, stocks' values were reassessed as a result, as odds of companies being takeover decreased [6].

Anxiety among institutions and investors increased, and it led to a heavy selling at the end of the 15th [7].

Markets continued to decline on the 16th, with increased price discrepancy between the value of the stock index in the futures markets and value of the stocks on the NYSE (New York Stock Exchange). By the end of Friday, with S&P 500¹, fallen over 9% over the week. One of the largest one-week declines of a preceding couple of decades [8].

The day of the crash, Monday the 19th, started with a high sell to buy ratio of orders on NYSE. Significant selling continued throughout the day, with between 18% to 23% declines for the Dow Jones Industrial Average, S&P500, and Wilshire 5000. In addition, S&P500 futures markets declined 29%. The next day, Tuesday the 20th, NYSE rebounded at the open, despite an overnight decline in foreign stock markets [9]. Later afternoon there was a sustained rise in financial markets as corporations announced stock buyback programs to support demand for their stocks [10].

Factors contributing to the crash is difficult to precisely pinpoint. Three widely referenced and discussed factors include rising margin calls, program trading strategies, and a combination of market psychology and difficulty of obtaining information.

When investors entered into a contract in futures markets, they were also required to post a portion of the value of that contract, the margin, in an account with the broker. If the investor's position declined due to the market, the margin account would be debited accordingly, and the investor would generally have to infuse additional margin into the account to be able to meet obligations when the contract

expires - a margin call [11].

When adjusting the margin accounts, margin exchanged between declining margin accounts and gaining margin accounts, the gaining margin accounts only got credited after declining accounts posted margin. When, and how many times calls for margin happened varied, but always happened at the end of the day. As to sharp price movements on Oct. 19 on futures contracts, the margin calls resulted in record highs. Difficulty to immediately meet the margin calls could likely have prohibited gaining margin accounts for entering new positions. In addition, the high margin calls could have contributed to stress in meeting the margin calls.

Notable program trading strategies during the market crash was portfolio insurance and index arbitrage. Portfolio insurance consisted of computer models computing optimal stock-to-cash ratios at various market prices. A strategy designed to protect individual investors from losses. A theory is that simultaneous use of computer models could have made the fall a systematic event, with a snowball effect. The effect of program trading is a question with divided opinions, however.

Lastly, the lack of information and news could have led to uncertainty, anxiety and a herd-like behaviour. During the sudden and fast change of prices, there was a lack of information about current market conditions. Certain stocks not being open for trading during the crash, rumors about potential market closing added confusion and anxiety to the situation. With uncertainty and investor seeking to sell due to market prices rather than news, led to a herd behaviour as reported in [12].

5 Discussion/Conclusion

In this section the theories around Black Swans and Antifragility will be discussed and applied to the market crash in 1987.

From a quick glance, the financial crash in

¹An American stock market index based on market capitalizations of 500 American companies.

1987 can be seen as a Black Swan in two ways. First was the unforeseen crash on Monday October 19, 1987 one Black Swan. Second was the extremely fast recovery of the stock market another.

The crash itself was quite unique in its appearance. Normally in market crashes only stock prices fall, but the futures stay quite stable. In the case of the crash in 1987, though, both stock markets and futures fell strongly. Some theories about why this happened this time has evolved after the crash and it has strongly affected the way we look at crashes today. For these reasons can both the crash itself and the fact that both stocks and futures fell simultaneously be classified as Black Swans.

In terms of the recovery, much was due to the Federal Reserve liquidity assurance. It was an unforeseen event that they did so, and it had big impact on the crash. For these reasons both the recovery and the event of assuring liquidity can be classified as Black Swans.

An important factor in the case of Black Monday was the usage of program trading strategies. At the time, a system was facilitated on the NYSE to enable program trading. It was automatic, and constructed to handle large number of trade orders. Due to the immense volume of trading orders on Oct. 19, many systems were reported to be overwhelmed. In some cases, trade executions were reported more than an hour late, causing confusing among traders [13]. The system in place for program trading at that time can be considered a fragile part of the economic system at that time.

In response after Black Monday, a number of protective mechanisms were enforced into the economic systems. Partly by the introduction of *trading curbs* [14] and *circuit breakers* [15]. Trading curbs is a temporary restriction put on program trading when dramatic price movements or volatility occur. For a certain security or market, the trading may be halted or certain sales can only be executed on an uptick. Circuit breakers are halts in tradings enforced when prices hit pre-defined huge intraday drops, or if a company's share

experience sudden large rises. Measures approved by the SEC following Black Monday.

The theories about Black Swans and Antifragility can not explicitly be used to reduce future risks. Though, when Black Swans occur, new data gets available and new theories about the root-cause is developed. This can help predict similar Black Swans in the future, although new situations will always occur and be impossible to predict.

6 Reading guide

If the reader is interested in immersing himself in the concept of Black Swans and Antifragility, we can recommend the author Nassim Nicholas Taleb, who is the founder of both of these concepts. Specially the books "The Black Swan - The impact of the highly improbable" and "Antifragile: Things That Gain From Disorder" can be recommended.

For further reading about the bank crisis in 1987 the article "A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response" by Mark Carlson can be recommended as a good starting point with an in-dept discussion about the crisis.

References

- [1] N. N. Taleb, *The black swan - the impact of the highly improbable* (The Random House Publishing Group, 2007).
- [2] N. N. Taleb, *Antifragile: things that gain from disorder* (The Random House Publishing Group, 2012).
- [3] P. Englund, "The swedish 1990s banking crisis",
- [4] M. Carlson, "A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response", (2006).
- [5] A. Murray, "Fed's New Chairman Wins a Lot of Praise On Handling the Crash, (The Wall Street Journal 1987, Nov. 25, page 1)",

- [6] “U.S Securities and Exchange Commission, Annual Report 1988”,
- [7] N. Brady, “Presidential Task Force on Market Mechanisms (1988): Report of the Presidential Task Force on Market Mechanisms., page 21.”,
- [8] “The Day the Dow Fell: Brokers Trade Stocks, Fists; Bulls and Bears Are Joined by Ducks and Chickens, (Wall Street Journal 1987, Oct 19, page 15)”,
- [9] N. Brady, “Presidential Task Force on Market Mechanisms (1988): Report of the Presidential Task Force on Market Mechanisms, page 36-40”,
- [10] N. Brady, “Presidential Task Force on Market Mechanisms (1988): Report of the Presidential Task Force on Market Mechanisms, page 41.”,
- [11] N. Brady, “Presidential Task Force on Market Mechanisms (1988): Report of the Presidential Task Force on Market Mechanisms., Study VI, page 23-24.”,
- [12] R. J. Shiller, “Investor Behavior in the October 1987 Stock Market Crash: Survey Evidence, Chapter 23”,
- [13] “Presidential Task Force on Market Mechanisms (1988): Report of the Presidential Task Force on Market Mechanisms, Study III, page 21.”,
- [14] *Trading curb*, [https : / / www . investopedia . com / terms / t / tradingcurb . asp](https://www.investopedia.com/terms/t/tradingcurb.asp).
- [15] *Circuit breaker*, [https : / / www . investopedia . com / terms / c / circuitbreaker . asp](https://www.investopedia.com/terms/c/circuitbreaker.asp).