Financial Risk
The fall of Knight Capital Group

Christos Saltapidas, Ramin Maghsood

May 13, 2018

Contents

1   Introduction

Knight Capital Group was an American financial services company that allowed access to the capital markets across equities, bonds, cash equivalent etc. to a huge network of clients, including buy and sell-side firms and corporate issuers. [1]

The Company was known as one of the greatest trader in U.S equities and its largest business was market trading. The firm was focusing on market making and trading across global equities, fixed income, foreign exchange, options and futures. Knight was one of the leading source of liquidity in U.S. equities among all securities firms across NYSE and NASDAQ-listed stocks, Exchange-Traded Fund and Over-the-Counter securities. [1]

Founded in 1995, Knight had its headquarters in New Jersey and was taking action in the United States, Europe and Asia. The company was worth nearly $ 1.5 billion in 2011 and and operated as a subsidiary of KCG Holdings until July 1st, 2013 and finally in 2017 the holdings acquired by Virtu Financial.

2   Aim

In this project, we will see how a human mistake, and more precisely how an error in Knight Capital Group's stock trading software algorithm, caused a major stock market disruption leading to a large trading loss for the company on August 1st, 2012.

3   Key Terms

Market Making: According to the definition, "a market maker is a member who commits to continuously put out buy and sell prices on the exchange."[6] In other words, it is a trading firm that is ready to buy and sell stock in order to get profits from the bid-offer spread and to provide greater liquidity.

To find out more, a better example is to consider the market maker as a dealer of used boats. If you want to sell your boat, you cannot predict if you are going to be able to find another individual to buy it. But you can take it to a used-boats yard, and they'll offer to buy it from you on the spot, in the expectation that they can then sell it later for more, and make a profit.

This was the main department of Knight Capital. Its Electronic Trading Team had under control more than 19,000 securities with an average daily trading volume of more than 21 billion dollars. That means that they were trading more than 3 billion shares every day! [3]

Algorithmic Trading: According to the information on Investopedia, algorithmic trading is a method of delivering a big order with the process of using automated pre-programmed trading instructions, taking into account variables such as time, price, and volume, to send small slices of an order out to the market over time. Algorithmic Trading was generated so that traders do not need to watch a stock all day and send those child orders manually over and over. You can also read more about the basics of algorithmic trading at [5]

Retail Liquidity Program (RLP): This is a quite complex term, so we will try to give a simple definition. According to the Wall Street Journal article, Retail Liquidity Program allows market making firms such as Knight Capital, to offer the investors a stock price that is 'fractions of a penny' better than the market rate. [7]

4 August 1st, 2012

4.1 How the Problem Arised

Knight Capital made two technological mistakes that led to the trading incident on Aug. 1, 2012. The company had discovered a problem with a critical error that happened in the operation of its routing framework.

Knight Capital moved a section of computer code in 2005, to an earlier point in the code sequence in an automated equity router, making a function of the router wrong. Even though this function should not have been used, Knight left it in the router.

In late July 2012, when the preparations for the new Retail Liquidity Program started, Knight Capital wrongly made use of a new code in the same router. As a result, certain orders which were accepted by the New York Stock Exchange's program, triggered the faulty function in Knight Capital's router, which was then impossible to be recognized when orders had been filled.

On August 1, just during the first minutes after the market opened, the problem arised and the Knight Capital's router rapidly sent more than 4 million orders into the market when attempting to fill just 212 customer orders! Knight Capital acquired several billion dollars in unwanted positions. According to the Bloomberg it leaded to a loss of $440 million for the firm. [8]

4.2 Aftermath

As stated above, instead of only 212 incoming parent orders that were to be executed, the defective code of Knight Capital sent instead millions of child orders (small parts of a parent order), which is almost 4 million executions in 154

different stocks for more than 397 million shares, in approximately 45 minutes. As a result, Knight Capital's stock price fell dramatically. Shares decreased by 70% from before the announcement, as seen in Figure 1. The nature of the Knight Capital's unusual trading activity was described as a **"technological breakdown"**. [2]

Knight Capital Group

Figure 1: Knight Capital's shares are down more than 75% following its $440 million trading glitch.

As written on a news in Reuters on Aug 1, 2012, "The problems at Knight Capital Group Inc KCG.N, one of the largest firms that buys and sells stocks to provide liquidity to the markets, emerged at the beginning of trading." [2]

Actually, those wrongly placed orders by the firm led to a massive fluctuation of the prices of the companies on the New York Stock Exchange, where according to the Reuters [2] the shares of Wizzard Software Corporation went from $3.50 in the previous day, to $14.76.

After four days, Knight Capital tried to raise almost $400 million from six big investors, with Jefferies (investment banking) having the main role. This was an intention to remain in business after the trading error. Jefferies held $125 million of the $400 million investment and became the Knight's biggest shareholder. [3]

5   The Results and Reflections

As the company's breakdown happened in a short time period and it was what we call it "A Big Loss" the firm couldn't keep continue as before. According to a report we achieved from Financial Times, the company lost nearly $461

million from these undesirable operations and it leaded the Knight to be bought by other financial firms. [9]

5.1 Behind the problem

Our research brought up that Knight Capital's accident was not appeared just from a mistake in the trading algorithm. The firm in some cases, did not follow all the rules and regulations of the New York's Exchange and Securities Commission. In fact there are some points showing that the company was not ready for events like this:

- According to information we found, Knight did not hold efficient controls in the guidance of the employees quick reaction to the events like the one happened on August 1. [10]

- If the firm had just a simple double-check of the development of the Retail Liquidity Program code, it would be possible to recognize whether a server had been missed or not.

- According to [10], the rules of Knight in restricting the firm's exposure from errors within the main servers, where in this case it was the mistakes of the software that sent child orders to fill parent orders, were not sufficiently logical.

- A rule of the Commission requires that "a broker or dealer's risk management controls and supervisory procedures shall be reasonably designed to prevent systematically the entry of orders that exceed an appropriate pre-set credit or capital threshold"[10]. In fact, Knight failed to fulfill this requirement.

5.1.1 Efficient Market Hypothesis (E.M.Y)

After reading about this large trading error and its impact to the market on August 1st 2012 and not only, it was a matter of time of bringing Efficient Market Hypothesis (EMY) on the table. First we will see what EMY is.

Efficient Market Hypothesis is the theory that beating the market is impossible, because stocks are already priced correctly and reflect all available information. So, it is theoretically not possible to make a profit following a specific strategy. For example, you can not use past stock dynamics to predict future prices. If one wants higher returns, one should purchase higher risk investments. [11]

Although, we think there are some reasons why EMY may be incorrect. The most relevant with our project are as follows:

I) Stocks take time to respond and adapt to new information of the environment.

II) Stock prices can be affected by human error. A massive example is the Knight Capital Group's accident.

III) Investors have proven that they can profit from market anomalies.

The financial trading disasters like the one we presented, making us believe that EMH is not always right. Knight Capital had a market share that big, meaning it was able to change stock prices of big companies, like General Electric, with just a faulty function.

Taking into consideration number III), if we want to take our thoughts one step further, one can suppose that this 'accident' was made on purpose. When someone lose money, someone else is getting richer in the market. Questioning the Strong-Form Efficiency of the market and supposing this was a scandal, maybe the technician who was responsible for this, had already shared inside information about the faulty algorithm and just let it run. Assumption like this one are 'heavy' and are left for further investigation from the reader.

6   Further Reading

- Knightmare on Wall Street, The Rise and Fall of Knight Capital and the Biggest Risk for Financial Markets, Kindle Edition.

- Knight Capital's Algorithmic Fiasco Won't Be The Last of its Kind, Forbes.

- Error by Knight Capital rips through stock market Caroline Valetkevitch, Chuck Mikolajczak.

- History's biggest 'fat-finger' trading errors, Ebony Bowden, The Daily, Oct 2, 2014.

References

[1] Bloomberg, "Company Overview of Knight Capital Group" available at:
$https : //www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId =$
386431

[2] Valetkevitch, C., and C. Mikolajczak "Error by Knight Capital rips through
stock market" Reuters Online, 2012
$https : //www.reuters.com/article/us-usa-nyse-tradinghalts/error-$
$by - knight - capital - rips - through - stock - market -$
$idUSBRE8701BN20120801$

[3] Wikipedia, "Knight Capital Group", Accessed: April 30, 2018. available at:
$https : //en.wikipedia.org/wiki/Knight_Capital_Group$

[4] Koppenheffer, M., "Everything You Need to Know About the Knight
Capital Meltdown" The Motley Fool, 2012 available at: $https :$
$//www.fool.com/investing/general/2012/09/14/everything-you-need-$
$to - know - about - the - knight - capit.aspx$

[5] Seth, Sh., Investopedia, "Basics of Algorithmic Trading: Concepts and Ex-
amples" available at: $https : //www.investopedia.com/articles/active -$
$trading/101014/basics - algorithmic - trading - concepts - and -$
$examples.asp$

[6] Market Makers, available at:
$http : //www.nasdaqomx.com/transactions/markets/commodities/markets/market-$
$makers$

[7] Russolillo, S, The Wall Street Journal (2012), "What Exactly Is NYSE's
Retail Liquidity Program?" available at:
$https : //blogs.wsj.com/marketbeat/2012/08/02/what - exactly - is -$
$nyses - retail - liquidity - program/$

[8] Philips, M, Bloomberg (2012) available at:
$https : //www.bloomberg.com/news/articles/2012 - 08 - 02/knight -$
$shows - how - to - lose - 440 - million - in - 30 - minutes$

[9] Massoudi, A., Financial Times (2012), "Knight Capital glitch loss hits
\$461 m" $https : //www.ft.com/content/928a1528 - 1859 - 11e2 - 80e9 -$
$00144feabdc0$

[10] Murphy, E., The Securities and Exchange Commission. available at:
$https : //www.sec.gov/litigation/admin/2013/34 - 70694.pdf$

[11] Investopedia, "Efficient Market Hypothesis", Accessed: April 30, 2018.
$https : //www.investopedia.com/terms/e/efficientmarkethypothesis.asp$