THE BURST OF TRADING THROUGH TECHNOLOGY

Trading and market microstructure

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1. Introduction

In this paper our goal is to analyse and explain how technology has affected the markets and the way that traders are influenced by these changes. To do so, we will follow a chronological order, starting during the 70s to move forward to the present days and what we expect to happen in the future.

To begin with, we will analyse the first electronic trading platforms and the evolution that they have suffered during time, starting with the DOT system and finishing with the Universal Trading Platform that is used in the present. Then, we will see the importance that technology had during the October 1987 stock market crisis and if it can happen again.

In the next part, as the 90s came to its end and the Internet took an important place in the world, we will see how it affected the markets, making them more accessible and volatiles. In this part, we will also see what are the present trends, as mobile trading and what impact will it have for the companies.

At the fifth point, we talk about the automatization applied to trading, defining what is it about and how automated trading systems are designed. We will also go through the consequences that the use of this systems can carry to the markets.

Finally, we will try to measure if the intensive use of technology is positive or has more drawbacks than advantages, analysing the speed and the contraposition of rationality against behaviourism.

2. 70-90 Evolution of high frequency trading

In this part of the paper we are going to analyse trading speed, indeed, we will focus on how trading has increased over the time and how high frequency trading has become an important role on the market trading world. We will first focus on the appearance of the designated order system (*DOT and SuperDOT systems*); then, we will see how these systems were replaced by the *Display Book System (SBDK),* and finally, we will conclude explaining the system that is used in the present, the *Universal Trading Platform (UTP).*

In the 60s and early 70s, technology had a very low impact on trading; for instance, as a curious feature, computers were not the principal tool in the world of trading (Windows OS and apple OS were not invented until 1975). Due to lack of technology advance, they was not a type of software to transmit market orders, thus, as we will see later on the figure, the daily transactions were very few.

1976 was a very important year for all traders; the appearance of the “DOT system” (Designated Order Turnaround system) will change the mechanisms of trading forever. Before going forward on the history, let´s stop for a moment and analyse this period. Let´s analyse carefully what does actually mean the “DOT System” and how this innovation had such an impact on trading.

The “DOT system” is a computerized order entry system that allows orders to buy or sell large baskets of stock to be transmitted immediately to the specialist on the exchange, when execution will occur quickly, depending on the basket size. Also, used for odd-lot transactions to occur at the prices and quantities available. That is, allows for a more efficient transaction because the order can be delivered directly to the specialist rather than phoned down to a floor trader and done manually.

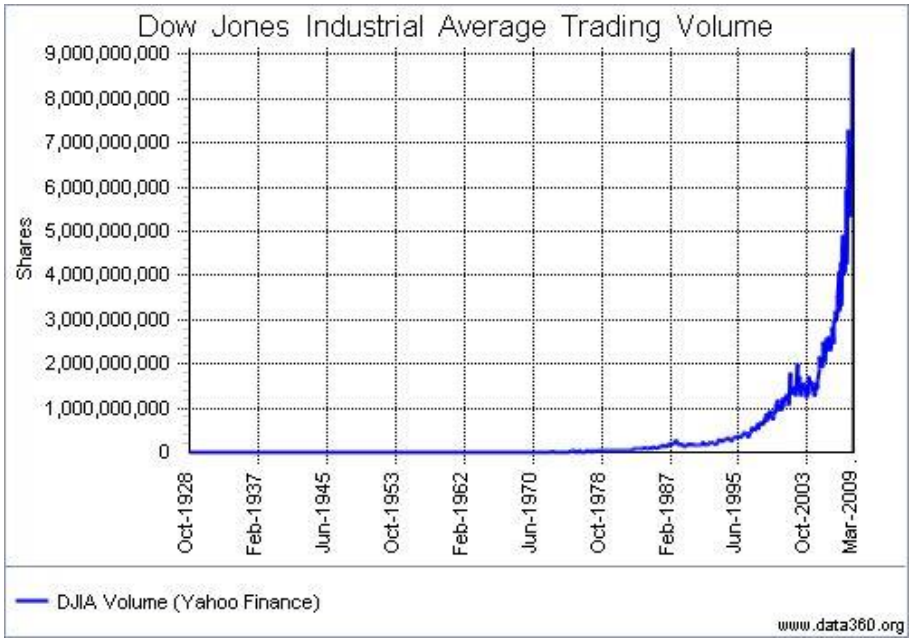
Thus, orders were, from now on, computerized. The “DOT system” is used by the New York Stock Exchange (NYSE). Later, the “DOT system” was upgraded to “SuperDOT system”. The process was identical, but the efficiency was even better. So, that the reader can have an idea, this new system can carry trades of up to 99.999 shares at a time. Indeed, more than three-quarters of the orders executed through the NYSE were done through the assistance of the SuperDOT system.

For a few years, “SuperDOT” system was dominating the high frequency trading. However, some years later, in 2009, this system was replaced by the new **“**Super Display Book System” (SBDK) for processing orders. This book system bypasses the floor broker and sends the order right to the specialist. If the order can be immediately executed, the system will send an electronic confirmation of the execution to the submitting broker dealer. All listed securities are eligible to be traded over the super display book system that is, it is used to display, record, and execute orders for securities. It routes orders directly to the correct specialist for immediate execution.

For easier understanding, let´s give a little more explanation of this concept: The SDBK is a computer program that holds and displays information such as the order type, quantity, price and timing. If the trader places a pre-opening order, the super display book can match orders automatically and then route them for execution when the market opens. In the event a matching order cannot be located immediately, the SDBK will hold the order in queue, and once the order is executed it will send an electronic confirmation back to the originating broker. Automated trading systems, like SDBK, have the capacity to execute orders with both speed and accuracy.

Little by little, we can observe how over the years technology is becoming the fundamental part of the market trading. Indeed, there is another innovation that has given the definite blow to the market trading: The Universal Trading Platform (UTP).
In 2012, the display book (SBDK) stayed old and UTP crop up. The Universal Trading *P*latform Market Data (UTP-MD) feed provides high speed, real-time market data for NYSE markets. It has the following features: Multicast technology, high availability, ultra-low latency. This has been the lust upgrade until now, in high frequency trading.

Once we have explained all the innovations occurred during the last years, we are able to understand the following figure:



(http://www.data360.org/dsg.aspx?Data_Set_Group_Id=251)
This figure captures the "Dow Jones Industrial Trading Volume" but clearly summarizes all the innovations in the electronic system we have explained above. As we can see, before 1976, the was barely trading volume, but after 1976 the number of trades started to increase thanks to the creation of the DOT and SuperDot systems. After this innovation, the number of transactions executed increase continuously. However, is not going to be until 2009 (replacement of SuperDOT to SDBK) where the volume of transactions executed are going to boost.

In conclusion, since 1970 until nowadays, the number of daily transactions has increased enormously. For instance, we have found, that the volume of electronic trading on the Forex is increasing all the time, indeed, the Forex trades about $5 trillion dollars per day, Is not that incredible? 30 years ago, we could not imagine such an outstanding number. All in all, as we will see later, the stock markets have become one of the most important fields of our economy; any change in the stock markets has direct repercussion in the whole economy. Much of this progress, if not all, is due to the improvement of high frequency trading.

3. Stock Market Crisis- October 1987

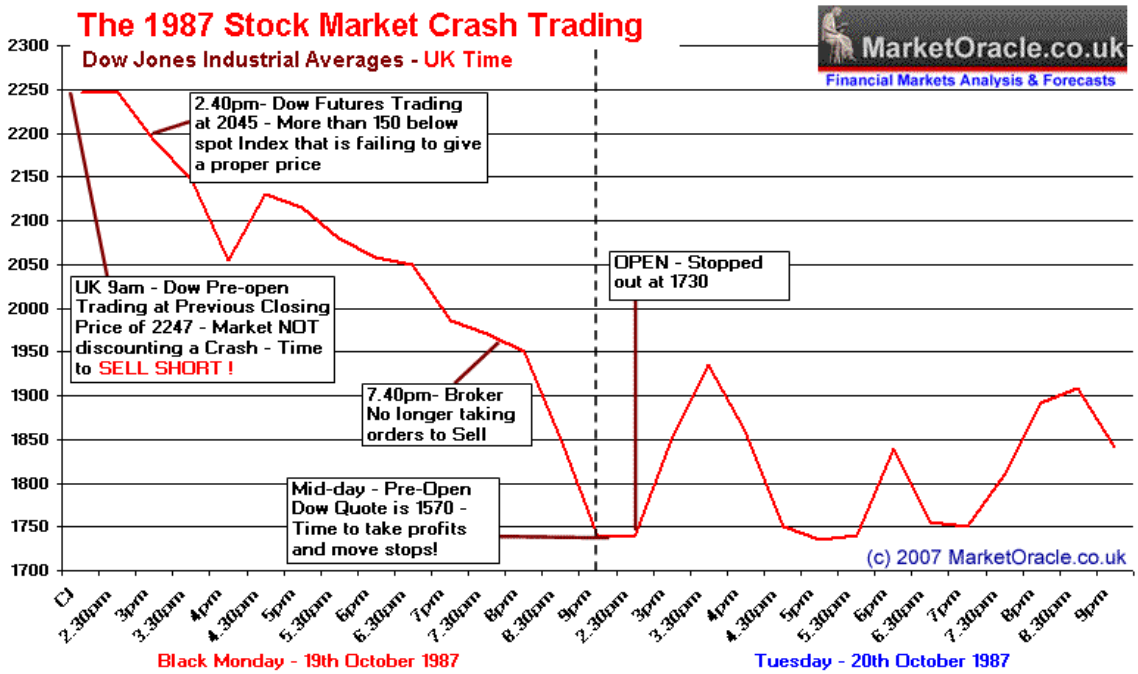
In this part, we have done a break between 70s-90s with an important Stock crisis in London and New York. We are going to do a brief description of the crisis; changes in the perception of the agent and the reasons. Finally, we will finish this section with a conclusion of the crisis.

3.1 Introduction

The Big Bang of Financial Markets was a deregulation of the stock (financial) markets in London, also in the US stock market.

It was the result of an agreement in 1983 by the Thatcher government and the London Stock Exchange to settle a wide-ranging anti-trust case that had been initiated during the previous government by the Office of Fair Trading against the London Stock Exchange under the Restrictive Trade Practices Act 1956.

On October 19, a violent fall in the value quotation occurred, with wide changes, it was complicated the disturbance between the markets, it took time to compensate these values, there was also a boom of hiring, which led to a weak functioning of Institutions that increased the risk of financial collapse.

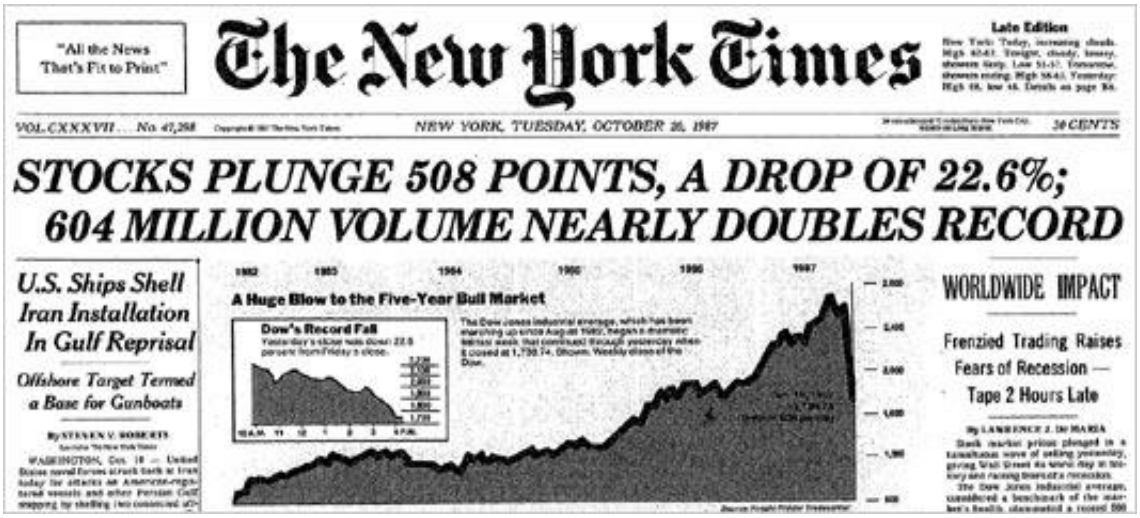


The day the London Stock Exchange's rules changed on 27 October 1986 was dubbed the "Big Bang" because of the increase in market activity expected from an aggregation of measures designed to alter the structure of the financial market.

The effect of the Big Bang led to significant changes to the structure of the financial markets in London. The changes saw many of the old firms being taken over by large banks both foreign and domestic and would lead in the following years to further changes to the regulatory environment that would eventually lead to the creation of the Financial Services Authority.

The stock market crash even surpassed that of October 28, 1929, when the main indicator of the US stock market fell 12.8%, as a prelude to the global economic crisis experienced during the 1930s and known as the Great Depression, A period during which US stock markets lost an average of 80% of their value.

On October 19, investors lost more than $ 500 billion in a single day on the New York Stock Exchange. Panic quickly spread to other financial markets. In hours, the snowball turned into a global panic. The chronicles of the time tell us that a failure in the rookie electronic market - which was installed on Wall Street - and in the derivatives market was the spark that triggered the alarms. It was the excuse.



"All the News That's Fit to Print"

The New York Times

Late Edition

VOL. CXXXVII . . . No. 47,258 NEW YORK, TUESDAY, OCTOBER 20, 1987 50 CENTS

STOCKS PLUNGE 508 POINTS, A DROP OF 22.6%; 604 MILLION VOLUME NEARLY DOUBLES RECORD

U.S. Ships Shell Iran Installation In Gulf Reprisal

Offshore Target Termed a Base for Gunboats

A Huge Blow to the Five-Year Bull Market

Dow's Record Fall

WORLDWIDE IMPACT

Frenzied Trading Raises Fears of Recession — Tape 2 Hours Late

3.2 Reasons

Changes in any fundamental component of the valuation model of stocks in the stock market.

Decline in future yields
Macroeconomic shock
Unexpected increasing of the interest rate
Uncertainty increasing

Failure of market mechanisms

The government of a country has a great contribution to the growth and development of the economy. It strives to achieve economic growth by making an optimal allocation of resources and working for social welfare.

However, classical economists believed that the role of government in an economy should be banned. In addition, they proposed that the economy adjusts itself without any control unit. However, these conditions are not applicable in the real world.

Changes in the perception of agents (speculative bubble)

The behaviour of market participants suggests that many had a significant drop in prices.

The asymmetry between sustained subdividing and sharp fall, and the inverse correlation between upward and downward quotation, are compatible with the existence of a bubble.
Nor was optimism about fundamentals in the summer and autumn of 1987 as high as it was in mid-1988. If, therefore, the stock market rose more dynamically in 1987, it can be interpreted as a symptom of a bubble.

1987 BEFORE	Black Monday	1987 AFTER
Your Nest Egg	20.47% Change	Damaged Nest Egg
$5,000,000	-$1,023,500	$3,976,500
$3,000,000	-$614,100	$2,385,900
$1,000,000	-$204,700	$795,300
$500,000	-$102,350	$397,650
$250,000	-$51,175	$198,825

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Trading programs, Overvaluation, Lack of liquidity, Market psychology

In trading programs, computers perform the execution of quick actions based on external inputs, such as the price of related values. Common strategies implemented by trading programs involve an attempt to engage in arbitrage and investment security strategies. As computer technology became more available, the use of the trade program grew dramatically within Wall Street firms.

After the crash, many blamed trading strategies program for the sale of stocks blindly as markets fell, further exacerbating the decline. Some economists speculate the theory boom leading up to October was caused by the trade program, and that the accident was nothing more than a return to normality.

Either way, trading programs ended up taking most of the blame in the public eye for the stock market crash of 1987. US Congressman Edward J. Markey, who had been warned about the possibility of an accident, stated that "The Trade Program was the main cause."

New York University's Richard Sylla divides the causes into macroeconomic and internal reasons. Macroeconomic causes including international disputes on foreign exchange and interest rates, and fears about inflation.

We have seen accounts that maybe about half of the quote on that day was a small number of institutions with portfolio insurance. Great guys were getting rid of their stocks.

In addition, the Chicago futures market was even smaller than the stock market, and people tried to arbitrage that. The proper strategy was to buy futures in Chicago and sell them in the New York cash market. It became difficult. The village insurance portfolio was also trying to sell their shares at the same time.

3.3 Conclusions

It can happen again

Since Black Monday, many of protection mechanisms have been incorporated into the market to prevent panic sales such as commercial curbs and circuit breakers. However, high frequency trading (HFT) driven by super computer algorithms move massive volume in just milliseconds, which increases volatility. The flash crash of 2010 was the result of high frequency trading that went awry, sending the stock market 10% in a matter of minutes. This resulted in tighter price bands being installed, but the stock market has experienced several volatile times since the year 2010. Increased technology and online trading have introduced more risk into the market.

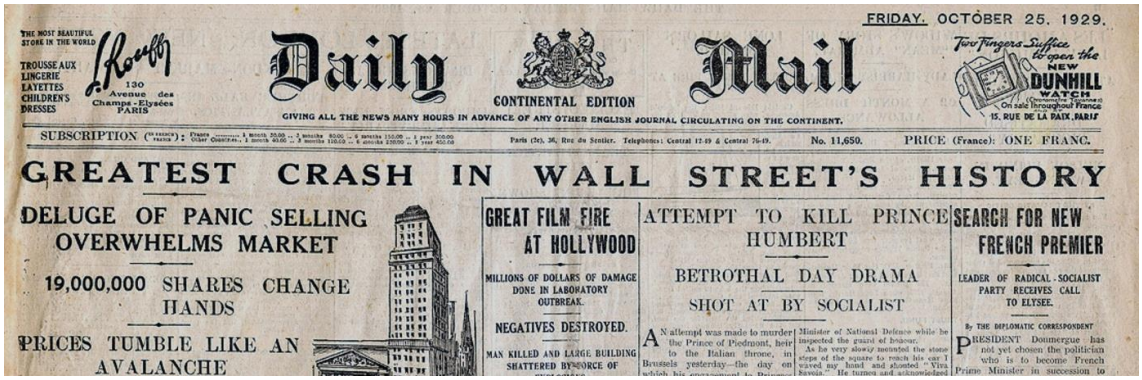
Lessons from Black Monday and Other blocks the market

Unless absolutely the end of the world, a market downturn of any duration is temporary. Many of the most pronounced market rallies have occurred immediately after a sudden accident. The steep falls in the market in August of January of 2015 and the year 2016 were both to 10% of possibilities, but the market recovered fully and they were united in a new one or near new highs in the following months.

A well-conceived long-term investment strategy based on personal investment goals should provide the confidence you need to remain calm while everyone else is in a panic. Investors who lack a strategy tend to let their emotions guide their decision making. Investors who have been invested in the Standard & Poor's 500 Index since 1987 have achieved an annualized return of 10.13%.

Knowing that blocking the market is only temporary, should be viewed as a time of opportunity to buy stocks or funds. Falls from markets are inevitable; Have a prepared purchase list of stocks or funds that would be more attractive to lower prices and buy while others are selling.

Long-term declines in markets such as Black Monday are shown as a small spotlight on the performance of a well-structured portfolio. Short-term market events are impossible to predict, and are soon forgotten. Long term investors are better off turning off the noise of the media and herd, and focusing on their long-term goals.



FRIDAY, OCTOBER 25, 1929.

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On sale throughout France
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GREATEST CRASH IN WALL STREET'S HISTORY

DELUGE OF PANIC SELLING OVERWHELMS MARKET

19,000,000 SHARES CHANGE HANDS

PRICES TUMBLE LIKE AN AVALANCHE

GREAT FILM FIRE AT HOLLYWOOD

MILLIONS OF DOLLARS OF DAMAGE DONE IN LABORATORY OUTBREAK.

NEGATIVES DESTROYED.

MAN KILLED AND LARGE BUILDING SHATTERED BY SOURCE OF

ATTEMPT TO KILL PRINCE HUMBERT

BETROTHAL DAY DRAMA

SHOT AT BY SOCIALIST

An attempt was made to murder the Prince of Piedmont, heir to the Italian throne, in Brussels yesterday—the day on

Minister of National Defence while he inspected the guard of honour.
As he very slowly mounted the stone steps of the square to reach his car I waved my hand and shouted "Viva Savoia." He turned and acknowledged

SEARCH FOR NEW FRENCH PREMIER

LEADER OF RADICAL-SOCIALIST PARTY RECEIVES CALL TO ELYSEE.

By THE DIPLOMATIC CORRESPONDENT

PRESIDENT Doumergue has not yet chosen the politician who is to become French Prime Minister in succession to

4. Accessibility, Internet, and volatility.

In this third section, we are going to analyse primarily the accessibility of trading. Accessibility can be given different meanings but we are going to define for our purposes as the ease of access to trading transactions to anyone interested in the field. We will also relate the access to the volatility of markets as well as the impact on the number of listed companies worldwide.

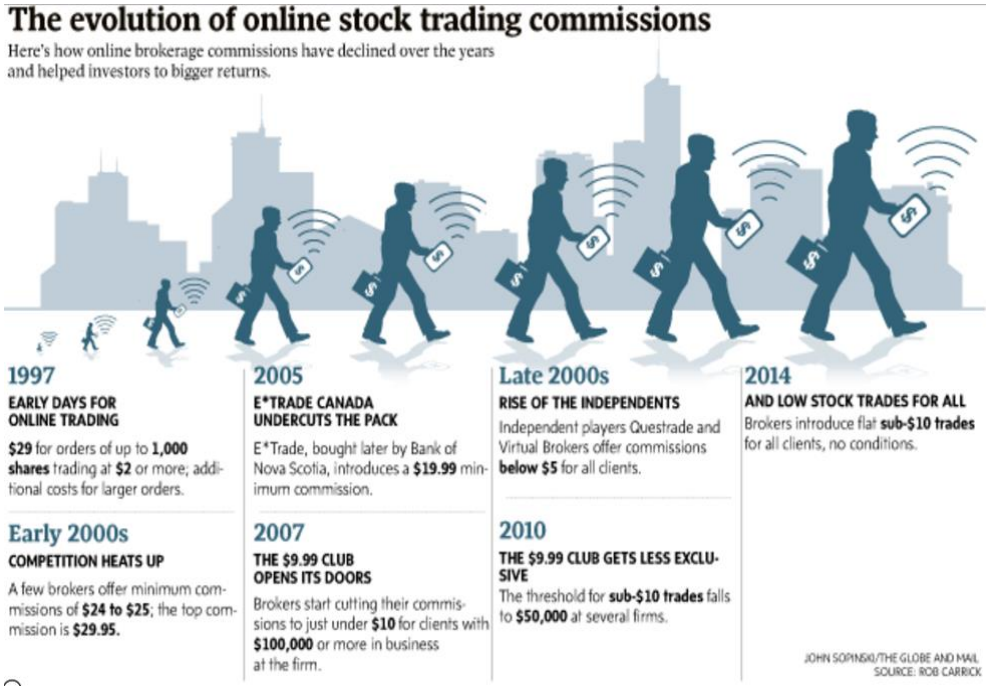
4.1 Accessibility Evolution

We will start by the beginning of online trade. As we have all seen in movies such as the Wolf of Wall Street, we see individuals, who call brokers to place a trade. Usually it is the broker who tries to persuade the individual to place it, which makes it even more demanding in time. But since the introduction of ECN's (Electronic Communication Networks) in 1971 the whole system has been changed. What used to take days, could now be realized in a matter of seconds. ECN's not only brought speed of transactions. They also brought accessibility to trade, and of course access to a big amount of data.
Nasdaq was the first to implement ECN's but in their first days they only used them to show data and not to materialize trades.
In 1967 Instinet was formed, it was the first platform to complete electronic trades. This platform had more success after the 1987 stock crash.

In 1982 Naico-Net was a big step on trading accessibility by letting the customer access all its trades as well as doing market research.
Thinkorswim is another example of service which gathered and analyzed data in detail.

In the 90's the increased access to internet, lower costs and rise of more trading platforms resulted in a boom of the home trading market.

It is important to state that the access to market has been granted by an increase in broker competition. The more access brokers have to markets, the more brokers there are and this has driven the costs down dramatically giving individuals cheap access to stock markets.
This picture reflects clearly the drop-in broker's commissions from 29$ with a lot of conditions to less than 10$ for any type of trades.



4.2 More access, more volatility?

Now that we have a clearer path of how online stock markets have raised, we can comment on the impact of such access increase.

As the amount of computer based programs where arising to give birth to the online stock markets we have to consider the fact that more and more people started getting involved in trading. Nowadays we have all types of careers concerning trading and some courses such as the one we are attending at NHH.

This could be seen as positive in a way that everybody having access to the market, if they manage to allocate their resources correctly they can profit from online stock markets.

However, as we will see in the last section, the more human implication in the markets can lead to greater market volatility. We know that brokers, especially inexperienced, have a hard time acting rationally and a clear example of it is that when a national soccer team wins, brokers tend to be more risk averse.

China market is now suffering the consequences of a too wide investor segment. Fang Xinghai, the vice chairman of the China Securities Regulatory Commission, said “Chinese markets are more volatile than other developed exchanges because they are dominated by individuals who lack the experience of large institutional investment houses”

This accessibility increase certainly increases instability. Computers again are part of the problem but as the same time of the solution as they are not influenced by emotions.

4.3 Mobile trading, the future of online trading?

Mobile phone trading is the ultimate step in online stock markets access. Nowadays, people carry all the markets and market information in their pocket and can influence it.

Since the latest financial crisis, investors and brokers want to have more control over their money and more live information of the market. The phone is then the perfect tool as they carry it with them 24/7.

Some stats about mobile phone trading provided by Fidelity, which is a financial advisor and one of the best online brokers, is that mobile trading has grown by 63% from 2012 to 2013 and the Fidelity app has been downloaded more than 3.5 million times. E-Trade Financial Corp. said that the share of their customers using phones to trade went from 6.5% in 2012 to 8.4% in 2013 and from 2010 to 2013 mobile phone trading increased by 713%.

But even if access to information can seem a good way of controlling and being aware of the markets financial state we wonder if it is ok to buy/sell directly from your smartphone. It is believed that transactions from phones can be even more irrational and guided by market trends.

However, there are a wide mix of opinions about online trading from phones. Some believe it is a threat to security of your account, others believe that it make your financial strategy dependent on the power of your signal or Wi-Fi 24/7 and other believe that it is similar to PC and it is better for the broker who can react quicker.

What is certain is that mobile phones have introduced a new step in online trading going hand in hand with the widespread of Wi-Fi. We will see the impacts of it soon.

4.4 The impact on listed companies.

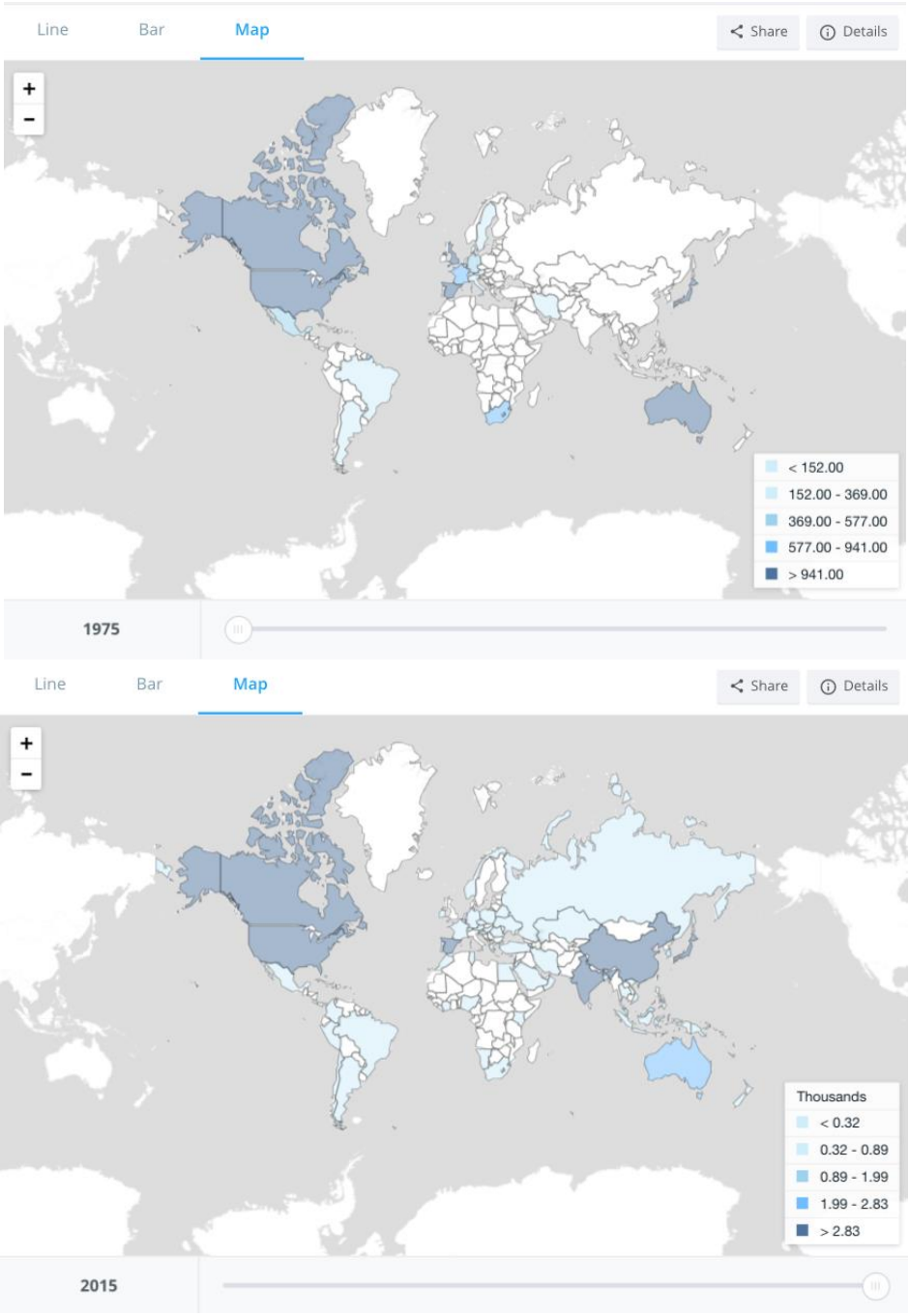
When we talk about accessibility it is important to think not only on the broker but also on the company listed. With online stock markets increasing their accessibility, we wonder if the number of companies listed has increased accordingly. We found a good graph provided by The World Bank showing the evolution from 1975 to 2015.



This graph clearly shows a big increase from the year 1992(25,154 companies) to the year 1997(39,401 companies) amounting to 8.8% per year where it goes from 25,154. The growth then starts shrinking and is less uniform after that year. This graph could also be representative of the digitalization in general and we can see a little stagnation around 1987 where the first financial crisis occurred.

The public listing of companies can be seen as positive for companies' growth and development of a country in general. Another interesting approach to market accessibility is the distribution among companies regarding the country. This world map also provided by The World Bank shows the distribution of listed companies around the world.

It is interesting comparing the map from 1975 to 2015. We can see that, as we might have thought, listing of companies in already developed worlds didn't increased so much. We see a big development in developing countries like India and China and a gradual increase in South America and Africa. It is interesting to notice the decrease in the UK and in the US even if it is not noticeable. This is due to the decrease in the need of funding through public listing and the availability of other resources.



All in all, we have seen the evolution of the accessibility of stock markets, its consequences on volatility and the introduction of mobile phone trading as well as its impact regarding listed companies worldwide.

5. Automatization in trading.

5.1 Introduction

People has always used machines to make their lives easier, automatizing every single aspect of their lives in order to improve efficiency and productivity. This is not an exception in trading systems, which are being highly affected by automatized programs. This is meaning a real revolution for the financial industry, and therefore we are going to analyse its origins, some technical concepts implied in the process of developing an automatized trading system and the implications that it has to the markets and society in general.
The origin of the automatization in trading can be found during the late 40s, when Richard Donchian, started to use rules to generate the buy and sell orders. These set of rules where often based on the study of trends in the markets, so it implied a lot of work in order to study each security and find the trends. Anyway, this practice became more and more popular as it simplified a lot the decision-making process for investors, but it was not until the 80s when it grew exponentially as traders started to use mathematic models that could be applied with the basic computers of that time. Like this, they could save more time investigating the data of the market, as the computers could analyse the data faster and of a more efficient way than humans.
As technology kept improving, it became a more accessible and therefore more investors could use these automatized techniques to generate their buy and sell orders. During the 90s, internet came into trading and was a complete revolution as it allowed many brokers to offer this kind of services to small investors that didn´t have the means to use them before. It also meant a revolution for the financial industry, as it was the first time that the computers had access to live information and they could send orders straight to the market, without the need of a broker to exercise the order. This change was also made possible because the stock markets modernized their systems and then implemented electronic trading markets.
We should also highlight that this technology is used mainly by big investors, as investment banks, that have spent millions in perfecting the software and the mathematic algorithms that they use. They have developed complex systems that are very focused on High Frequency Trading, that consists in using very powerful computers to place large number of orders at a high speed. To decide which orders do they place in the market, they use algorithms which contain complex sets of rules so the computer places the order when the conditions are met. Big firms make profit from this by earning the spread of the markets, as with so fast orders they can reduce the spreads to the minimum, but thanks to the volumes they trade they still make huge profits.

5.2 Definition

To get into the technical concepts of this way of trading we will begin with the definition of algorithm, which is the base of every automated trading system. An algorithm is a specific set of clearly defined instructions aimed to carry out a task or process. Then, using this set of instructions to program computers that have

access to the data of the markets to take decisions about buying or selling financial products is called algorithmic trading. Thanks to that, these computers are able to trade at really high speeds and therefore be more efficient than humans. To make this even more efficient companies are investing great amounts of money to improve their connections with the market servers. To do so, they try to place their servers as close as possible to the market and they use the last technology in telecommunications to make it even faster. For example, they use optical fiber and spend millions of dollars in reducing the time of connection a small fraction of second. An example of this is the next picture, taken from the documentary “Algorithm Trading, Impact of Automated Trading Programs on Markets”:



In that picture, we can clearly see that the investment bank servers are much larger than Nasdaq servers and they are allocated only on the other side of the street. Like this, they can assure that they have the fastest connection to the market and then they have the first move advantage.

5.3 How to design an automated trading system

Now we will proceed to explain a basic example of how does automated trading works. The first thing that the trader interested in using this kind of techniques needs to know is at least basic programing skills. This is because for setting up an automated system, we need to use a language that the computer is able to understand. That is part of its complexity, as it depends on the coding language that the platform works with. For example, we can find systems that works with C, which is a widespread coding language, or others that have their specific coding language, as it could be the one that uses Tradestation, MetaQuotes, which allows particular investors design their own automated systems.
Anyway, big traders as investment banks design their own systems with a complexity that is hard to understand. This can be seen in their recruiting processes, where they look for more technical profiles as mathematicians, informatics or graduates in statistics, rather than the more classical profile of a finance master graduate at a top business school. Right now, they are not even so interested in the university where the candidate got its title, as they organize coding contests, so only the best ones get the job.
For example, the process to design a basic automated trading system will follow the next steps:

- First you need to design the system by thinking in which rules are you going to base the decisions that the computer is going to make. After that, you need to define the components involved in each rule. Then you need to define the actions that are going to take place when the rules are matched (like sending sell or buy orders).
- Second, once that you have defined all the system in a theoretical perspective, you need to make it understandable by a computer, so now is the moment when we need to translate our ideas to the coding language that our platform uses. This is probably the most tedious part, as it is very technical and requires knowledge in coding language. There are two main parts in a program, which are Variables and Statements. Variables are simply the data that goes into the program from the markets. On the other hand, Statements consist in the manipulation and interpretation of the data, so the program get results that are translated into actions.
- Once we have our system properly designed and coded, is time to test if it works properly and correct any bugs. For that, and this is a great advantage of this systems, we can use past data to see how will it behave with previous situations where we already know the results in the markets, so we can appreciate if the program makes the right decisions in many different scenarios. Like this, we can depurate and improve the way that our automated trading system makes decisions without taking the risk of losing money in the real markets. During this stage, you can also find errors in your code that make it work differently from what you thought or just does not let it work. Anyway, it is impossible to develop a perfect automated trading program, but with that we try to make the most accurate in right decision making with the information available.
- Finally, you have to compile all your code and use it in the real world with the platform for which you designed the program. In theory, at this final stage it should work properly as you wanted, but anyway is always good to keep revising how it performs in order to find ways to improve it and make it even more efficient and effective.

5.4 Consequences of automated trading

The proliferation of this kind of automated systems and the fact that year after year are more accessible to more people means that as we said before, a bigger stake of the volumes traded in the market come from automated systems. That has many important effects on the market.

One of them is that as these programs operate with high volumes at high speeds, the speed of the movements of the markets have been increased considerably. A perfect example of that was the flash crash that took place the 6th of May 2010, when the Dow Jones Index fell 1000 points (about a 9%) and recovered to previous levels of the crash in the following minutes. Clearly, this was not because of human action, and the SEC made an investigation that concluded that this was produced by High Frequency Traders and a delay in the information displayed by the market. Basically, the market got saturated of so many orders, and ended with a delay of up to 36 seconds in the information that reached the

automated trading systems received. This generated a great controversy about the use of automated trading systems. Another example of this kind of issues took place the 6th of October 2016, when the pound had a flash crash of a 6% in less than a minute, to recover from it in the following minutes.

Other important effect that automated trading and high frequency trading has on the markets is that it reduces the spread between bid and ask in the trading book. That is good up to a point, as it means that there is high liquidity in the market. Anyway, there are many detractors about this that call this liquidity “ghost liquidity”, as it comes to the market and leaves it so fast that only High Frequency Traders benefit from it, as a regular investor could not operate as fast and therefore use that liquidity.

One important characteristic of this kind of programs is that they don´t have feelings, so we can eliminate them at our decision-making processes, being more objective. Like this, we can also end with the human errors as pressing the wrong button or getting over excited about the future perspectives on a security.

Another consequence of the implementation of these systems is that the job of the classic trader is in danger, as it is evolving to become a technician that gives support to the automated trading programs. This does not have to be necessarily negative, as people can focus on more efficient tasks than just placing orders in the markets, but is true that it implies the destruction of thousands of jobs. There is a possibility that is being considered by many experts that implies that due to the automatization of many jobs, we can experience something similar to the XIX century Luddites, which started destroying the machines of the industrial revolution because they made their jobs more efficiently. Anyway, history show us that even if this kind of movements reappear, technology will keep moving forward and other jobs will be created.

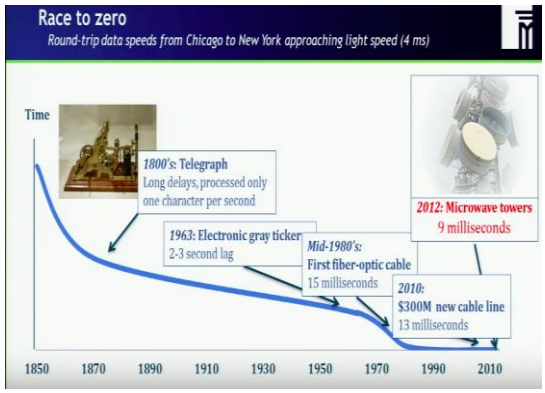
Finally, we can conclude that the automatization applied to financial markets is a reality and is probably going to take over so many jobs that we assume that are going to exist in the future. Then, for us this means an important revolution of the way we should understand and work with the markets, so it can also be a great opportunity for students that know how to use this technology to get a good seat at the financial industry in the future.

6. Balance of technology applied to trading

As we have seen, in recent years technology has changed trading in a radical way. But in this section, we would like to deepen in the advantages and disadvantages of this new type of trading.

6.1 Speed

Overtime, there has been an enormously progress and advance on how quick an order can be executed. Moving from the days of the telegraph when we needed hours or even in the worst circumstances days to send and receive an order, to recent days that we use milliseconds as a metric to count trading speed. It is also important to highlight how our capacity to process information has increased. This is since buy and sells orders can be match easily and quickly with the help of computers.



For this reason, we can argue that trading speed and information processing can improve: market liquidity, decrease volatility and reduce trading costs.

Using automated trading or HFT we can Increase market liquidity because bid-ask spread is narrower. In other words, high frequency trading traders can be seen as marketmakers who provide liquidity into the market.

As we have seen, we started using Designated order system and now we have moved towards Universal Trading Platform. These changes allow us to do more trades which means more volume. Volatility is a statistical measure of dispersion regarding the value of a stock, so then if we have more volume volatility will decrease.

On the other hand, there is another vision that shows that speed can be used to provide an unfair competitive advantage. Some companies can invest their money in having the best trading speed. According to Michael Lewis, the market is rigged by high frequency trading who front run orders placed by investors. He wrote a book called “Flash Boys” which was a best seller two years ago. In this book, he explained the case of Spread Networks. This company offers Internet connectivity between New York City and Chicago using a cable as straight as possible. The velocity between the normal speed of internet and Spread Networks’ connections differs in 5 milliseconds. It may seem like a short amount of time, but in trading 5 milliseconds are enough time to get a competitive advantage.

Setting up a trading’s business is more expensive than some years ago, to become competitive with speed. You need bigger facilities such as hardware, software, licenses and human resources to enter the market and survive during time.

These expenses present a major disadvantage of technology in trading, particularly to businesses that are entering the technology era for the first time. Then, we can say that implementation expenses are higher.

6.2 Rationality vs Behaviourism

There exist different types of ideologies of trading behaviour. Nevertheless, the most important ones according to economist are:

On one hand, some economists opine that people should be thought of as rational economics agents. This type of ideology is the most traditional and it is called neoclassical. This ideology defends that people are rational. Or in other words that people are *Homo economicus,* which means that we are rational decision-makers with perfect information and perfectly ordered preferences.

On the other hand, there are behaviorists economists who think that people don't have a rational behavior. A rational behavior decision-making process is based on making choices that result in the most optimal level of benefit or utility for the individual.

We can illustrate that showing an experimental research. An economist called Dan Ariely conducted several experiments to show that people are not rational. One of these experiments was in a supermarket. Soy milk was used to stack on the shelfs, because it did not need a refrigerator. However, people did not buy soy milk because they were not used to buy milk outside the freezer. Hence, supermarkets started to stack soy milk inside the freezer spending more energy, even though soy milk did not need to be inside the freezer. Thereafter, the consumption of soy milk in that supermarket increased.

As we have seen, people are not even rational in a simple and easy market like supermarkets. Thus, we can expect that traders are not 100% rational.
Technology allows us to act in a more a rational way, because it does not have instincts and feelings as humans have.

Advantages	Disadvantages
Speed	
Increase market liquidity	Unfair activities
Decrease volatility	Implementation expenses
Reduce trading costs	
Rationality vs behaviouralism	
More rational behaviour using technology	
Less instincts and feeling	

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