

Flash Boys Study Guide

Flash Boys by Michael Lewis

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Summary

Flash Boys, by Michael Lewis, begins in a financial world that has been revamped. In the past, the majority of share trading was funneled through Wall Street and the New York Stock Exchange (NYSE). Michael Lewis points out that the old system is typically what people envision of Wall Street. Images such as one of “thick-necked guys in color-coded jackets standing in trading pits” come to mind. Back then, if investors panicked and wished to sell enormous batches of stock, it wasn’t uncommon for brokers to simply not pick up their phones. The old stock market was based on human limitations. The new stock market, however, has replaced the human element with technological ability. The centrality of the stock exchange has dissolved, as numerous stock exchanges have sprung up in multiple states. Stocks are traded simultaneously in different markets through a click of a button. When an investor places an order, it no longer passes through a broker. Instead, it goes through miles of fiber-optic cables that transmit signals at light speed. Indeed, the new market has broadened the landscape for small enterprises to enter the market and trade. With the expansion of possibilities, new flaws have also appeared. For instance, Royal Bank of Canada stockbroker Brad Katsuyama discovered that nearly all his trades had a predictable result. He lost money when he should have gained. Before he could blink, shares which would have likely profited traded far worse than the original market price. Brad wondered if his computer was damaged. After trial and error, he discovered that it was not a technological glitch at all. It was the new concept of high frequency trading.

High frequency trading firms measure value by unfathomable speed. If an investor’s trade is executed at 10 milliseconds, an HFT firm with a 9-millisecond capacity will intercept the signal and manipulate the price for their benefit. For example, if an investor wants to buy a share of X at \$10, a high frequency trader will buy the share for that amount and sell to the investor at \$12 before the investor even notices the change. Hungry to have a technological edge, high frequency traders obsessively seek to shave off milliseconds, nanoseconds, even microseconds (millionths of a second) from their transmit time. Due to this technological drive, Wall Street banks, stock exchanges, and online brokerage firms that practice high frequency trading invest millions of dollars in the latest high-speed computers and fiber-optic lines. Characters such as Dan Spivey supervise the construction of these aforementioned lines that cut through cities and rugged terrain in order to achieve the shortest distance between two financial markets. High frequency traders co-locate within the exchanges and collect information about trades before everyone else.

Of course, no human can employ information at those speeds, so Wall Street firms rely on the expertise of computer programmers to generate complicated algorithms to do it for them. Sergey Aleynikov was one such programmer who worked for the large investment bank, Goldman Sachs. Lewis describes Serge as a dutiful employee who rarely questioned his role in facilitating high frequency trading. Rather, he was fascinated by large-scale complex systems and code. The code he helped develop, which was used for HFT, became Goldman Sachs property even though the culture of computer programming depends on collaboration and sharing. When he left his position



with Goldman's code saved to his computer, he was promptly arrested at the airport. He was convicted and sentenced to eight years in federal prison. All the while, Lewis contends, high frequency trading and the theft of investor's money, retirement saving, and pension funds continues unabated and sanctioned by government regulators.

Outraged by this new "predator" on Wall Street, Brad Katsuyama teamed up with the technologically gifted Ronan Ryan, as well as a host of other talented Wall Street computer programmers and disenchanted stockbrokers to build a new system that removes HFT from the marketplace. In their first attempt, they developed a program called Thor that essentially equalized the time of simultaneous trades by slowing down the faster speeds. If multiple trades are synchronized, high frequency traders find it difficult to intercept the faster trade in order to manipulate the slower one. Thor, however, was limited in its reach. The market was still imbalanced. From here, Brad and Ronan quit their jobs at the Royal Bank of Canada and took up the ambitious project of creating a new stock exchange based on fairness and transparency. The new stock exchange, the Investors Exchange (IEX), successfully facilitates trade without the exploitation of HFT. However, Lewis reminds readers that HFT has not been totally abolished. It still operates in certain areas where unknowing investors are exposed. Nonetheless, Flash Boys serves as an account of a dozen or so individuals on Wall Street who were fed up with the injustice. They were out their energy, time, and money to fix the crisis, when most saw HFT as a lucrative opportunity. Lewis argues that the injustice that cheats investors is the same injustice that locked Sergey Aleynikov away in prison and that undermines the entire financial system.



Introduction

Summary

Michael Lewis begins *Flash Boys* with the story of Sergey Aleynikov, a former computer programmer of Goldman Sachs. Sergey, or “Serge,” had been arrested in 2009 for stealing Goldman Sachs computer code. “I’d thought it strange, after the financial crisis, in which Goldman had played such an important role, that the only Goldman Sachs employee who had been charged with any sort of crime was the employee who had taken something from Goldman Sachs” (Page 1). Other than being alarmed at the double standard of Wall Street prosecutions, Lewis thinks it is also bizarre that Serge was accused of stealing a code that could allegedly be used to manipulate the market in unfair ways. If this were the case, should Goldman Sachs be trusted with that particular code?

The other consideration Lewis has for writing *Flash Boys* is to explain in the simplest terms an increasingly complex financial system. Gone are the days of brokers crowding the stock exchange floor scrupulously reading ticker tape and shouting orders at one another. According to Lewis, the stock market is totally digital and less centralized. It is heavily based on the speed of fiber-optic technology.

Analysis

In the Introduction, Michael Lewis explains why he is writing a story which centers around Sergey Aleynikov, a former computer programmer for Goldman Sachs who was arrested and convicted for stealing a computer code he helped design. Lewis gives three reasons for his writing. The first reason is the blatant hypocrisy of the justice system. If this lowly computer programmer is to be so vigorously prosecuted, why isn't the same standard applied to the bank executives responsible for the policies that led to the financial crisis of 2008?

Secondly, Lewis finds it strange that one of the fears Wall Street regulators have of Aleynikov is that the code he “stole” could manipulate the market in unfair ways. If Aleynikov couldn't be trusted with the code, why should anyone believe it would be safe in Goldman's hands? Lastly, and perhaps most importantly, Lewis wrote *Flash Boys* to explain the complexity of the current state of the financial system in a simplified way. The concept of high frequency trading is difficult to understand, even for those entrenched in Wall Street trading. It is this complexity and ambiguity that has allowed the new system of trading to succeed at the expense of the ignorant.

Lewis also sets out to dismantle the old image of the stock market, which is built on trust and comfort. In the old system, trading was more transparent and slow, so investors could make strategic decisions and hopefully make money. When an investor logged into their online trading account and pressed a button, they could generally expect their



outcomes. Now the market system has changed. Rather than a bustling stock exchange where brokers shout out the latest updates on stocks, "the U.S. stock market now trades inside black boxes, in heavily guarded buildings in New Jersey and Chicago." In essence, the stock market is mostly digital. Those making money have the most advanced technology. Speed, rather than tactical wisdom, is now of greater importance.

Vocabulary

holler, investor, coherent, magnitude

Chapter 1

Summary

Chapter 1 begins with the construction of a fiber-optic line. Since this specific line does not serve any public utility, those working on the site wonder why it needs to be installed. Lewis compares the line to an underground reptile, complete with individual needs and wants. The burrow it lives in needs to be as straight as possible, without kinks or turns. This straight line will connect the South Side of Chicago to a stock exchange in northern New Jersey. Because the line must be as straight as possible, the surface configuration of the land becomes irrelevant. Holes are blown through mountains even when going around would be cheaper and less labor-intensive. Once again, those working the line are perplexed, but nonetheless, are kept in the dark. They are only given limited information, mostly concerned with the logistics of the line, rather than its purpose.

However, one individual who has an idea about why the fiber-optic line must be designed in a particular way is Dan Spivey. As a former stockbroker in his hometown of Jackson, Mississippi, Spivey was always aware of the importance of speed. Up until 2007, speed was limited to how fast a stockbroker could buy or sell a particular stock. Now, exchanges are digitized and speed is determined by how fast a signal can travel between data centers across the country. Value is now being measured in milliseconds, or one thousandths of a second. When milliseconds cannot be salvaged, then microseconds and nanoseconds are given value. Given this knowledge, Spivey's new obsession centers on how to shorten the distance traveled by a line in order to increase the speed of a signal. He also finds an important, if not lucrative role to play; a middleman between Wall Street insiders determined to capture increased trading speed and local governments who are knowledgeable both of the land and the laws concerned with digging it up.

Spivey enlists the help of people like Steve Williams to supervise portions of the project, Jim Barskdale, the former CEO of Netscape Communications to fund its \$300 million price tag, and Barskdale's son David to convince the municipalities and towns to allow digging in their communities. They name the company Spread Networks. After the project begins, a primary concern of Spread Networks is what to charge for access: how much is it worth to a single player in the U.S. stock market to have an advantage over the rest of the market? Although the line is beset with a number of problems, both socially (asking permission from local authorities and landowners) and logistically (renting a \$2 million drill from Brazil), Spivey is always confident the project will prove profitable. Although he admittedly does not know the specifics of how the speed is used by Wall Street companies, he knows they want it badly and will pay exorbitant sums to obtain it.



Analysis

In this chapter, the reader is introduced to the “new” stock market. The new stock market abolishes the traditional image of Wall Street being the center of activity. In the old market, trading was done in a specific city at a specific exchange. The new market, however, is spread out across the United States and connected by fiber-optic lines that transmit signals from city to city. Lewis unpacks the mechanical ingenuity needed to build this network of lines. However, this particular line, which will connect a stock exchange in Chicago with New Jersey, is unusual. The shortest distance between two points is a straight line; therefore, the line is built without regard to environmental or social obstacles. Mountains and bodies of water cannot be circumvented. Lobbyists are hired to convince local governments and businesses to allow the line to pass through their properties. To make it more bizarre, those installing the line are made unaware of its purpose. They are simply told to build and, if need be, report any persistent curiosity of their fellow worker to a supervisor. In this regard, Lewis treats the reader like the workers on the construction site. Rather than reveal how the fiber-optic line will be used, Lewis only gives tantalizing clues. The reader is made aware of the obsession of management to minimize the line’s distance and the willingness of Wall Street banks to pay millions of dollars to have access to the line and push out their competitors.

The secrecy surrounding the line is not a conspiracy, however. It is a deliberate attempt on the part of Spread Networks to maximize the line’s value while minimizing the chances some other company will replicate their efforts. In Dan Spivey’s mind, and the minds of those involved in Spread Networks, speed has value and scarcity equals profit. The more exclusive their particular line, the more Wall Street institutions will pay for it. In fact, Larry Tabb, the industry consultant Spivey hires, estimates that a single company could make upwards of \$20 billion in profits due to the “product” offered by Spread Networks. In a competitive marketplace, many companies would like a share of those profits and pay for access. More importantly though, Spivey understands he is needed by Wall Street. The market has changed and speed is its most important commodity. Companies that have slower, older technology miss out on the millions of dollars of profits their competitors will inevitably make. If he fails to take advantage of this opportunity, someone else will.

Vocabulary

circumspect, bewilder, arbitrage, subterranean, discrepancy, minuscule, modus operandi, wordsmith



Chapter 2

Summary

In Chapter 2, the reader meets Brad Katsuyama, an employee of the Royal Bank of Canada (RBC). Brad is described as analytically gifted, conscientious, and team-orientated. As a young man, he chose to follow his girlfriend and friends to a lesser-known Canadian college rather than accept admission into a world-class university. He hated to be singled out for his gifts and perceived inadequacies. He preferred the energetic and bustling environment of trading stock on Wall Street. Brad was also a model employee. He fit into the culture of so-called “RBC nice,” where employees demonstrated fairness and respect in stark contrast to Wall Street's environment. The employees of RBC and Brad were selfless and determined to uplift the group as a whole. Lewis notes that, “Brad Katsuyama had trusted the system; and the system, in return, trusted Brad Katsuyama” (Page 27).

After being transferred to New York from Toronto, Brad began trading U.S. energy and tech stocks for RBC before the \$100 million merger of RBC and Carlin Financial, an electronic trading firm. Almost immediately, differences between the companies became apparent: “The RBC guys were understated and polite; the Carlin guys were brash and loud” (Page 29). In one instance, the CEO of Carlin Financial, Jeremy Frommer, took charge of organizing the company Christmas party and reserved a room at the ritzy and extravagant Marquee nightclub, much to the chagrin of the low-key RBC employees. Even though Brad felt alienated by his new colleagues, he was moved into the Carlin Financial offices. It was during this period of transition that he noticed an alarming change in the financial market. In the past, when he wanted to buy a particular share at a given price, he simply clicked a button to do so. Now when he performed the exact same procedure, the offer vanished before he could complete the order. Once he lost a small fortune by buying 5 million shares of an electronics company from a large investor only to sell far below the original share price before he had time to react. “It was as if someone knew what he was trying to do and was reacting to his desire to sell before he had fully expressed it” (Page 32).

Determined to discover what was going on, Brad sought answers from his colleagues. Tech support believed he was clicking the wrong buttons at the wrong time, whereas his friends argued that his computer was too slow. Brad also found changes in the behavior of stock exchanges. For starters, the fees charged to RBC to use the stock exchanges had risen exponentially. A few stock exchanges even paid investors such as RBC rather than charge them to create a trade. Stock exchanges traditionally placed a fee on investors in order to facilitate a trade. However, those who paid clearly wanted to give investors an incentive to trade with them. As a result, Brad organized an experiment with a team of programmers to investigate what happens between the time you push the button to trade and when the exchange receives the order. The more exchanges they attempted to buy the stock from, the less stock they actually bought. It became clear to Brad that someone out there was using the fact that stock market orders arrived



at different times at different exchanges to front-run orders from one market to another. Whatever was causing the problem, a 2-millisecond delay between two exchange orders was a sufficient window to be intercepted. In order to ameliorate this problem, Brad and his team developed a program called “Thor” that would essentially delay a faster order so all orders to separate stock exchanges could be synchronized. The program was a success. Brad and his team set out to contact investors and educate them on the new “predator” in the market and how Thor would help them combat it.

Analysis

Brad Katsuyama enters the scene during the most important changes of Wall Street. Financial transactions have been digitized and stock exchanges have been springing up to meet the growing demand for more trade. At the expense of speed and choice, the new system was less personal because there was no interaction with someone inside the exchange. You submitted your order by computer, and it was directed to the exchange. Brad began working for the Royal Bank of Canada (RBC) as a stockbroker during those changes. The RBC itself was going through major institutional changes. The bank’s reputation had generally been a positive one. They were always cautious with their clients’ money and only took calculated risks to make profit. People at RBC rarely boasted about their individual achievements. As an employee of RBC, Brad believed that “the best way to manage people ... was to convince them that you were good for their careers” (Page 26). However, in order to adapt to the changes in the market, RBC merged with a Wall Street electronic trading firm, Carlin Financial. The differences in culture between the two institutions were readily apparent, but the executives of RBC were confident they had made the right move to improve the bank for the better.

It was during his time at RBC that Brad began to notice something peculiar about the markets. Whenever he placed an investor’s order on the stock exchange, he would lose money. In the spring of 2007, his screens showed 10,000 shares of Intel offered at \$22. But, when he pushed the button to buy, the offers disappeared. He wasn’t the only one who experienced this phenomenon. Brokers throughout RBC were also losing money with each trade. This struck Brad as highly unusual given RBC’s recent acquisition of Carlin Financial, a company that specialized in electronic trading. If the technology he was using was not responsible, what was the cause? At the time, Brad believed that RBC had miscalculated by merging too quickly with Carlin Financial. Further investigation showed Brad that he simply was missing out on what was happening on the market. Firms like Getco were 10 percent of the market, and he hadn’t even heard of them. Stock exchanges were paying brokers to access the information of clients as opposed to charging them to make trades.

In order to discover what was causing his trades to be manipulated, Brad organized a small team of programmers to develop an algorithm to identify the issue. Brad and programmer Rob Park hypothesized that the reason trades were being manipulated before they could be executed was due to the fragmentation of the market. In other words, the surplus of stock exchanges received trades at different speeds. Perhaps



someone or something was taking advantage of the delays in the market? Brad and his team set out to develop Thor, which synchronized the times of trades occurring at in different exchanges. It worked. Whatever was causing the manipulation of his trades was happening so fast human eyes couldn't detect it. In the new market regime, money was being made at the expense of those with outdated technology and an outdated mindset. A system based on high frequency trading had emerged.

Vocabulary

profligate, immerse, abstruse, muse, staid, heretofore, virtuosity, hemorrhage, increment



Chapter 3

Summary

Born and raised in Ireland, Ronan Ryan traveled with his family to the United States when he was sixteen. He grew up poor, but his father was determined to buy a home in Greenwich, Connecticut, so that Ronan could attend the local school. He grew to love the excesses of American culture and became enamored with money, finance, and Wall Street. Unsurprisingly, after graduating college, he sought the Wall Street job of his dreams, only to fail on multiple occasions. His first real break came when an Irish acquaintance offered him a position with the telecom company, MCI Communications based in New York City. During his time at MCI Communications, Ronan started to learn about the technology used in finance and the ins-and-outs of Wall Street. He learned things like how a copper circuit conveyed information and which hardware companies produced the fastest computer equipment. Most importantly, he learned how to increase the speed of a digital signal. With his growing skill set, Ronan moved from MCI to other telecom companies such as Qwest Communications, Level 3, and BT Radianz. His chief responsibility was to travel to big Wall Street banks such as Goldman Sachs, Lehman Brothers, and Deutsche Bank to install the latest technological equipment, as well as offer his consultation on improving the fiber-optic signals.

The most important consideration Wall Street companies had when subcontracting Ronan's services was whether he could shrink the latency time of their signal. Latency time is the time between the moment a signal is sent and when it is eventually received. Latency time is determined by three factors: boxes, logic, and lines. The boxes are the machinery the signals pass through from Point X to Point Y. The logic is the software that operates the boxes. The lines are the glass fiber-optic cables that carry the information from one box to another. High frequency traders became obsessed with these three factors and hired Ronan to improve each one. After Ronan moved the computers of a Kansas City company to New Jersey, shrinking trading time from 43 milliseconds to 3.8 milliseconds, his services were in high demand.

Around this time, the Royal Bank of Canada (RBC) contacted him and invited him to interview for a finance job. The interviewer was Brad Katsuyama. Brad was looking for someone to trade stock who was knowledgeable of HFT. Willing to take a pay cut, Ronan accepted Brad's offer and became the "Head of High-Frequency Trading Strategies." One of Ronan's first projects was to improve Thor, the program developed by RBC to battle HFT. Thor worked perfectly in synchronizing smaller trades between a few exchanges. However, for the larger Wall Street investors, Thor was woefully inadequate. Ronan explained to Brad that the reason that Thor was inconsistent in timing was hard wired in the fiber network. Together, Ronan and Brad developed their own fiber optic network and turned Thor into a product that could be sold to investors and start a reformation of the market.



Analysis

As high frequency trading grew in importance in new stock market, the length of cable and proximity to stock exchanges became the priorities of Wall Street companies. A competitive advantage in technological equipment equaled higher profits. Not satisfied with having equipment near a stock exchange, companies were willing to shell out millions of dollars to have equipment housed within the stock exchange. This is the world where Ronan Ryan made his career. Originally a salesman in the telecommunications industry, Ronan came to see the value placed on having a technological background. He delved into fiber optics, electronics, boxes, routers, and software. He concerned himself with topics like engineering, mathematics, and physics. Proximity to Wall Street would be used for co-locating within exchanges to gather financial data as quick as possible: Banks, brokerage firms, proprietary trading firms, and high-frequency trading firms all had a rapacious appetite for speed. They all wanted to trade faster than their competitors. Since Ronan knew how to solve their technological problems, his services became highly sought after. Through Ronan's eyes, the reader has a vantage point of the technological underpinnings of a new market centered on high-frequency trading. The reader sees which data switches or servers increased the signal speed. Ronan even knew which types of glass within the fiber-optic cables would facilitate a better signal. The knowledge Ronan had is exactly what Brad wanted. Brad hired him without question.

This chapter also discusses the “flash crash” of 2010, where the price of certain stocks dropped dramatically, selling for a little as a penny, then rising again to soaring heights – all within a matter of minutes. Although the reason for the crash was unclear, Lewis suspects high-frequency traders may have been behind it due to the speed at which the event occurred. In the new market, trade was done in microseconds. If one didn't have the technological capacity to read transactions at those speeds, they missed the market entirely. The consequence of the flash crash was that investors started to pay Brad and Ronan more attention. Investors wanted to know what high frequency trading was and how they could protect themselves and their customers from it. After the flash crash, Brad and Ronan had a platform from which to educate others about the new market and to sell Thor. Ronan understood that the predator in the market was high frequency trading. Ignoring Ronan and his knowledge made an investor vulnerable.

Vocabulary

enamored, latency, emblazon, keen, condescension, extemporaneous, rudimentary, glad-handing



Chapter 4

Summary

With Thor on the market, Brad and Ronan's stars rose. The two men began to earn reputations as being trustworthy and considerate, which inevitably rubbed off on their employer, RBC. Soon enough, former employees of large Wall Street banks flocked to RBC for jobs. One of those aspiring to work for RBC was John Schwall, a former employee of Banc of America Securities. After Banc of America was absorbed by Merrill Lynch, Schwall was confronted with the ugly side of Wall Street acquisitions. Many of his friends were fired while the corporate executives pocketed millions of dollars in bonuses, showcasing how Wall Street had little corporate loyalty to employees. Brad hired Schwall to be a project manager, a bridge of communication between RBC computer programmers and traders on the Wall Street floor.

Schwall's engrained sense of right and wrong, as well as his obsession over minute details, drove him to investigate HFT. He set out to learn more about it, who was behind it, how it was legal, and how it could hopefully be stopped. Schwall soon discovered the legal foundation of HFT: Regulation National Market System (Reg NMS). The SEC passed this law in 2005, requiring brokers to find the best market prices (SIP) for the investors they represented. Originally designed to combat "front-running" of investments, or manipulation of stock at the investor's expense, Reg NMS had inadvertently created a loophole where HFT could thrive. Seeking out the lowest price for an investor became brokers' primary concern, regardless of the fact that the stock exchange was crawling with high-frequency traders. Even if one requested 100,000 shares of X at \$30.01, the broker must first purchase share X at \$30.00 from another exchange. This made it especially easy for high frequency traders to predict where an investor's next move would be and beat them to a stock.

Meanwhile, Brad began to see even more limitations of Thor. Even though Thor had become popular among investors for safeguarding their trades, RBC continued to be a mid-sized player on Wall Street. The stock market system remained largely intact, and HFT was unabated. In fact, many of the regulators involved in the creation of Reg NMS left their government jobs for lucrative careers in HFT or firms that lobby for its behalf in Washington. It was beginning to appear that HFT was here to stay. Stock exchanges saw no reason to challenge HFT either. Due to the front running of orders performed by HFT, trade in the market place was doubled, creating even more revenue for the exchanges. It appeared to Brad and his colleagues that the only way to combat the menace of HFT was to create their own stock exchange based on transparency and free trade.



Analysis

In Chapter Four, Lewis unpacks high-frequency trading further. In particular, he tells how and why it was sanctioned by the law. In the new stock market, high-frequency traders were buying shares at a lower price and selling them at a higher price faster than the investor could comprehend. In Lewis's eyes, every transaction done by high-frequency traders was "riskless, larcenous, and legal" (Page 122). A man who shared Lewis' outrage was John Schwall. He was hired by Brad and RBC as a project manager, but quickly became Brad's private investigator, aggressively peeling back the secretive world of HFT. Schwall was noted for his engrained sense of right and wrong. When someone was being taken advantage of, he got upset. When Brad revealed Thor to Schwall and explained why it was important for investors to use the program, Schwall became livid. He became obsessed with understanding how such a blatant market injustice came about and how it could possibly be legal. Early into his "investigation," Schwall uncovered Regulation National Market System (Reg NMS), the legal justification for high-frequency trading. Reg NMS was originally designed to protect investments and secure the free flow of capital for productive enterprise. In the past, stockbrokers had the discretion to purchase shares for an investor at any price. Some brokers, however, abused their clients' trust by front-running orders for their personal benefit. In response to this, Reg NMS mandated that stockbrokers purchase shares at the best price throughout the entire market. If an investor wanted to buy 10,000 shares of Microsoft at \$30.01 on the NYSE, the broker must first purchase the 100 available shares from the BATS exchange at \$30. Schwall realized that this market fragmentation, or the mandate of collecting prices from every single exchange, ironically created more of an opportunity for front-running, this time by high-frequency traders. With the power of speed, high-frequency traders could pick up trade from one exchange and use that information to manipulate the price of the same stock in another exchange.

Reg NMS was not the first time regulatory legislation produced a greater financial threat than the issue it was designed to address. Schwall discovered that almost every Wall Street scandal in the past 200 years arose from a loophole found in a regulation. To make matters worse, many of the government officials tasked with creating Reg NMS became high-frequency traders themselves. The problem of HFT permeated every crack and crevice of Wall Street. The market would need more than Thor to combat it.

Vocabulary

collective, equity, upend, animosity, cul-de-sac, ineptitude, discretion, pernicious, infinitesimal, albeit, digression, synonym, abate, quant, stymie, machismo



Chapter 5

Summary

This chapter begins with the story of Sergey Aleynikov, the individual discussed in the introduction. As a Jew, Sergey was often persecuted in his native Russia. He was barred from attending certain universities and could only study what the state allowed. Computer programming was not one of those fields. So, he traveled to the United States in the early nineties to follow his interest. His skill immediately became apparent during his time at Rutgers University where he earned his master's degree, and afterwards, when he worked for the telecom company, IDT. There, he designed computer systems and wrote the code to route millions of phone calls to the cheapest available phone lines. During his time at IDT, a headhunter contacted him and told him that Wall Street demanded people like him. Companies needed programmers to write the code that would parse huge amounts of information at great speed. Goldman Sachs, in particular, wanted to meet him.

The interview process was unconventional. After going through a series of telephone calls, Goldman Sachs gave him a daylong face-to-face interview. Goldman employees set out to stump him intellectually, by giving him tricky brainteasers and puzzles. Another Russian computer programmer, Alexander Davidovich, presented Serge with an unusual question about a three-dimensional room with a spider on the floor and a fly on the ceiling: Serge was asked to calculate the shortest distance the spider could take to reach the fly. He solved the question by transforming the three-dimensional room into two dimensions, and he got the job.

Goldman Sachs sought out Serge's expertise because they weren't making the same "big bucks" as other firms that utilized HFT. Speed was value, and they wanted to improve the speed of their system. Serge recognized that Goldman Sachs had layers and layers of code that was heavily centralized and slow. Every signal had to pass through a central location built on old software. It wasn't only the technology that seemed inefficient to Serge. He felt the culture at Goldman Sachs was highly competitive, possessive, and individualistic. Employees were often kept in the dark about what the bank was up to and how they made their money. Regardless, he set out to improve the system and decrease the time they could transmit (or intercept) trades. He decentralized the network, setting up mini-Goldman hubs within the various stock exchanges, and improved the speed of Goldman's private exchange – their dark pool.

Serge also saw that his relationship to open source, or the free exchange of code and algorithms, would prove disastrous now that Goldman Sachs employed him. Everything that passed through Goldman's servers was now the sole property of Goldman Sachs, even if a code was taken from open source. When Serge was offered a position with a hedge fund where he was given an opportunity to create a new platform rather than patch up an old one, he gladly accepted. Before he left, he mailed himself the source code he had been working on, something that was not uncommon for programmers to



do. After leaving Goldman and while on route to Chicago, he was promptly arrested for “stealing code.” He had no idea how valuable the code was or how it was being used, but he was sentenced to eight years in federal prison after signing a confession.

Analysis

Sergey Aleynikov was a product of the times. Born and raised in the Soviet Union, he was drawn to computer programming at a young age, in part due to the nature of the Soviet economy. Everything was scarce and conditions were horrible; yet, anything could be obtained if one knew how to locate and exploit the government’s many loopholes. Computer programming was a way to traverse the complicated terrain of a planned economy. Energy rationing was commonplace, so Russians learned how to work quickly and efficiently. As a result, many Russians learned computer programming without the luxury of endless computer time. This made Serge an especially talented computer programmer, and he landed on Wall Street at the exact moment his skills would be needed. HFT was becoming an important tool of large banks, stock exchanges, and high-frequency traders to skim profit off of investors. The incomprehensible speeds at which HFT functioned required programmers to write tricky computer algorithms. With his clear talent, Sergey was quickly headhunted to help write code.

In the book, Sergey is depicted as an innocent bystander, who was sucked into the world of HFT and thrown out when he was no longer needed. In a way similar to how HFT took advantage of investors, the passion of a young computer programmer was exploited by Wall Street and Goldman Sachs, in particular, for their benefit. Then, he was harshly when he became independent. As a Goldman Sachs employee, Serge helped design the codes used in the dark pool to rip off investors. Stock would be bought cheaply from an investor and sold at inflated levels to the same individual. For much of this process, Serge was left in the dark. He enjoyed solving technical issues and computer programming, but he didn’t thrive in the dog-eat-dog world of finance. In this regard, Lewis believes Serge cannot be held entirely responsible for the culture of HFT. Yes, he helped create the program, but he had no idea about how it would be used to cheat investors.

Vocabulary

cornucopia, mirage, abet, perverse, amalgamation, proximity, assuage, privy, shrewd, entropy, repository, bewilder, nefarious



Chapter 6

Summary

When Ronan left Ireland, he never looked back. American culture excited him and the Irish, in his opinion, were backwards and outmoded. However, he cherished the time he could spend with his parents and he admired his father's simple honesty. When Brad approached Ronan about starting a new stock exchange based on fairness and transparency, Ronan traveled to Ireland to consult his father. The new exchange they wished to create would be based on fairness. HFT wouldn't be able to gain a foothold because Thor would reroute and slow down orders. Ronan agreed and accepted Brad's proposition. After resigning from the RBC, Brad and Ronan traveled around Wall Street trying to collect capital for their venture. Major investors like T. Rowe Price were intrigued with the idea, but were suspicious of lending out their customers' orders for a third party (the new stock exchange) to execute. Furthermore, investors questioned Brad and Ronan's motives given the whopping \$10 million price tag to jumpstart the project. Investors wondered, "Why are these men so concerned about my well-being?" Morality was not a central tenet of Wall Street. They were confused why Brad wanted to create a new stock exchange for "moral purposes" that had no guarantee of a monetary return.

In addition to financing the stock exchange, Brad and Ronan sought the expertise of software developers, network engineers, operations people, and salesmen. During this headhunting process, Brad met Don Bollerman, a man well regarded for his capacity to handle his emotions during "financial surprises." He oversaw Nasdaq when it became a public trade entity, and he managed how quickly its revenue was derived from HFT. With a bit of capital in their pockets (including Brad's personal savings) and a team of specialists, Brad and Ronan named the new stock exchange IEX, or the investor's exchange. The intent of the stock market is to channel capital to productive enterprise, not to be solved like a puzzle. The design was made with careful precision so as not to be vulnerable to outside "gamers" dedicated to undermining and exploiting IEX's contents.

The programmers, or "Puzzle Masters," as they are called, were tasked with discovering the IEX's vulnerabilities and fixing them to discourage HFT. The Puzzle Masters worked to remove things like "Hide Not Slide" trades from IEX where high-frequency traders would buy stock above the market price in order to receive a rebate and become the first to sell that stock at an inflated price. While the Puzzle Masters worked out IEX's kinks, Ronan helped develop the hardware for the new stock exchange. Brad and his team's mission was to create a uniform signal within IEX so trades could occur simultaneously in other exchanges. Ronan discovered that if he coiled the line, it would effectively create the illusion of distance and increase the latency period for a trade. Fairness did not necessarily depend on speed, but IEX had to be first to see and react to the wider market to protect investments. They would no longer sell the rights to any trader to put his computers next to the exchange. No more kickbacks and no more



unfair advantages. The new stock exchange, IEX, was built to “cut off the food source for all identifiable predators” (Page 176) with the ambitious idea of institutionalizing fairness in the market.

Analysis

After coming to the conclusion that peddling Thor to an investor here or there inadequately addressed the issue of high-frequency trading, Brad and Ronan decided to develop their own stock exchange with Thor as its backbone. The Investors Exchange (IEX) was tasked with the mission of protecting investments from outside manipulation. Although a worthy cause, many investors remained skeptical of Brad and Ronan. The culture of Wall Street was highly competitive, and altruism and idealism were frowned upon. In an interview with Lewis, Brad said, “We had a saying that seemed to appease everyone when they asked why we are doing this...we are long term greedy” (Page 157). Brad also believed that sooner or later, investors would prefer to trade with IEX rather than remain vulnerable to attack if they continued to trade elsewhere. For Brad, HFT was a fact of the new market. Those who ignored it were prey.

It is interesting to note that IEX was not created to entirely eliminate HFT. Rather, it was designed to remove its position of privilege. IEX would not create the surplus of opportunities to profit found in other exchanges, but HFT would still occur in other parts of the market. Trades that occurred in other exchanges and dark pools would still be susceptible to manipulation. In Brad and Ronan’s minds, IEX would serve as an oasis in the proverbial desert of fair trade. Similarly, IEX was not built to outpace the speed of HFT. Lewis notes that, “high frequency traders would always be faster at processing the information they acquired from any exchange” (Page 173). Brad and Ronan acknowledged this. Even if IEX performed one microsecond faster than the quickest trader, there would be no guarantee that their advantage would last. Rather than try to beat HFT at their own game, the foundation of IEX was Thor, which would delay bids and offers by 320 microseconds to ensure uniform and synchronized trade. The new stock exchange would cut off HFT’s food source, and, hopefully, usher in fairness and free trade.

Vocabulary

indefinite, obfuscate, consortium, entreaty, convulsion, expediency, disillusion, embed, taxonomy, precedent, queered, incredulous, conciliator, collusion, stillborn



Chapter 7

Summary

In Chapter 7, the team at IEX obtains another Wall Street type with moral convictions, Zoran Perkov. Through the crisis of 9/11, Zoran realized that he had a knack for maintaining composure in moments of crisis. He also learned that he genuinely cared for the well being of others. He found that he was able to utilize both of these aspects of his character when working as a technologist at IEX. He was given the task of running the exchange. Zoran entered the scene at a period of instability in the marketplace. In 2013, the percentage of U.S. households that participated in the stock market had dipped to 52 percent, a drop of 11 percent from 2010. Wall Street companies were plagued with “technical glitches” that cost them millions of dollars. Stock exchanges were paying to have their fiber-optic lines enlarged for thousands of dollars so they could trade one or two microseconds faster. Meanwhile, Brad and Ronan were out selling their basic commercial strategy to investors: opening a private stock market and converting to a public exchange once their trading volume justified the millions of dollars of regulatory fees. Although elements of IEX mirrored the dark pools of large banks, they published their rules for the sake of transparency.

IEX as the new player in the market rattled a number of Wall Street sabers. Many brokers and banks wanted IEX to disappear. The NYSE offered to buy IEX for hundreds of millions of dollars, while banks would often refuse to send the bulk of their customer's orders to the new exchange. Banks also performed curious trades on IEX. Brad noticed that most of the traffic on IEX was from big banks trading small increments of a share, often only 100 shares at a time. This was likely due to front-running. To illustrate this point: big investors like pension funds would make an investment in say, Proctor and Gamble. The pension fund is acting on behalf of ordinary Americans whose retirement savings are being traded. A broker at Bank of America is tasked with making a profitable trade. Bank of America pings IEX with an order for 100 shares only to see if there is a larger seller. If one exists, they avoid him, thus driving up the price and increasing the chances the trade will take place in their own dark pools. Bank of America then sells high frequency traders the right to exploit orders (retirement savings) inside the dark pool. Even with IEX's mission of increased fairness, large banks were one step ahead, driven to make profit.

On December 19, 2013, the idea of IEX being a small-time player on the stock market changed once and for all. On that day, Wall Street banks, including Goldman Sachs gave IEX an honest shot to execute its customer's orders even though they were given incentives to place the orders in their own dark pool. Ron Morgan and Brian Levine of Goldman Sachs were intrigued by IEX's mission and pushed millions of dollars of stock through IEX. Brad thought if Goldman Sachs saw the value in IEX and the new doctrine of fairness and transparency, perhaps other banks would follow suit.



Analysis

The introduction of IEX to the market was not without flaws. It was attacked by Wall Street institutions and brokers, especially by those who profited from HFT. Most brokers ignored IEX in the hopes of starving it of trade. They refused to route their customer orders to IEX, even if explicitly told to do so: “Wall Street banks were already saying to investors to dissuade them from sending orders to IEX: It’s too slow...They’d even dreamed up a technically-sounding name for the absence of speed: duration risk” (Page 216). Some Wall Street banks were downright aggressive. Malicious rumors were spread about the exchange, one being that IEX was a tool of the Royal Bank of Canada, Brad’s former employer. And in one instance, employees at IEX received threatening calls and text messages. Many of the banks that did trade with IEX did so disingenuously. On the opening day of IEX, they flooded it with small 100-share lots. They used these shares as “bait” in order to tease information out of the market with little risk. “It was as if they wished to appear to be interacting with the entire stock market, while actually they were trying to prevent any trades from happening outside their own dark pools” (Page 223).

Despite the best efforts of brokers and banks to undermine IEX, Brad and his team had the last laugh. Their first quarterly statistics showed that their trades were the biggest in the market. The trading that occurred on IEX was more likely to be at midpoint (fair market value). They were also more random and unlinked to activity elsewhere in the market. But the biggest success occurred on December 19, 2013. On that day, IEX trades rose to 40 million and 92% of the orders traded at midpoint, or their fair market value. Banks like Goldman Sachs provided some of the largest trade traffic, which proved they took IEX seriously. IEX was now a market player and demanded one’s attention: “If Goldman Sachs was willing to acknowledge to investors that this new market was the best chance for fairness and stability, the other banks would be pressured to follow...the harder it would be for the banks to evade this new, fair market” (Page 242).

Vocabulary

bedlam, arbitrary, skittishness, poise, erratic, metaphor, gist, conspicuous, complacency, quixotic, preposterous, overture, obelisk, disingenuous, heuristic, stagnant, myopic



Chapter 8

Summary

In Chapter 8, the reader returns to the trial of Sergey Aleynikov. Things were not going well for him. The new stock market was incredibly complicated. Concepts like HFT made the jurors' eyes glaze over. The prosecution, themselves ignorant of finance in many ways, resorted to cheap emotional tricks to persuade the jury in their favor. Even the so-called expert witnesses had only an introductory level of knowledge of what Sergey actually did while employed at Goldman Sachs. Sergey could only sit back in frustration and watch his chances of escaping jail-time go down the drain. Although Sergey was convinced his act was entirely innocent and part of being a programmer, the disinterested jury was more persuaded by slogans such as "take code and you could go to jail" (Page 247). There was no grey area when it came to stealing, and the prosecution knew this. Sergey was sentenced to eight years in prison.

Lewis argues that the system of justice for people like Sergey is woefully inadequate. Not once was Sergey asked to explain to the jury his duties at Goldman Sachs. Also, he was not asked to try to simplify what he had supposedly done. Unhappy with the result, Lewis conducted his own "trial" with programmers and acquaintances of Sergey. Lewis discovered that many aspects of Sergey's "crime" did not add up. Most importantly, he discovered that Sergey knew almost nothing about how Goldman Sachs made their money because he spent the majority of his time troubleshooting their computer problems. How could he know if a code was valuable if he didn't understand its use? Additionally, Lewis concludes that rather than stealing the code and replicating it for another company, it would have been faster and more efficient for Sergey to simply create new code. Sergey didn't take the strats, something more valuable than the code itself. The code had virtually no value outside of Goldman Sachs. It was old and outdated. It worked imperfectly outside of its original system. Lewis concludes that an innocent man had been locked away in prison.

The consequences of Serge's imprisonment were especially bad. Not only had his reputation been shattered and his life savings extinguished, but his wife divorced him and moved away with his children. As a strict vegetarian, prison food was difficult for Sergey to eat. He ate only beans and rice for months. The only meaningful outside contact he had was with his lawyers. But, Sergey remained curiously optimistic about his new reality: "You begin to realize that your life is not ruled by your ego and ambition and that it can end any day at any time...so why worry?" (Page 259)

Analysis

Sergey has been found guilty of the crime of stealing property from Goldman Sachs and sentenced to eight years in prison. According to Lewis, the trial was a sham. Most of the supposed witnesses used for the prosecution hadn't the slightest idea about what



Sergey had done or why exactly it was a crime. Dissatisfied with the results of the first trial, Lewis conducted his own “trial” with Serge's friends and former colleagues. As supporters of Sergey, they may be personally biased, but objectively, the idea that Sergey stole code from Goldman Sachs with the intent to sell or exploit the market just didn't add up. The most important consideration discussed in the second trial was Sergey's complete ignorance of what Goldman Sachs did to make their money, let alone how his algorithms were specifically used. The culture of Goldman Sachs was incredibly secretive. A computer programmer would certainly be left in dark, and Sergey was no exception. Sergey's peers were also convinced that Sergey didn't take the code for his own financial gain. Although he certainly had the opportunity, he never took the more valuable strats of the code. They concluded that Sergey was simply doing what most other computer programmers did. He was keeping a record of his work for future reflection. In addition, the code he took had no relevance outside of Goldman Sachs' platform. The trial also shed light on Sergey's character. Although these considerations would have been inadmissible in court, Lewis believed it was important to draw a picture of the man himself. Sergey was quiet, unassuming, and passionate about his work. Great wealth did not appeal to him. He preferred solving complex puzzles and building programs from the ground up. Although socially inept at times, he was harmless. He cared for the well being of others. With these aspects, both circumstantial and social, Lewis paints a picture of a man who had been wrongfully accused. Sergey had been pulled into a system for his talent, but rejected and punished for doing what programmers have always done.

The scenes of Sergey in prison are particularly tragic. He has lost everything. His savings are drained, and his reputation has been irrevocably damaged. He is isolated and malnourished. On top of everything else, his wife has left him and taken his children. However, given his enormous challenges, Serge remained touchingly optimistic. Rather than feel overwhelmed with sadness, he chose to focus on the positive aspects of his incarceration. His experience taught him the importance of family and friends. Much later, his children reattach themselves to him: “There was no fear, no panic, no negativity” (Page 258). Simple pleasures such as sunlight and the wind gave him comfort. He even found time to write a memoir about his experiences in prison. For Lewis, Sergey's life represents the silver lining of a stock market warped for the narrow interests of a few. Because the system is unjust, individuals like Sergey emerge as tragic figures revealing something beautiful about the human spirit.

Vocabulary

paucity, abstruse, eunuch, devious, incarceration



Epilogue

Summary

Lewis opens the epilogue with an anecdote of biking through Pennsylvania with women from the local Women's Adventure Club. While biking, the women reminisce about biking years ago when construction workers blocked off areas of the road to install the fiber-optic lines directed to Wall Street. Much of the line had been installed on public land; yet, the women were forced to re-route their bike trip. The line would give high frequency traders a 3-millisecond edge over their competitors. Lewis and the bikers travel along Spread Networks line, along miles of fences and No Trespassing signs. They pass a round barn that has been designed without right angles to prevent mice from invading its dark and protective corners. In much the same way, Brad and his team worked to create a new stock market without corners, where high frequency traders couldn't make profit in the shadows at others' expense.

Lewis then transitions back to Wall Street and the changes taking place there. The event of December 19, 2013, revealed that Wall Street banks may be abandoning HFT after all. They simply cannot compete with the technological advantage of HFT firms. However, the profit-motive is what drives large banks, not moral considerations. The current system will remain intact as long as the actors in it see no reason to change. In addition, the market is digitized and the human element has been reduced: "A day's journey in cyberspace would lead anyone who wished to know it into another incredible but true Wall Street story, of hypocrisy and secrecy and the endless quest by human beings to gain a certain edge in an uncertain world" (Page 271).

Analysis

At the end of Flash Boys, the reader sees the landscape has changed for good. The physical landscape of the Midwestern U.S. is marred with trenches dug up for fiber-optic cables. Giant microwave towers used to amplify the signals sent from Chicago to the East Coast pepper the horizon. Public land has been sectioned off for private use. Lewis also reminds the reader that the economic landscape has also been transformed. High-frequency traders dominate the marketplace, trading at speeds so incredibly fast, investors don't even know what is happening. Banks have created enormous dark pools, or privately traded exchanges, that swallow up investors' trades and feed them to high-frequency traders. That, at least, has been the story for most of Flash Boys.

Some in the marketplace have reacted to this new injustice, and worked to stop it. People like Brad Katsuyama and Ronan Ryan have used their technological, social, and economic expertise to create a new stock exchange that weakens the hold of HFT. As a result of IEX, the market has reacted in positive ways. Large banks are starting to see the futility of competing with high-frequency traders. Due to their small size and independence, they will always have a technological edge. Wall Street banks are also



starting to see the value of IEX, as illustrated by the events of December 19, 2013. In the book's final chapter, Lewis acknowledges that the problems associated with the new stock market are vast. Nonetheless, *Flash Boys* is a story of incredible courage and hope, even in an environment that punishes those who don't put profit first. Despite Wall Street's culture of conformity, there are still some willing to stand up and fight for change. Figures like Sergey remain optimistic even while entrenched in hopeless circumstances: "A day's journey in cyberspace would lead anyone who wished to know it into another incredible but true Wall Street story, of hypocrisy and secrecy and the endless quest by human beings to gain a certain edge in an uncertain world" (Page 271).

Vocabulary

enterprise, modernity, aggregate, ancillary



Important People

Brad Katsuyama

Brad Katsuyama is the first to recognize the problems associated with HFT and the man who led the charge in reforming the market. Brad is an unusual character because he is a product of Wall Street who has retained his moral principles. Wall Street culture is highly competitive. When an opportunity to profit arises, one learns to simply embrace the opportunity without moral consideration. For Wall Street, the opportunity provided by HFT is no different. This latest technology has equipped traders with the ability to intercept an investment with legal justification. Brad, however, can't escape the injustice perpetrated by this new system, and he works to change it. Lewis claims that even though Brad has devoted his career to dismantling market inequalities, he is no radical. Brad prefers just to be part of the team and not to stand out. This is perhaps the greatest mystery of Brad's character. Throughout *Flash Boys*, Lewis never makes it clear what drives Brad to confront the market, other than his pursuit of fairness. Brad is simply at the right place at the right time. Brad feels compelled to act out against the inequities of HFT simply based on the fact that no one else would. Brad is also a gifted stock market expert. He understands the stock market completely, can unpack complicated press releases, comprehend the mechanisms of HFT, and can even build a new stock exchange from the ground up. However, even though his skills would earn him a great fortune, he prefers to take on his moral crusade, educating investors on the risks of HFT and reforming a financial system plagued with corruption.

Sergey Aleynikov

Sergey Aleynikov is the former computer programmer for Goldman Sachs who was later convicted in 2009 of stealing their computer code. Sergey emigrated from his native Russia in search of opportunities in computer programming. After working in the telecommunication industry, he landed a job at Goldman Sachs as a computer programmer. It was his responsibility not only to fix the lags in Goldman's signal, but also to develop the complex algorithms used for HFT. Even though he was paid handsomely for his work, he lived a relatively modest life. He came home from work every day. His wife prepared a vegetarian meal for the two of them. He was never drawn into the excess of Wall Street, but simply enjoyed unpacking large-scale complex puzzles, which Wall Street provided for him in spades. He was a true computer programmer at heart who delighted in sharing information with his fellow programmers. The moment Serge copied the code of Goldman to his personal computer, he sealed his fate. He was eventually convicted of stealing Goldman Sachs' code – even though it was a code that Sergey wrote himself – and was sentenced to eight years in prison. In the book's introduction, Lewis remarks that Sergey's case is what propelled him to write. He found it unusual that only one man was being prosecuted from Goldman Sachs and that the man didn't even play a role in the 2008 financial crisis. The injustice of Sergey's



prosecution and incarceration pushed Lewis into a deeper exploration of the stock market where he later discovered the dark and secretive world of HFT.

Ronan Ryan

Ronan Ryan is the gifted technologist hired by the Royal Bank of Canada as an HFT. Ronan is an Irish immigrant who wholly abandoned his past to embrace American culture and the excesses of Wall Street. He is described as having pale skin, narrow shoulders, and an “uneasy caution.” His career began in the telecommunications industry. Later, he moved into consultant work. He collaborated with large Wall Street institutions, such as banks and exchanges, on how to improve the fiber-optic networks that would later be used for HFT. After his reputation grew, he was contacted by RBC and asked to interview for a trading position. He gladly accepted and built a close relationship with Brad Katsuyama. They collaborated on Thor and later built the stock exchange IEX in order to combat HFT. The reason Ronan worked against the system that could have brought him great financial gain is even less clear than Brad’s motivation. Lewis suggests that Ronan fought alongside Brad out of loyalty, friendship, and mutual dedication. Ronan wanted his life to be significant, and he saw his work at IEX as a vehicle to those means.

John Schwall

John Schwall is a talented programmer first picked up by the RBC as a project manager. It is his responsibility to build communication between the often socially awkward computer programmers and the traders on the stock market floor. Schwall is described as a “good soldier.” He is someone who lives by simple, moral platitudes and fervently believes in right and wrong. As a former employee of Bank of America, he oversaw the treatment of the bank’s employees during the financial crisis of 2008. Many lost their jobs while the corporate executives made millions in bonuses. He was attracted to the idea of a stock market based on fairness, and he worked wholeheartedly to build Thor and the IEX. His obsession with details led him into numerous private investigations, one of which was discovering the legal basis for HFT.

Dan Spivey

Dan Spivey is an executive of Spread Networks, a company dedicated to building the fastest fiber-optic lines available for lease. He is described as both an opportunist and a worrier. He quickly noticed an opportunity in the market. Wall Street corporations would fork over millions of dollars for a technological advantage over their competitors. But, he often worried that others had already filled the market. He worried that if he couldn’t find the shortest distance between two cities, someone else would and drive him out of the market.



Don Bollerman

Don Bollerman is hired by Brad and Ronan as they start their new stock exchange venture. Don was shaped by the events of September 11. On that day he worked near the World Trade Center for a small electronic stock exchange. He felt the explosion of the towers. He earned a reputation as someone who managed his emotions well during times of crisis, something which Brad desired in an employee working for the start-up exchange. Don was also extremely knowledgeable of the ins-and-outs of stock exchanges. He witnessed how Nasdaq went from being a small-time stock market player to one that collected two-thirds of its revenue from HFT. According to Brad, Don also contained a "fine moral sentiment."

Dan Aisen (Puz)

Dan Aisen (Puz) is one of the computer programmers for IEX hired by Brad Katsuyama to prevent the new stock exchange from being "gamed," or exploited by outsiders. He is extremely intelligent, winning the "Microsoft College Puzzle Challenge" in which thousands of teams of the best and brightest mathematics and computer programming students compete. He has a peculiar talent for solving puzzles. As an employee for IEX, he was tasked with locating network vulnerabilities in order to remove them. His main goal was to make the puzzle of IEX unsolvable from the outside.

Michael McSwain

Michael McSwain is the FBI agent in charge of the case against Sergey Aleynikov. As a former trader, McSwain was dumped from Wall Street as computers (and computer programmers) replaced his position. He resented Sergey and did everything in his power to put him behind bars. McSwain's investigation was marred with problems. He never sought out expert advice on how Serge broke the law. He simply took the story from Goldman Sachs employees at face value. Despite his insufficient evidence, McSwain managed to coax a confession out of Sergey, sealing his fate behind bars.



Objects/Places

High Frequency Trading (HFT)

High Frequency Trading (HFT) is the practice of intercepting a stock market trade and manipulating the share price to make a profit before an investor can react. Lewis uses the fictitious “Scalpers Inc.” to illustrate the phenomenon. Every time an investor wants to buy 1,000 shares from company X, Scalpers Inc. is immediately informed and buys 1,000 shares. Without taking the risk of owning the stock, Scalpers Inc. sells the 1,000 shares to the initially interested investor at a higher price. HFT preys on the slow speed of investors. If trades are conducted in multiple exchanges for a given stock, high-frequency traders pick up the faster signals and manipulate the slower ones. HFT is also the reason Wall Street companies scramble to find the latest equipment and fastest routes to stock exchanges. Value is measured in microseconds. A computer algorithm reacts, not a human. Even though HFT cheats investors, it is sanctioned by the law. Brokers are constrained by law to route their investor’s stock to the cheapest price. When price is the sole determinant of where a trade will happen, high-frequency traders know when to strike. HFT is also the primary reason characters like Brad Katsuyama and Ronan Ryan demanded a change of the marketplace. The stock exchange, IEX, is created not to eliminate the threat of HFT, but to diminish its power. HFT trades for the sole purpose of interfering with trading that would have happened without it. In essence, it is a tax on trade and upsets the free and fair marketplace.

Fiber Optic Cables

Fiber Optic Cables are the technology used to transmit computer signals between cities at light speed. Simply referred to as “lines” throughout *Flash Boys*, this technology is the backbone of HFT. The lines are made of glass, span hundreds of miles across the country, and connect various companies to stock exchanges. The shorter the line is, the faster the signal. When the lines must travel great distances, amplifiers are placed on route to maintain the strength of a diminishing signal. Dan Spivey, and his company Spread Networks made their fortunes off the construction of continental fiber optic lines that delivered signals to Wall Street.

Investors Exchange (IEX)

Investors Exchange (IEX) is the stock exchange developed by Brad Katsuyama, Ronan Ryan, and a host of others who were dedicated to the idea of creating a fairer marketplace. It is based on the ambitious goal of “institutionalizing fairness.” Investors who trade through IEX can enjoy a middle price unaltered by the schemes of high-frequency traders. An investor’s order is distributed evenly through various exchanges at the same time, which eliminates the possibility of front-running. The rules are transparent. At first, Wall Street was deeply threatened by the existence of IEX.



Malicious rumors were spread about Brad and his intentions with IEX. The exchange was either ignored or picked apart by high-frequency traders. However, due to growing calls for market reformation, IEX grew to become one of the most influential stock exchanges on Wall Street.

The Better Alternative Trading System (BATS)

The Better Alternative Trading System (BATS) is a stock exchange located in Weehawken, New Jersey. It accounts for 12% of the equity trade in the United States. BATS was essentially developed by HFT firms to lure investors into trades that could easily be manipulated. Traditionally, brokers would be charged to participate in an exchange, but BATS pays brokers to exchange through their system. In doing so, BATS entices brokers to reveal their customers' intentions so they can be exploited elsewhere.

Thor

Thor is the software program developed by Allen Park and Brad Katsuyama in response to the inequalities created in the marketplace by high frequency trading. If an investor trades multiple stocks in multiple exchanges, Thor slows down the faster signals to synchronize every trade. In doing so, high frequenting traders are unable to pick up an offer (or bid) made with a faster signal. The price of the slower trade cannot be manipulated.

Dark Pools

Dark Pools are privately traded stock exchanges, or alternative trading systems, often offered by banks or large corporations. Trading in a dark pool can be riskier because information is only made available to the host. For this reason, dark pools are favorites of high-frequency traders. Investors place their money in a dark pool in the hopes of alerting others that a big-seller has entered the market, only to have it ravaged by HFT.

Regulation National Market System (Reg NMS)

Regulation National Market System (Reg NMS) is a financial regulation statute passed by the Security Exchange Commission (SEC) in 2005. However, it was not implemented until 2007. It was intended to create equality of opportunity in the U.S. stock market. Instead, it inadvertently marched investor orders into traps set by high frequency traders. The primary goal of Reg NMS was to eliminate the front-running of investments by coercing brokers to locate the most favorable price in a trade. As a result, high-frequency traders built an entire industry on predicting with tremendous accuracy where a broker would buy or sell. Oddly enough, many of the officials who wrote the language for Reg NMS left their government jobs to pursue lucrative careers in HFT.



Goldman Sachs

Goldman Sachs is a large investment bank on Wall Street and the former employer of Sergey Aleynikov. In the new universe of HFT, Goldman Sachs was described as outdated. They wanted the profits made from HFT, but their technology was too slow. As a result they put enormous energy into installing fiber-optic lines. They hired the brightest computer programmers to design their algorithms. The culture of Goldman Sachs is described as highly competitive, individualistic, and secretive. Goldman Sachs is also used to illustrate the irony of Wall Street justice. While the bank can get away with their involvement in the financial crisis of 2008, Sergey, a lowly computer programmer was slammed with an eight-year prison sentence. The behavior of Goldman Sachs is not all bad, however. At the end of the book, Goldman is one of the leading supporters of IEX, funneling millions of shares through the exchange and propping it up as a major player in the new marketplace.

Hide Not Slide

Hide Not Slide is the term ascribed to a financial transaction used by high-frequency traders whereby a stock is sold at an inflated price in order to receive a rebate. Sometimes referred to as “rebate arbitrage,” a high-frequency trader buys a stock higher than the market price, sells it to an investor, and collects the rebate provided by the exchange.

The Royal Bank of Canada (RBC)

The Royal Bank of Canada (RBC) is the former employer of both Brad Katsuyama and Ronan Ryan, and the first Wall Street institution to utilize Thor in their transactions. The RBC always stood out as a fair player on Wall Street. An inherently cautious bank, it never squandered its clients' money. As a consequence, the RBC only constituted 2% of the stock market. The employees of RBC are described as “RBC-nice,” mild-mannered, and sincere. However, Brad notes that the executives of the bank, based in Toronto, are simply out of touch from what is actually happening on Wall Street, saying, “They don't have the slightest idea of the ins and outs of Wall Street.”

Themes

Injustice

With his exposition of high frequency trading, Lewis sets out to shatter the lie that the stock market is fair. Lewis brings attention to the injustice perpetrated against unknowing investors by the greed of large Wall Street banks, stock market exchanges, and high frequency traders themselves. Unlike some of the characters he profiles, Lewis is not concerned with the economic ramification caused by HFT. Rather, he is outraged that this activity exists and that the general public doesn't know about it. Investors blindly put their money into the stock market only to have portions of it siphoned off by high frequency traders. To make matters worse, the system that continually rips off investors has legal backing, which Lewis finds particularly unjust. The Regulation National Market System (Reg NMS) of 2007 demanded that stockbrokers seek out the best price for their clients, but it opened the door for high frequency traders to exploit them.

Injustice is also seen in the trial and conviction of computer programmer Sergey Aleynikov. Sergey was essentially innocent of the crime for which he was accused because his confession was coerced by an overzealous detective. Nevertheless, he was locked away in prison for eight years while his employer, Goldman Sachs, got away with their own crimes. Goldman Sachs, who pushed aggressively for Sergey's conviction, were themselves guilty of falsifying documents related to Greece's debt and of knowingly preparing toxic sub-prime mortgage packages to be sold for profit. Yet, they were never tried for these crimes. It appears that wherever one turns on Wall Street, the big guy gobbles up the little guy. Virtue always loses to vice.

In addition to the injustice perpetrated by HFT, Lewis curiously mentions the injustice of the September 11, 2001, attacks throughout Flash Boys. September 11 restructured companies, traumatized and molded people like Don Bollerman and John Schwall, and transformed the culture of Wall Street. Companies like BT Radianz, a telecommunication company that Ronan Ryan worked for, was founded on the mission of making Wall Street communications less vulnerable to outside attack. Many people lost their lives in such a violent fashion on September 11. Lewis utilizes this injustice as a parallel to the menace posed by high-frequency traders.

For Lewis, the concept of injustice is not independent of morality. The two are very much intertwined. Morality establishes the boundaries between right and wrong. If that boundary is crossed, it feels unjust. Despite the seemingly innate injustice of Wall Street, Brad and his team have somehow preserved a moral sense even when not given an incentive to do so. A moral conviction drove them away from their lucrative careers to enter the risky environment of challenging Wall Street banks and high-frequency traders. John Schwall notes that HFT "really pissed me off...that people set out this way to make money from everyone else's retirement account. I became hell-bent on figuring out who was doing the screwing" (Page 95).



Puzzles

The codes, high frequency trading, investments, and arbitrage of the stock market interconnect in the form of a puzzle. Although highly complicated, each component of the new market plays off the next to produce recognizable patterns. As the pieces of the puzzle shift, opportunities arise and disappear. Tremendous profit awaits those who recognize a pattern and use it to their advantage. Those kept in the dark or who fail to notice these patterns inevitably lose. In this regard, high frequency traders approached the stock market as a gigantic puzzle that could be solved and exploited for profit. Reg NMS had created a legal loophole that forced brokers to trade at the lowest price. Given this information, high-frequency traders knew where to look for investments, which enabled them to predict the broker's next move. Banks hired out the expertise of computer programmers to churn out algorithms identifying exploitable patterns. Unbeknownst to investors who believed the market was fair (and in a way “unsolvable”), high-frequency traders intercepted trades and manipulated prices.

The theme of puzzles also comes into play with the creation of the Investors Exchange (IEX). One of Brad's chief considerations was that the exchange be impervious to gaming attacks. In order to achieve this, Brad sought out Dan Aisen or “Puz” as he was referred to by colleagues. Puz grew to relative prominence for winning the “Microsoft College Puzzle Competition.” He had proven time and again, that he could solve the most challenging puzzles. As an IEX employee, he was tasked with locating the new exchange's vulnerabilities. Essentially, he “solved” the IEX puzzle with the intention of building protection against future attacks. In Puz's mind, he needed to solve the puzzle before someone with malicious intent did. IEX is the product of men like Brad who believed the stock market puzzle needn't be for nefarious means. Even though vulnerabilities exist in the stock market, IEX argues that it is possible for the stock market to be fair. Like Puz did for IEX, those wishing to change the stock market must be first at solving its puzzles and refashioning the system in such a way that protects investments and facilitates free trade.

Competition

The book's setting, Wall Street, is constructed entirely on capitalist competition. Outpacing and outthinking one's competitor is what guarantees profit. Competition permeates nearly every transaction, hiring process, and conversation. The dollar is king on Wall Street. There are identifiable winners and losers. Those who are not competitive, lose. In particular, high-frequency traders illustrate the theme of competition. The technology needed for HFT must always be the best. Expensive servers, boxes, and fiber-optic lines are bought with the hope of creating a fast signal, only to be dumped for something better months later. Projects that cost millions of dollars must be undertaken so microseconds can be shaved off signal speeds. The moment a bank's competitor gains an edge in speed, the bank has lost the opportunity to profit. Competition is what drives high-frequency traders to find loopholes in the system and exploit investors for a profit. The new stock market based on HFT is also



remarkable for its complete absence of free competition. As long as financial transactions are being manipulated, the system is rigged. Due to the technological advantage of high frequency trading firms that specialize in generating profit off other trades, an investor will never be able to beat them. The incomprehensible speeds at which high-frequency trading functions removes the ability for an investor to notice what has happened to their trade, thus removing the competition. Regardless of what knowledge an investor has about a particular stock, high-frequency traders will act on it first, and they will be the one to benefit. The mission of IEX is to combat this rigged system and restore competition to the market.

Styles

Structure

In the Introduction of *Flash Boys*, Lewis lays out his rationale for writing the book. Foremost was his desire to educate the reader on what he believes are incredibly complex financial, legal, and business concepts. He notes that he is not necessarily interested in the stock market. However, he felt compelled to write about HFT. To Lewis, it is unfair that ordinary Americans have lost their jobs, businesses, or retirement savings to an incomprehensible financial system. Therefore, Lewis takes great care to whittle down terms like dark pools, arbitrage, and fiber-optics into something understandable. Lewis targets the secretive and complex world of high-frequency trading. In a way, Lewis sees himself as somewhat of a lone hero, bravely traversing the dark passages of Wall Street, revealing to the reader that the system is rigged by design. Lewis leaves little room for dissent. In his mind, and in the book's message, the system is clearly broken: "[HFT] was like a broken slot machine in a casino that pays off every time. It would keep paying off until someone said something about it; but no one who played the slot machine had any interest in pointing out that it was broken" (Page 233). A few alternative voices do appear. Some on Wall Street argue that transparency hinders investors from entering the market and HFT facilitates additional trade. This opinion, however, is drowned out by the multitude of unhappy investors who have been cheated out of making a profit from a fair trade.

Because HFT is a clandestine activity and at the time of the book's construction, rarely discussed publicly, Lewis relied heavily on information gleaned from Wall Street insiders. Little outside published research has been done on the topic, and in this respect, Lewis acts more like a journalist than an academic, exposing the world to a secretive and precarious activity. He is drawn to Brad, Ronan, and Sergey, and uses their stories to help explain how the new market functions: Brad and Ronan are confronted with the problem and work to solve it. Sergey is involved in the problem and is destroyed by it. The minor characters are personalities that remind readers that even though Wall Street can be systematically unjust, it is comprised of human beings. Wall Street is a construction of the human imagination and can therefore be changed.

Flash Boys is divided into seven main chapters. An introduction that discusses the author's motivation for writing about HFT and an epilogue make up the book's remaining sections. Rather than functioning as an argumentative essay, *Flash Boys* reads like a novel that is complete with dynamic characters and a story arc. The first three chapters establish what the new market is and introduce the book's main characters, Brad Katsuyama and Ronan Ryan. The reader sees Dan Spivey scramble to construct fiber-optic lines in the middle of an obscure, rural American town. The reader sees Brad flabbergasted at the loss of his client's money when he was confident of gain. The reader sees Ronan swept up into an industry he does not fully understand but that pays him handsomely for his services. In Chapter 4, the reader delves into the world of high-frequency traders, how they make their money, and their legal basis in



doing so. Chapters 5 and 8 cover the tragic irony of Sergey Aleynikov: how he assisted high-frequency traders steal millions of dollars from investors, and how he was sent to prison time for a fabricated crime. The remaining chapters cover Brad and Ronan's work as they developed a new stock exchange, IEX, in order to reform the marketplace.

Perspective

Tone

Quotes

The financial markets were changing in ways even professionals did not fully understand. Their new ability to move at computer, rather than human, speed had given rise to a new class of Wall Street traders, engaged in new kinds of trading.

The line was more valuable the fewer people that had access to it. The whole point of the line was to create inside the public markets a private space, accessible only to those willing to pay tens of millions of dollars in entry fees.

It happens on such a granular level that even if you tried to line it up and figure it out you wouldn't be able to do it. People are getting screwed because they can't imagine a microsecond.

The U.S. stock market was now a class system, rooted in speed, of haves and have-nots... The haves enjoyed a perfect view of the market; the have-nots never saw the market at all.

The HFT guys didn't need perfect information to make riskless profits; they only needed to skew the odds systematically in their favor.

How was it legal for a handful of insiders to operate at faster speeds than the rest of the market and, in effect, steal from investors?

The programming types were different from the trader types. [Trader types] knew their worth in the marketplace down to the last penny. They understood the connection between what they did and how much money was made, and they were good at exaggerating the importance of the link.

[RBC] did have a goal: to restore fairness to the U.S. stock market – for the first time in Wall Street history, perhaps, to institutionalize fairness.

By the summer of 2013, the world's financial markets were designed to maximize the number of collisions between ordinary investors and high-frequency traders – at the expense of ordinary investors, and for the benefit of high-frequency traders, exchanges, Wall Street banks, and online brokerage firms. Around those collisions an entire ecosystem had arisen.

Now [Brad] explained just how badly the market wanted to remain in the shadows – and just how badly the people at the heart of it wanted IEX to fail. Even before IEX opened, brokers from big Wall Street banks went to work trying to undermine them.

[Brad] attacked the newly automated financial system at its core: the money it made from its incomprehensibility.

If Goldman Sachs was willing to acknowledge to investors that this new market was the best chance for fairness and stability, the other banks would be pressured to follow.



Topics for Discussion

Topic for Discussion 1

On page 157, Lewis notes that Brad felt compelled to combat high-frequency trading: “He’d come to see that if he didn’t do it, no one else would.” Why do you think Brad was driven to create a new stock exchange? What arguments does Brad make to convince investors that his concern is genuine? How do his motivations compare / contrast to Ronan’s? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 2

Do you think it’s possible for HTF to ever be eradicated? Why or why not? Do moral exchanges like IEX do enough to change the way stocks are traded? Or, is the United States still at risk for another economic crash? How can you tell? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 3

Michael Lewis claims that he set out to write *Flash Boys* with the intent of educating Americans about the dark world of HTF. He hoped to break down the stock market into an easily understood system that the average reader could understand. Do you think Lewis accomplished his goal? What did this book most teach you about the stock exchange? Is anything about the stock exchange still confusing? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 4

The Regulation National Market System (Reg NMS) is a law created to abolish the front running of investments. Yet, the law inadvertently opened the door for more pernicious cheating in the stock market. How can it be that legislation that was designed to fix a problem in the market produced a larger problem? Who should be blamed for this injustice? Are there any other laws passed in U.S. history that mirror what happened with Reg NMS? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 5

In the book’s epilogue, Lewis mentions that banks like Goldman Sachs are beginning to understand that their trades will always be outpaced by HFT. What effect will this have on their business? By explaining the relationship between Wall Street banks and HFT,



describe what will happen to banks like Goldman Sachs if they fail to heed Brad's warning. Be sure to include examples from the text to help support your arguments.

Topic for Discussion 6

Given that Regulation National Market System (Reg NMS) produced such disastrous results (as illustrated by the emergence of HFT and the complete unraveling of fair exchange), do you believe that government regulations are the answer to address problems in the market? If so, what legislation should be considered? If not, what is an alternative solution? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 7

Wall Street culture is based on profit, not moral considerations. This makes the behavior of the characters in *Flash Boys* and their objective to create fairness in the marketplace all the more unusual. Choose at least three characters who are described as "moral" in the book and describe how they confront the problem of high-frequency trading. Of the three, which do you think tackles the issue best? Why?

Topic for Discussion 8

In the second "trial" of Sergey Aleynikov conducted after his conviction, Lewis comes to the conclusion that even though Sergey took the Goldman Sachs computer code, he had no malicious intent. What are the reasons Lewis gives to support his decision of Sergey's innocence? Do you agree with Lewis that Sergey was wrongly imprisoned? Why or why not? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 9

The new stock exchange developed by Brad Katsuyama and the team at IEX set out to create a fairer trading environment. What specific changes did they feel were most important to incorporate in the new exchange? Why were so many Wall Street companies aggressive toward these changes? How did they ultimately succeed? Be sure to include examples from the text to help support your arguments.

Topic for Discussion 10

Author Michael Lewis never goes into detail about why he named his book *Flash Boys*. Also, no group in the book is ever referred to by that name. Whom do you think Lewis had in mind when naming his book? Do you think it is an appropriate title? Why or why not? Be sure to include examples from the text to help support your arguments.