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Changes of financial system in the context of financial crisis

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Declaration of Authorship

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Abstract

In this paper, we analyse the relation between financial system and financial crises. Our goal is to find how, on the one hand, changes in the financial system affect the prospects for financial crises and, on the other hand, how the occurrence of financial crises shape the core elements of the financial system. We start by defining the financial crisis from three different perspectives. After it, we present the comprehensive history of financial crises that will allow us to continue by drawing some common patterns that are universal. Universal patterns in crises give us the ground for contemplating on some universal policy responses where we again follow different approaches.

Taking into account the specifics of modern times and using the young and promising economy based on the blockchain, we are asking the question “is this time different?”. Analysis of initial development steps in the digital, trustless world gives us the basis for drawing parallels with the reality and the history.

Our results suggest that there are many similarities throughout history and between the real and digital world. Instead of providing an exact answer on the question “is this time different” we conclude that there is a present strong feeling of *Déjà vu*.

Keywords

Financial crisis, Financial system, Blockchain, Ethereum, Smart contracts

Definition of financial crisis

While having an opportunity to read and often hear about financial crises, economic literature is not unison with defining the term financial crises. It is clear that it is about some disturbance that hurts our well-being but the universal definition is not laid down yet.

One of the possible standpoints is the **monetarist approach**. Monetarists (beginning with Friedman and Schwartz 1963) associate financial crisis with bank runs which occur when a large number of customers withdraw or want to withdraw their deposit simultaneously because they are concerned about the bank's solvency. The importance of that mechanism is underlined as being perceived a primary source of contractions in the money supply with resulting contraction in economic activities.

Monetarists do not see economic events with a sharp drop in wealth but without a potential for bank runs (and latter sharp decline) as real financial crises that require any central bank interventions. They call these real economy events "pseudo financial crises" (Mishkin F. S., 1991) and in their opinion, any intervention of the Central Bank is unnecessary or even harmful because it can decrease the economic efficiency by bailing out companies that should otherwise fail and it can result in the increase of the inflation rate arising from the money growth. The only involvement of the Central Bank that they propagate is the role of the "lender of last resort", meaning a form of a bailout for financial institutions, especially banks to prevent the bank runs. Monetarists approach is regarded as a bit too narrow, focusing only on bank runs and their effect on the money supply.

Pretty much opposite view is more in line with traditional economists, and it was proposed by **Hyman Minsky** (often considered by monetary theorists as too pessimistic and gloomy for his

insisting on the fragility of the financial system and its tendency for disaster). Minsky was growing up during the Great Depression, and he wanted to understand why financial crises are occurring over and over again. In his model, he highlighted that pro-cyclical increase in the credit supply in good times and decline during downturns make investors overreact, thus enhancing the likelihood of the financial crises. Most of the times when everything looks good, lenders are often keen to offer cheap money, and it is an invite for investors to forget about being savvy and increase the demand for risky assets.

In 1992, Minsky wrote his "Financial Instability Hypothesis," describing three stages in the economy based on the degree of leverage employed: hedge financing, speculative financing, and Ponzi financing. Hedge financing is the safest, companies rely on their future cash flows to repay all their borrowings. Speculative is riskier, in a manner that they still rely on their cash flows to repay the interest on the loans but must roll over the debt to repay the principal. Ponzi financing is the most dangerous. In this case, cash flows cover neither principal nor interest. Companies are expecting that underlying assets will appreciate and cover their liabilities. If that fails to happen, like in the case of any downside pressure in the economy, they are left exposed to the crash.

This is an excerpt from the defining whitepaper:

The first theorem of the financial instability hypothesis is that the economy has financing regimes under which it is stable and financing regimes in which it is unstable. The second theorem of the financial instability hypothesis is that over periods of prolonged prosperity, the economy transits from financial relations that make for a stable system to financial relations that make for an unstable system. In particular, over a protracted period of good times, capitalist economies tend to move from a financial structure dominated by hedge

finance units to a structure in which there is large weight to units engaged in speculative and Ponzi finance.

Furthermore, if an economy with a sizeable body of speculative financial units is in an inflationary state, and the authorities attempt to exorcise inflation by monetary constraint, then speculative units will become Ponzi units and the net worth of previously Ponzi units will quickly evaporate. Consequently, units with cash flow shortfalls will be forced to try to make position by selling out position. This is likely to lead to a collapse of asset values (Minsky, 1992).

Minsky's view was propagated by Kindleberger as well (Kindleberger, 2005), and they have a much broader definition of what is a financial crisis than monetarists. They argue that financial crises could come in the form of either sharp decline in asset prices, failures of large companies, deflations or disinflations, disruption in foreign exchange markets or a combination of these factors. Because any of these market disturbances can lead to potentially dangerous consequences, they propose a broader role for the intervention. The main concern with this approach is that there is no strict and precise definition of the financial crisis and that was the main target of the critics.

Monetarists, as usual on the side on liberalisation, claim that Minsky-Kindleberger broad definition is only used as a justification for various types of government interventions that are not beneficial for the economy in long-term because they distort normal market forces and kill productivity.

There is a third approach, based on the ideas of **asymmetric information** theory that provides a definition of the financial crisis that is broad enough while giving us the theory that does not justify every government intervention in the case of the sharp drop in wealth. The asymmetric information literature which looks at the impact of financial structure on economic activity

focuses on the differences in information available to different parties in a financial contract. (Mishkin F. S., 1991).

When we apply the asymmetric information theory to the financial sector, we have several different occurrences. In the debt market, a lemons problem occurs when lenders have trouble assessing if a borrower has a good (low-risk good business ideas) or bad risk (highly dangerous bad investment ideas). Because the lender cannot make this assessment, the result is the increase in the interest rate that fits the average risk. As another level of development, because good risk borrowers do not want to pay higher interest rates, they are going out of that market thus further increasing the perceived average risk of the market and further increasing the interest rates. The main issue here is that the market lost an important opportunity to facilitate high-quality investment projects and therefore has a substantial effect on the overall market performance.

The second occurrence of the lemons problem is when lenders are averse to lending because at the higher levels of interest rates only borrowers with high-risk projects are keen to ask for loans. This leads to the situation when lenders are trying to stay in the safe zone and decrease the number of loans approved. On a macro level, this can result in a significant drop in the number of loans¹, as presented in the model of credit rationing (Stiglitz & Weiss, 1981). Furthermore, in his work, Greg Mankiw demonstrated that a small rise in the riskless interest rate could lead to a substantial decrease in lending and possibly even a collapse in the market (Mishkin F. S., 1991). The information asymmetry is even higher in cases when the lender is

¹ This phenomenon is easily observable in the case of Eurozone these days.

not the bank because banks have much better information basis and possibility to perceive the risk than the rest of the lenders market.

The level of influence of the asymmetric information on the debt market can be easily understood by observing the corporate bond markets. High-quality issuers are usually clients that give the best information about their business, keeping the information asymmetry at a minimum. Therefore the influence is minimised, and the interest rate they can obtain in the market is relatively low. On the other hand, if the issuer cannot provide sound information basis to the bond market at the time of issuance, keeping the information asymmetry high, they will be able to issue bonds only with the relatively high-interest rate. Measuring the spread between high and low-quality bonds can provide information on when the adverse selection problems become more severe in the debt market. The same goes for the equity market and IPO's. The lower the information asymmetry, the lower the cost of capital.

An important concept for the debt market is collateral. By transferring risk from the borrower's risk profile to the asset in the collateral, adverse effects of the information asymmetry are reduced, but another problem arise. Namely, both lender and borrower are less restrained and thus keener to engage in the transaction, and that increases space for risk.

A similar mechanism of deposit insurance was introduced during the Great Depression in the 1930s, and now represents a standard tool on a global scale. In this case government directly or more often via specially designed fund makes a guarantee on some level of savings. While well-intended, this concept is responsible for the particular problem of **moral hazard** and stimulates risk incentives, especially because the guaranteed amounts are now much higher than average yearly salary. By using and expecting that savings are insured and covered,

investors are not assessing risk properly anymore, but rather chose their deposit banks based on the level of interest rate/yield offered. Moral hazard, in this case, comes from the expectation that someone else will pay for the possible adverse outcome of the investment. One of the recent examples was the Iceland/UK conflict later named Icesave. Icesave was a branch of Icelandic bank Landsbanki that offered British and Dutch clients higher interest rates on deposits. Relaxed by the expectations of deposit insurance, some 400,000 British and Dutch savers opted for Icesave instead of local, stronger and bigger banks. After Landsbanki had gone into receivership, the total amount of €4 billion was left uncovered (Gylfason, 2014).

There is a moral hazard issue also coming from the asymmetry of information between lenders and borrowers. Namely, because it is hard for lenders to properly assess the quality of the investment projects that borrowers want to start, the borrower has the incentive to engage in activities that could be beneficial for them personally but increase the probability of the default which at the end harm the lender. Due to this, lenders will be more careful in approving loans and both lending and investment will be at suboptimal levels. The asymmetric information theory approach is offering enough explanatory power for the definition of financial crises and enlighten some mechanisms that could be necessary for prevention. To put everything in the definition:

A financial crisis is a disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities. (Mishkin F. S., 1994)

History of financial crises and changes of financial system

"Those who fail to learn from history are doomed to repeat it."

Winston S. Churchill

Financial crises are not a modern phenomenon. They were happening throughout history and probably will continue to happen. One of the primary roles of the financial system is to smooth away biggest ups and downs and to make the world more predictable. In many crises, the financial system changes to save what can be saved and, if possible, to prevent future occurrences. We will list the most significant financial crises in history that in essence shaped the current form of the financial system. To show that, we will not only describe the consequences but rather go through the reasons and mechanisms.

Tulipmania

Usually cited as the first major financial bubble (in the form of speculative mania) in history*, this crisis tells us much about the psychology of investing and financial crises in general.

Tulips were brought from Turkey into newly founded The Dutch Republic in 1593. Soon after, it was realised that this specie of flowers could accustom with relative ease to the local climate. Furthermore, the flower was uncommon for Europe, demand was high, and it was sold with a premium. After contracting non-lethal virus named Mosaic, Dutch tulips got even more exotic. Many people started trading in tulip bulbs as it looked like an excellent business opportunity. Due to its very nature, tulips grow in cycles meaning that they need to be planted in the autumn and they need six to eight months.

As the flowers grew in popularity, professional growers paid higher and higher prices for bulbs with the virus, and prices rose steadily. That sparked speculation, and by 1634, the market was already behaving irrationally. The sale of 40 exotic bulbs was recorded that amounted to 100,000 florins (the equivalent of €1 million in 2002).

The full craze in tulips began after September 1636, when bulbs were no longer available for examination since they had been planted to wait for the following spring. Prices were rising so fast that people were ready to liquidate anything they could to get more bulbs. The initially overpriced tulips enjoyed a twenty-fold increase in value in only one month.

It is important to note that the trade took place in taverns and not within official Exchange² and that no bulbs were actually changing hands³. As it usually goes, some prudent traders decided to capitalise their gains and after that prices started to dive. Soon after, people realised that they traded their houses and land for nothing more than a type of an onion (at the end of the crisis, the price was similar as well).

Kipperzeit und Wipperzeit - Currency debasements

This story about one form of monetary crisis is important because it was happening before mechanisms of modern financial systems existed, in periods with only metallic money and without any bank loans included. The terms from the title refer to the financial epidemic in the beginning of 17th century on the territory of Holy Roman Empire, an area that was

² They even had to pay so-called Wine money, form of a fee, up to 2.5%.

³ In fact the trade happened often 10 times per one bulb, all without a physical presence of the bulb itself. This resembles the trading with CDO's in 2007-2008 crisis, when traders didn't have proper knowledge about the asset

covering today's territory of the Czech Republic as well. It was a complex of multi-ethnic territories in Central Europe during the Early Middle Ages until its dissolution in 1806.

It was a period before printed money, and the value of money was depended on the content of precious metals. During the start of "Thirty Years' War", local governments, princes, abbots and even Holy Roman Emperor were using the technique of metal coinage debasement – in fact lowering the value of money. It was done through the worsening of the coinage, either by mixing in cheaper metals or by literally shaving down coins from edges and reissuing smaller coins in the same denomination. The result is the lower intrinsic value of the coinage so more coins can be made with the same quantity of precious metal⁴.

Initially, rulers were using this practice on their territory, but soon they realised that it is even more profitable to "export" bad coins into nearby areas and exchange them for good coins with ordinary people not suspecting a thing. Of course, after that, the good coins were brought back and melted into local currencies. This practice soon became so overused, and everybody was preparing for a war with it that in the end, all coins⁵ became, in essence, worthless, and children played with them in the street, much as recounted in Lav Tolstoy's short story, 'Ivan the Fool.' (Kindleberger, 2005).

It is important to notice that coinage debasement was not an invention of Holy Roman Empire and 17th century. Even in Roman Empire, the value of Denarius – local silver currency, decreased significantly over time. At the beginning of use (first time minted in 211 BC), it was made from almost pure silver and weighed about 4.5 grammes. During the Julio-Claudian

⁴ The same principle is used nowadays with printing money (issuing electronically) on a global and much larger scale, that's why we are calling it fiat money.

⁵ It is important to notice that local governments used this technique on subsidiary coins, used by common people. The golden coins with high value were not shaved. It was some kind of a tax on poor.

dynasty, the Denarius contained approximately 4 grammes of silver, and then Nero reduced it further to 3.8 grammes. At the end of its use (second half of third century AD), it contained only about 2% of silver. The infamous Henry VIII of Britain was also engaged in the currency debasement in an epic manner. Sweden achieved a debasement of 41 percent during the single year of 1572. The UK made 50 percent debasement in 1551, Turkey's debasement was 44 percent in 1586 (Reinhart & Rogoff, 2008).

To represent the level and the spread of this practice, we are showing the average content of silver in ten main currencies in Europe during 1400-1850 period:

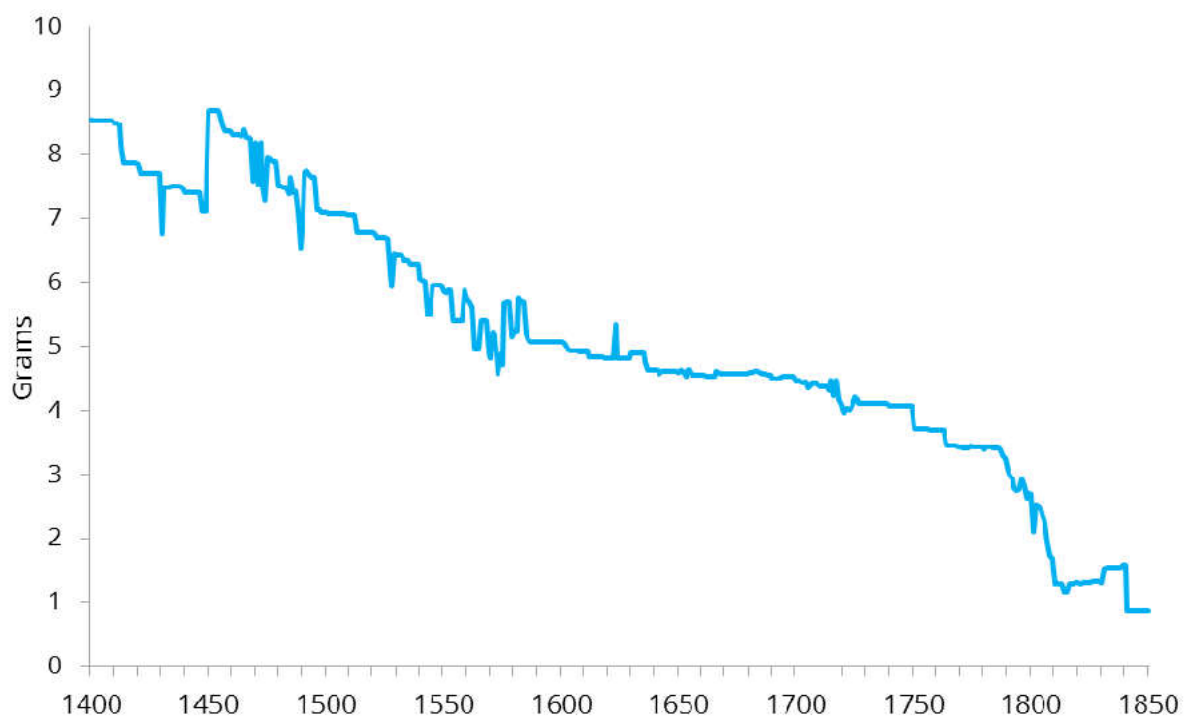


Figure 1: The average silver content in ten currencies in Europe, 1400-1850
Data source: www.carmenreinhardt.com

Whenever the currency debasement as a way of extracting *seigniorage* happened⁶, it was a form of inflation, and this trend only increased later after introducing fiat money.

⁶ Seigniorage extraction was more often used in the more unstable countries. (Cukierman, Edwards, & Tabellini, 1989)

Mississippi and South Sea bubbles

"I can calculate the movement of the stars, but not the madness of men."

Sir Isaac Newton⁷

The story about Mississippi and South Sea bubbles is considered to be a first international crisis, and both cases are well interconnected.

The South Sea company was founded in 1711 in Great Britain as a public-private partnership and was granted a monopoly on trade with South America with the goal to consolidate and reduce the cost of public debt. In that time South America was still under the control of Spain, and the chances that trade with that part of the world will become the second India were appealing to profit-hungry investors. They regarded South Sea Company as a potentially most lucrative monopoly on earth.

John Law was a Scottish economist and gambler who exiled from Great Britain to France after murdering a man in a duel. He was a proponent of the idea of issuing banknotes backed by land and precious metals, in contrast to the use of metal coins. Moreover, after being appointed as *Controller General of Finances* of France, he founded *Banque Générale* in 1716, responsible for the development of paper money use and in essence first central bank in the country.

To improve finances of France, John Law also founded a joint-stock trading company *Compagnie d'Occident* (The Mississippi Company, or in translation "Company of West") and granted it with a monopoly on trade with North America and Caribbean Basin. Within two years and after the acquisition of two more monopolies, *Compagnie d'Occident* had a trade monopoly on all seas (including Africa, India, and China) and a monopoly on mineral wealth.

⁷ Lost as an investor £20.000 in the South Sea bubble (equivalent of £2.4 million in modern terms)

Then the company purchased the rights to mint new coins and the right to collect most of the French taxes. All these activities and privileges were financed by issuing additional shares in the company. After controlling all of France's finance and money creation, it looked like he created the most successful conglomerate. On top of it, Law exaggerated the wealth of Louisiana French colony with an effective marketing scheme.

The value of shares in the Mississippi company rose dramatically as the empire expanded, the demand was much higher than supply and prices of shares rocketed in wild speculation. Realising that he can attract substantial levels of capital, Law decided to issue even more shares. Investors from the whole Europe rushed in Paris to invest their money⁸. In January 1719, when they started trading, the value was around 500 livres⁹. By December of the same year, the price reached 10,000 livres, an increase of 1,900 percent in less than a year. Even the new word was coined: *Millionaire*. The market became so seductive that people from the working class began investing whatever small sums they could scrape together (Moen J., 2001).

On the other side of the canal, South Sea company managers used "the most extravagant rumours" about the potential value of its trade in the New World and shares of South Sea Company also exploded. In January 1720, the value was £128 per share, in March £330, at the end of May £550 and finally reached its peak of £1,000 in early August. Its success caused a country-wide frenzy, as all types of people, from peasants to lords, developed a sudden interest in investing and many of them bought shares on credit¹⁰. Like in most of the bubbles, once more prudent, more experienced and better-informed investors capitalised their gains.

⁸ Even soldiers had to be sent during the nights to maintain order between all investors.

⁹ French unit of currency in that time.

¹⁰ The whole frenzy spread to the whole market and many companies went public in that time. Among the many companies to go public in 1720 was one that advertised itself as "a company for carrying out an undertaking of great advantage, but nobody to know what it is". (Mackay, 1841)

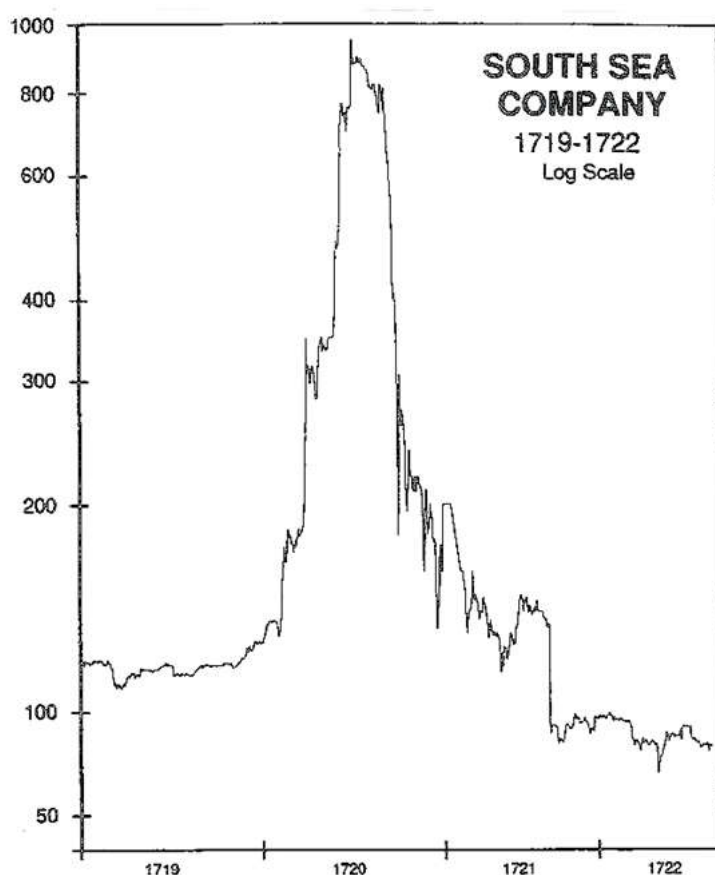


Figure 2: The South Sea Company Bubble
Source: www.elliottwave.com

The level of sales of the shares in the South Sea Company at the £1,000 level was so high that caused the price to go down.

That triggered bankruptcies of buyers on credit and the fall further gained in speed. The price of the shares finally reached the pre-bubble level of £100 in December same year.

Back in France, the weak spot in the plan of John Law was his willingness to issue more bank notes than he had underlying assets available. When smart investors started selling shares at the price peak in December 1719 and then converting gains into gold coins, it became apparent that there are not enough assets behind notes and to stop sell-off, Law restricted payments in gold bigger than 100 livres. This move only increased panic further, and the share price was back on 1,000 livres (as before the bubble) in December of 1720. After experiencing this level of crisis, France finance was left in disarray, and it would be eighty years before France would again introduce paper money into its economy (Moen J., 2001). However, some of the ideas of John Law and the role of monetary expansion as a support for an economy still live.

The financial panic of 1792 in the U.S.

One of the interesting financial crises, from our perspective, is the one that is often overlooked: the financial panic of 1792 in U.S. The reason for its importance is that some of the levers in financial crisis management were invented and then applied and sometimes it is called “the foundation of modern finance”. It started in 1790, only 14 years after the independence and the young country of the United States was in constant state of the bankruptcy. Only countries that had modernised their financial systems in that time were the Dutch Republic (the modern Netherlands) about two centuries before and Great Britain, starting perhaps a century earlier.

The key institutional components that characterise modern financial systems in this sense are (Sylla, Wright, & Cowen, 2006):

- Stable public finances and debt management
- Stable value of money
- An effective central bank
- A functioning banking system
- Active securities markets
- A growing number of business corporations, financial and non-financial.

In 1789, the newly founded nation had none of the six components (it had only five banks and a few insurers), and the man that will build the grounds of the financial system was Alexander Hamilton, the first U.S. Treasury Secretary (1790 – 1795). He knew a lot about the successful financial revolutions of the Dutch and the British, and the aborted efforts of John Law in France (Sylla, 2010).

At that moment, every state had its own IOUs¹¹. In the creation of new financial systems, his idea was to issue government bonds traded in open markets thus allowing the government to borrow cheaply. Furthermore, America would also need a central bank and Hamilton came up with the idea of the First Bank of United States (BUS), independent in its very nature, owned 20% by the government and 80% publicly. This 80% means that out of \$10m in BUS shares, \$8 were made available to the public in the IPO (Initial Public Offering) on July 4, 1791.

BUS's IPO was oversubscribed in an hour and was a great success. The mechanism behind was even more attractive. Namely, to get right to own a \$400 BUS share, investors had to buy \$25 certificate (called "*scrip*"), and 75% of reminding money was payable in government bonds. This way he managed to support both mechanisms by each other. The problem was that the deal was too good for its sake and the price of a scrip exploded to \$300 within a month.

At that moment, one of Hamilton's personal friends gone rogue. William Duer, a speculator from New York, and well-connected businessman knew that investors needed federal bonds to pay for their BUS shares. The scheme involved a plan to launch a large new bank in New York City thus driving the price of the Bank of New York stocks down, and eventually to get control of it. In a second step, he planned to use that position to corner the market for government bonds that BUS IPO subscribers needed to meet their future payments for BUS shares. To fund this operation, he borrowed heavily from his wealthy friends, from the public and from companies that he ran. In doing this, he often acquired new loans in order repay old ones.

On the other hand, BUS was as well too big for its sake, from the very beginning dwarfing all other lenders in the country. It started accepting deposits on December 12, 1791, by the end

¹¹ IOU stands for acknowledgment of debt, abbreviation in phonetic terms of "I owe you"

of the same month BUS had issued \$1.1m of notes and deposits and discounted bills of nearly \$1m. At the end of January 1792, it already made almost \$2.7m in new loans. All this newly available money pushed residents of New York and Philadelphia on a speculative fever. The price of government bonds (U.S. 6s used for the BUS IPO repayment) increased from 110% to more than 125% in just a month and a half.

The panic started to unfold in the March of 1792. The BUS began to run low on the underlying assets that backed its paper notes and had to cut the supply of credit as fast as it had expanded it. The credit tightening from the biggest lender hit Duer and his overleveraged speculative company hard, and rumours about his troubles brought down the house of cards. The prices of government bonds, shares of BUS and a couple of more traded companies fell by almost 25% in two weeks. By March 25, 1792, Duer was in prison¹², and a mob of angry investors was throwing stones at the New York jail where he was held.

Being familiar with the history of French financial crisis in 1720 and John Law's failure, Hamilton was acutely aware of the dangers that failure in managing financial crisis can cripple the financial system for years to come, especially to the fragile new-born country. His response was what many call the first bailout in America. On March 19, Hamilton wrote the letter to William Seton, the director of privately owned The Bank of New York (the bank that Hamilton himself cofounded in 1784) to begin a series of *lender of last resort* operations that would last for several weeks to contain the panics.

¹² Being Hamilton's friend, Duer informed him of his default on the March 11, explaining that the misfortunate events happened while he was absent from the city. Hamilton wrote back briefly on March 14 advising Duer to "*Act with fortitude and honor*" (Sylla, Wright, & Cowen, Alexander Hamilton, Central Banker: Crisis Management and the Lender of Last Resort During the U.S. Financial Panic of 1792, 2006).

He used public funds to buy government bonds to support their falling prices and investors that bought at the price peak, diverting cash to troubled lenders and provided that banks with proper collateral could borrow as much as they wanted, with a penalty rate (The Economist, 2014). As a reaction to this turmoil fuelled by speculation and to prevent market volatility, in April 1792 American lawmakers even passed the rule to ban futures trading. This rather aggressive move motivated a group of 24 traders to meet under a Buttonwood tree to set up their private trading club, the predecessor of New York Stock Exchange.

This bailout worked out entirely, panics was contained and public confidence restored. American financial system continued to develop rapidly, and by 1795, U.S. already had all six mentioned elements of the modern financial system. The importance of successful and healthy financial system and one of the measures of Hamilton's success was epitomised in the famous Louisiana Purchase in 1803. In that deal, U.S. were able to pay a total of \$15m for the acquisition of the Louisiana territory (2.14m km² – the land of 15 present states) from France, which was in financial disarray after failing to develop a proper financial system (and after having regicide and several accompanying wars). The same applies in the advantage that Great Britain had in the upcoming war with France (who had to finance the same war with proceedings from the sale of the Louisiana Territory).

While the panic of 1792 very likely resulted in institutional changes with long-run positive influence on the development of U.S. securities markets, Hamilton's bailout also had some significant negative influence on future generations. Namely, he set a precedent, the sign that in the case of crisis, the Government will come to help. This policy, in fact, fuelled many of later crises by setting the fertile ground for moral hazard.

The Panic of 1825 – the first modern financial crisis

Centred in London, this crisis was cited as the first modern financial crisis, the first Latin America crisis, and the first emerging markets crisis.

After the end of Napoleonic Wars in 1815, the Bank of England wanted to go back to the golden standard and the assumption of convertibility abandoned during the war financing. After several years of tight monetary policy and deflation, it finally managed to restore the convertibility in May 1821. In the upcoming years, Britain was booming. Manchester became the world's first industrial city by producing higher-value goods, the coal mining industry in Wales was an export champion, and London replaced Amsterdam as the financial capital of Europe. Between 1820 and 1825, industrial production grew by 34%.

As a result, cash-rich investors from Britain wanted somewhere to invest their funds. Domestic government bonds yield went down from 5% in 1822 to 3.3% in 1824. With inflation levels averaging 1% per annum, investors were bored with that option. Luckily, London bond market was developing pretty rapidly. In 1820 there was only one foreign bond issuance listed on the London market, by 1826, there were 23. Investors enjoyed higher returns in bonds issued by Russia, Prussia, and Denmark.

The yield hungry investors wanted even more, and it looked like the answer was in investing in the new, emerging markets of South America. As Spain lost control of South America, several independent countries emerged, hungry for the infrastructure development and exploration of their mineral reserves. Mexico, Chile, Colombia, Argentina, Peru and Guatemala had a huge demand for funds and technical expertise needed. Within a period from 1822 and 1825, stated countries managed to successfully sell on the London market total of £21 million (\$2.8 billion in today's prices) despite the lack of proper tax administration structures and yet

unconfirmed mineral resources. Another investment option that got ground was investing in mining companies from Britain with prospects of mineral resources exploration in South America. The share price of one such company, “Anglo-Mexican”, rose from £33 to £158 in a single month (The Economist, 2014).

The biggest problem with this new investment opportunities was distance. Round trip from Great Britain to South America lasted six months at best. That means that information were late and mostly coming from journalists paid to promote them. In that time, the rules for listing and underwriting were not so strict, and banks were eager to borrow money to investors who expected that Britain would help these emerging countries in case of emergency because they were its strategic interest. As it usually happens, the loose underwriting rules, inadequate information basis, and general speculative fever invited fraudsters.

Sometimes called “History’s most audacious scam”, the best example of a fraud in this financial crisis is a case of Scottish adventurer Gregor MacGregor¹³. He got attention in London by advertising vast resources, excellent civil service and the strength of the army of the Central American Principality of Poyais (placed on territories of present Honduras), in his words a developed colony with an existing community of British settlers. MacGregor even claimed that *“King George Frederic Augustus of the Mosquito Coast in the Gulf of Honduras had created him Cazique of Poyais”*. He prepared luxury presentations, organised preparation of promotional ballads that praised life in Poyais, drew uniforms for all regiments of its army and even sold impressive-looking land certificates for prospective emigrants. The problem with Poyais was that it did not exist. However, he was so convincing that he managed to float a large bond

¹³ This was an example of so-called affinity fraud, because he was playing on the unquestioning trust people grant those from their own religious or ethnic group, mostly Scottish investors.

issue on the London Stock Exchange in 1822 at only 6 percent yield, almost as same as for Mexico or Columbia.

In the summer of 1823, it was clear that there will be no Britain's support for the emerging markets and Spain was on the verge of default. As anxiety started to spread, bond prices plummeted. By the summer of 1825, the price of Latin American bonds had fallen by half. Banks were highly exposed to such debt, so their nervous depositors began to withdraw. By December, there were outright runs, and as the panic spilt into 1826, full 10 percent of the banks in Wales and England failed (Morgan & Narron, 2015).

The crisis was made even worse by Bank of England's initial failure to act as a lender of last resort. Most blame was directed to small local banks in forms of private partnerships and for their loose lending policies. Part of the blame should go to investors who did not make proper due diligence before investing, blinded by greed and guided by herd behaviour. The outcome of this crisis was the move toward bigger and bigger banks based on joint-stock ownership, the trend that gloriously blossomed in the case of Royal Bank of Scotland that eventually became the largest bank in the world, and the largest to fail in 2009.

Panic of 1857 – First global financial crisis

The beginning of the 1850s was a prosperous time for both, Great Britain and the United States economies. In the U.S. the results of California Gold Rush (1849) were still palpable, and that vastly increased the money supply, while similar gold discovery in Australia (1851) led to export bursts from Britain and enlarged the credit base in Europe. Due to strong trade and high trade deficit that U.S. had with its main trade partners (Britain with colonies), the opposite

side was capital inflow from Britain to the States. Americans bought more goods than they sold, with Britain was buying American assets to provide the funds, just as China does today. By the mid-1850s Britain held an estimated \$80 million in American stocks and bonds (The Economist, 2014).

In that time, hot sector for investing was railway companies. Investors from Britain invested heavily despite very high Price Earnings ratios. That was the bet on future growth, and they even set on the boards of these companies. In Britain, already big and aggressive joint-stock banks were highly successful. Their deposit grew by almost 400% from 1847 and 1857 (The Economist, 2014). On top of banks, another lending sector developed in the meantime. Discount houses, small financial institutions with lower capital requirements were taking money from investors and connecting it with companies in need. In hard competitive conditions, they relied on actions of Bank of England from the past and operated with close to zero capital reserves (the assumption was that they would borrow as much as need from BoE in the case of the turmoil).

Every crisis has its hero. This time his name was Edward Ludlow, the manager of Ohio Life Insurance Company. While many invested heavily in railroads, Ludlow went all in. Out of \$4.8 million of total assets, he put \$3 million in railroads. As unwise as it looks, that decision led to the crash of highly leveraged and over-exposed Ohio Life as soon as shares in railroad companies started to fall in late spring 1857. This crash happened to be only the first domino, and the contagion spread to the east, with many exposed investors bankruptcies. Banks also dumped railroad stock further pushing price lower. On October 13th, 1857, banks on Wall Street refused to convert deposits and that magnified problem even further.

In Britain, first failed merchants involved in trade with the U.S. and one American bank that was operating locally. At that moment investors did not believe more into dangerously undercapitalized discount houses¹⁴ and started to pull their money out which led to bank runs. Bank of England changed its policy and discount houses could not borrow as much as they wanted. During the last three months of 1857, there were 135 bankruptcies, wiping out investor capital in a total of £42 million.

The important lesson from this crisis is that it was evident that introduction of safety nets (bail-out and lender of last resort) led to excessive risk-taking which was one of the causes of the new financial crisis. In this crisis, it was the first time that things went a bit back. Namely, Bank of England decided to change its practice of rescuing big lenders deserved to fail. As one of the notable effects is that after it, Britain enjoyed 50 years of financial calm, which some historian attribute to the prudence of a banking sector stripped of moral hazard.

1907 – Knickerbocker Crisis and foundation of FED – third time is a charm

At the beginning of 20th century, we had a quite different situation in the strongest economies on two sides of Atlantic Ocean. In Britain, Bank of England was an al-mighty central monetary authority, and joint-stock banks dominated banking industry. In the U.S. however, Hamilton's Bank of United States lasted only until 1811 and its replacement, Second Bank of the United States ceases to exist after U.S. President Andrew Jackson allowed the charter of the Bank to expire in 1836. For more than 80 years the United States were without any central monetary authority, and an atomised, decentralised system developed. That did not represent a

¹⁴ One discount house reportedly had only £10,000 of capital supporting risky loans of £900,000.

problem for booming of the banking industry and by 1907 America had 22,000 banks or one per every 4,000 people.

On top of it, the industry of trust companies developed as well. Initially developed to hold their customer's investments in stocks and bonds, by 1907 they also were conducting underwriting and distributing shares as well as managing properties and railways and also took deposits. These para-banking companies were not the central part of the payment system, and therefore their operating requirements were lower – 5% of cash reserves relative to deposits in comparison to 25% for regular banks¹⁵. They also invested in more exotic assets than banks, and by 1907 the whole industry was almost big as the national banks, with a rise of nearly 250% in ten years. One of the largest and most renowned trust company was the Knickerbocker Trust from New York.

In that time, the economy was performing well with average GDP growth of 5% in 1896-1906 period. As we already saw, in the times of prosperity we can often see the occurrence of fraudsters. This time, men in charge were Augustus Heinze and Charles Morse. Heinze was the majority owner of United Copper, a company which shares were traded on the curb¹⁶ outside of New York Stock Exchange. They both acquired a chain of banks, using the equity of one bank as collateral to buy the next one.

The grand scheme was to corner the stock of United Copper and make a killing by squeezing the short-sellers. However, after economy experienced a slowdown in 1907 the price of copper fell and that put pressure on the shares. However, to support the price, they began to tap funds from the banks they owned, eventually losing vast sums of money in the October of

¹⁵ There is a striking similarity with the already described discount houses in Britain during 1857 panic

¹⁶ This trading on the curb was later formalized as the American Stock Exchange - AMEX

the same year. Connected banks failed and when the news emerged that Knickerbocker Trust had connections with Heinze and Morse, nervous depositors lined in front of Knickerbocker Trust building. After a weekend, on October 21st, the director of Knickerbocker was fired, the National Bank of Commerce announced that it would no longer act as their clearing agent, depositors withdrew on the next day nearly \$8 million and the trust suspended its operations.

The suspension of Knickerbocker Trust sparked a full-scale financial crisis in New York and immediately runs on other trust started as well. On the day of Knickerbocker Trust closure, the annualised rate jumped from 9.5 percent to 70 percent, then to 100 percent two days later. At times, there were no credit offers at that rate (Moen & Tallman, 2015). In help came notorious John Pierpont Morgan, who locked the entire New York banking community in his library until they agreed on the \$25 million bailout fund. This crash led to a nationwide shortage of money and money alternatives started to circulate.

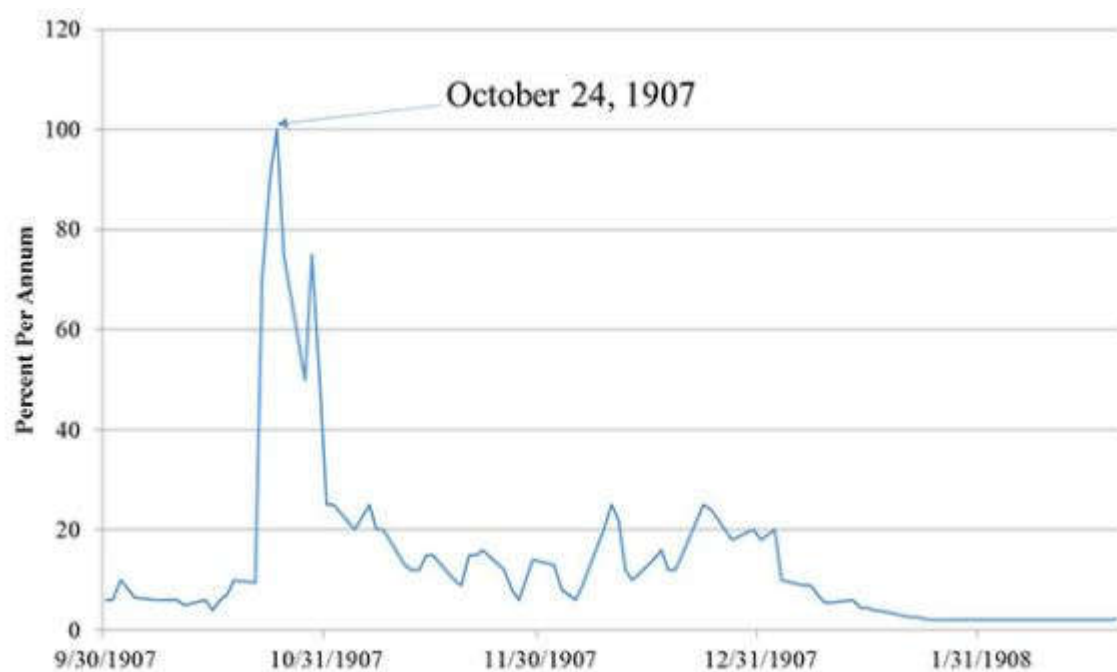


Figure 3: Daily Maximum Call Loan Interest rate during 1907 panic

Source: www.federalreservehistory.org

The change in financial system caused by the Knickerbocker crisis came after the foundation of the National Monetary Commission, which decided after four years of debating that a proper lender of last resort is needed. As a result, Federal Reserve Act was adopted in 1913, and the third central bank in the U.S. (now known as all-mighty Federal Reserve or FED) was founded in December.

Stock market crash and Great Depression – 1929-1933

After the First World War, a period during the 1920s was known as The Roaring Twenties. It was a prolonged period of economic and social prosperity in the United States and Western Europe. Widespread prosperity was driven by a boom in construction, rapid growth in mass production, consumer goods such as cars and radios and the overall momentum in the economy was strong. The stock market was in the longest bull market ever recorded, and the Dow Jones Industrial Average grew ten times between 1921 and 1929. Some claimed that the share prices would continue to rise forever. Famous economist Irving Fisher stated that “stock market had reached a permanently high plateau”.

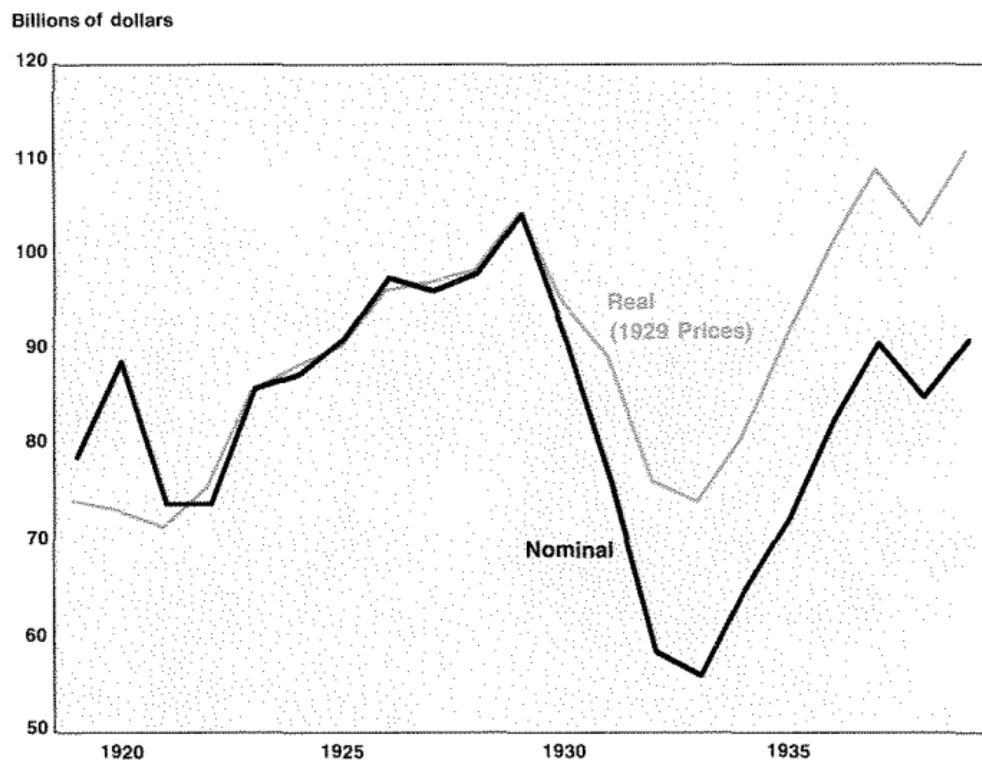


Figure 4: Real and nominal GDP during "Roaring 20s" and the Great Depression
Source: (Wheelock, 1992)

As it usually goes, this euphoria attracted more investors to the market, because there is hardly anything so moving as seeing a neighbour becoming rich. Many of these investors were what Walter Bagehot called *blind capital* – ordinary people investing without understanding risks and market mechanisms and there were hundreds of thousands of them. Most of the investors were trading on margin with borrowed money. By 1929, in total, about 40% of loans were used for stock purchases. Over \$8.5 billion was out on loan, more than the entire amount of currency circulating in the U.S. at the time. This raised some alarms, and prudent investors closed their positions. It is famous the case of Joseph P. Kennedy (the father of John F. Kennedy) who claimed that he knew that wild speculation of the end of the 1920s would lead to a certain crash. He said that it was clear the timing is right when he received a stock tip from a shoe-shine boy¹⁷.

¹⁷ He later wrote that he survived the crash "because he possessed a passion for facts, a complete lack of sentiment and a marvelous sense of timing". By moving from stock-market into entertainment, shipping and real estate in the time of crisis, he managed to increase his wealth from \$4m in 1929 to \$180m in 1935 (equivalent to \$2.9bn today) that set him on course to change the history of U.S. (The Time, 1967)

Federal Reserve warned of excessive speculation on March 25th, 1929 and that caused a mini crash but many saw that as another buying opportunity. The economy started showing signs of slowing down, steel production declined, car sales went down as well, and excessive overproduction in farming put a pressure of prices thus threatening farmers with extinction.

The stock market peaked on September 3rd, 1929. On the other side of the Atlantic Ocean, jailing of one prominent investor for outright fraud and forgery¹⁸ took the London Stock Exchange to crash on September 20. That hurt confidence that was already shaken and a sell-off was coming, and it was huge. Over October 28th and 29th, The Dow Jones lost almost 25%. The rumour of *"11 brokers had jumped out of windows"* started to circulate further increasing panic. By November 13th, Dow Jones was full 45% down¹⁹.



Figure 5: Dow Jones index in 1920-1940 period, unadjusted for inflation
Source: www.macrotrends.net

¹⁸ Clarence Hatry was a fraudulent investor that built a web of connected companies. His greatest project was merger of steel and iron companies into \$40 million big United Steel Companies. However, it was discovered that this job was funded by loans secured against forged share securities.

¹⁹ The lowest point was reached on July 8th 1932. That day it closed at \$40.56, 90% down from peak.

Aside from the stock market, things went even worse. Bank failures came in waves, first with bank runs in agricultural states and then in Chicago, Cleveland and Philadelphia in 1931. Banking panics were also in Austria and Germany, and Britain dropped the Gold Standard which further put pressure on the U.S. exporters. Americans started to hoard cash, and final panic happened on March 4th, 1933, after a series of bank bankruptcies, when Federal Reserves decided not to act as a lender of last resort and declared a week-long bank holiday. It was the blackest week in the darkest period of American finance (The Economist, 2014).

Consequences of this crisis were devastating.

Almost 11,000 banks failed between 1929 and 1933, money supply dropped by 30%, unemployment exploded from 3.2% to more than 25%. The Dow Jones went back to the same levels only after 25 years. Together stock market crash and Great Depression formed the largest financial crisis of the 20th century. It is important to notice that the panic was global and that share prices fell almost globally between October 24th and 29th 1929, in all important markets except Japan.

values in %	1929	1932	Increase
Belgium	4.3	39.7	35.4
Netherlands	7.1	29.5	22.4
United States	3.2	24.9	21.7
Australia	11.1	29.0	17.9
Switzerland	3.5	21.3	17.8
Canada	5.7	22.0	16.3
Norway	15.4	30.8	15.4
Austria	12.3	26.1	13.8
UK	10.4	22.1	11.7
Czechoslovakia	2.2	13.5	11.3
Poland	4.9	11.8	6.9
Germany	n.a.	31.7	n.a.
Japan	n.a.	6.8	n.a.
Average	7.3	23.8	17.3

Figure 6: Unemployment rates for selected countries
Source: www.carmenreinhardt.com

The changes in the financial system were inevitable. To de-risk the system, the first step was a massive injection of publicly supplied capital (\$1billion or a third of existing equity). To prevent future risks, in the U.S. was adopted the Glass-Steagall Act ruling the separation of traditional banks and investment banks and further increasing the power of Federal Reserves.

Lastly, to prevent future bank runs, on the January 1st, 1934, the Federal Deposit Insurance Commission (FDIC) that promised to protect \$2,500 of deposits per customers. This concept prevented bank runs for 70 years, but also transferred risk to taxpayers with consequences that would rear their ugly heads much later.

Global financial crisis 2007-2008

This crisis developed in our modern, globalised and highly integrated world and it was followed by a global economic downturn – Great Recession and European debt crisis. In comparison to previous times, the financial system was much more complex, the speed and velocity were much higher, and the scale of everything was much bigger. It is considered the worst financial meltdown since the Great Depression, having profound adverse effects on the well-being of people around the world. It began with the collapse of the subprime mortgage market in the U.S. in 2007 and then developed into the full-scale international financial crisis.

Similar to previous cases, we will try to explain in short the basic mechanisms behind the crisis. It was a time when the theory of efficient markets and the use of computers for financial modelling offered some confidence that “this time is different” and that market will self-regulate. There were several waves in **financial deregulation** that allowed better ground for the crisis to develop. One of the most important was the repelling of a Glass-Steagall Act in 1999 that removed division between deposit and investment banking allowing once again models for excessive risk taking from the past. Adoption of Community Reinvestment Act in 1977 made it easier to obtain mortgage loans to the poorer and less financially strong part of the population. Commodity Futures Modernization Act of 2000 removed regulation from Over

The Counter (OTC) derivatives after the financial industry managed to lobby through the idea that this part of the market will self-regulate operating within "safety and soundness" standards. Loose regulation on hedge funds and similar entities that do not have banking licenses allowed them to compete with conventional banks as well. In 2004, SEC adopted relaxation of the net capital rule, allowing an investment banks substantial increase in their leverage.

Combined with low interest rates introduced to soften the effects of Dot-Com crash and September 2011 terrorist attack²⁰, these liberalisation waves led to an **enormous increase in indebtednesses** in all parts of the economy. Additional funds and pressure on real-estate prices came from abroad. Due to the high deficit, the substantial capital of foreign investors was buying U.S. assets in large quantities. From 1978 to 2007, the amount of debt held by financial sector soared from \$3 trillion to \$36 trillion, doubling its share in GDP. Investment banks, being lightly regulated that commercial banks, operated on a dangerously low level of capital reserves. They used leverage ratio as high as 40 at the moment when crises started. This essentially means that the drop of 2,5% in the value of assets they invested in would erase their capital. To further increase risk and show how irrational and arrogant behaviour was, they used short-term lending (usually overnight loans) to finance their activities.

The most photogenic example is the case of Bear Stearns bank at the end of 2007, having \$11.8 billion in equity and \$383.6 bln in liabilities and it was borrowing as much as \$70 billion in the overnight market. It was the equivalent of a small business with \$50,000 in equity borrowing \$1.6 million, with \$300,000 of that due each and every day (The Financial Crisis Inquiry Commission, 2011). Many institutions were using the practice of hiding the leverage in

²⁰ From 2000 to 2003, the Federal Reserve lowered the federal funds rate target from 6.5% to 1.0%. Source: federalreserve.gov.

derivative positions and off-balance-sheet entities²¹. That way, combined leverage in government-sponsored institutions Fannie Mae and Freddie Mac was staggering 75.

Households were also increasing their indebtedness. From 2001 to 2007 the amount of mortgage debt per household increase from \$91,500 to \$149,500, more than 63%. The practice of mortgage underwriting was very loose and motivated by short-term profit goals. Many mortgage lenders were offering loans without proper collateral or even proof of funds. One popular product was NINJA mortgage (no income, no job, no asset verification required). It was a popular practice to indirectly influence borrowers to lie in the application, only to get enough basis for loan approval. All this fueled the housing bubble, in which home prices increased by 124% in the 1998-2006 period in the U.S. Similar increase in the housing prices was a trend in the world, also due to low-interest rates and expectations that prices will constantly rise.

The unregulated market of OTC derivatives spiralled out of sight and control, growing to \$673 trillion in notional amount (The Financial Crisis Inquiry Commission, 2011). **Financial innovation** in the form of securitization was also responsible for creating overly complex financial instruments that at the end no one knew how to value. The implicit guarantee by the US government created a moral hazard and led to risky lending. In order to protect from the risky mortgages, original mortgages were securitised by bundling into Mortgage Backed Securities (MBS) and then combined with Credit Default Swaps (CDS) were sold to investors usually in the form of Collateralized Debt Obligations (CDO) that offered attractive interest rates. This process introduced a veil between the investor and the source of risk and that veil was covered (or it was expected to be covered) by **rating agencies**. Three rating agencies

²¹ Off-balance-sheet entities was a practice that brought Enron down in 2001.

(Moody's, Fitch and S&P) were responsible for assessing risk and attaching proper risk category to different tranches of CDO's. It was impossible to sell all mortgage-related securities without rating agencies and investors relied on their seal of approval. The problem was that they did not do risk assessment properly and they attached AAA rating to many dubious securities²², often operating in the conflict of interest driven by rewards from issuers²³.

Another important lever in this financial crisis was the development of **shadow banking system**, comprised of hedge funds and similar institutions that did not require banking licence, thus being lightly regulated. This shadow banking surpassed the size of the traditional banking sector, and it was a leader in promoting complex securities and were heavily involved in the multitrillion-dollar repo market, thus borrowing short-term and investing long-term²⁴.

Another problem were **widespread failures in financial regulation and supervision**, where state institutions did not do their job in recognising all the risk. As already said, a big chunk of the real market was hidden in OTC derivatives, overnight lending market and shadow banking system and often was not part of the regular statistics. Supervision was slower than the problems it should monitor. The general issue was that regulation could not stay relevant with newer and newer products and tricks from the industry. Financial sector managed to introduce thick veil of opaqueness by using off-balance sheet accounting, special purpose vehicles for riskier investment, and a vast amount of implicit guarantees. This lack of

²² The famous statement from that time is from a Moody's managing director: *"These errors make us look either incompetent at credit analysis or like we sold our soul to the devil for revenue, or a little bit of both."* (Morgenson, 2008)

²³ From 2000 to 2007, Moody's rated nearly 45,000 mortgage-related securities as triple-A (The Financial Crisis Inquiry Commission, 2011)

²⁴ This practice is a bet that general prices will rise and that short-term funding will be available and it very risky.

transparency made the supervision difficult, but numerous occasions showed the incompetence of the employees in the supervising institutions.

The common ingredient of financial crises, fraud, was this time widespread²⁵. From the fact that financial sector lobbied \$2.7 billion in 1999 to 2008 period in the U.S. alone, predatory lending practices that pushed loans they knew they would not be paid, homeowners who was taking loan knowing they cannot repay them, rating agencies that placed AAA ratings on a dubious securities no one else knew how to value, investment banks that were betting against the very products they were selling to their clients, just to name some of them. If we recall the words of Andrew Mellon some 70 years earlier, this time the rottenness was systematic, developed on moral hazard behind the idea that state or someone else will pay for their risk taking. The general feeling was that the whole system is rigged.

Many families simply could not afford to pay their mortgages, especially in cases when prices were rising and when they signed for variable rate mortgages. This led to high delinquency rates that resulted in a rapid devaluation of connected mortgage-backed securities. After it was evident that there is a big problem around a corner, liquidity evaporated, and the investment banks were hit hard. **Lehman Brothers** bank filed for bankruptcy in September 2008, and it was expected that next in the row would be AIG (big American insurer), Merrill Lynch, Freddie Mac, Fannie Mae, Royal Bank of Scotland, Fortis and Hypo. Faced with a hard choice between risking the collapse of the whole financial system and injecting trillions of taxpayers dollars into the financial system, the U.S. government decided to go with massive

²⁵ While it is really hard to single out one hero of this crisis, it would be a shame not to mention Bernard Madoff. This financial advisor of Jewish origin managed to run Ponzi scheme that is considered the largest financial fraud in the U.S. history. The total amount involved was close to \$65 billion. He used the same approach as Gregor MacGregor in 1825 – affinity fraud, by targeting wealthy Jewish communities misusing his in-group status.

bailout packages. Troubled U.S. investment banks ended up differently: Merrill Lynch and Bear Stearns were sold with at fire prices and Morgan Stanley, and Goldman Sachs decided to become commercial banks, thus being subject to stricter regulation rules.

Consequences of this crisis were stark, and we can still feel them. It spread globally, causing havoc in financial markets, harming economies and well-being of normal people. In the U.S. only, 4 million families lost their homes in the foreclosure processes, nearly \$15 trillion in household wealth has vanished from 2007 to 2009. S&P index fell 57% from the peak in October 2007 till March 2009. U.S. national debt increased from 66% of GDP in 2008 to over 103% in 2012. Almost all countries employed generous fiscal stimulus combined with programs of liquidity increase. In the U.S. the Dodd-Frank Act was adopted in 2010 and Basel III on a global scale with the goal of preventing future crises.

Financial system mechanisms forged in the furnaces of crises

By going through the history of financial crises, we could easily observe that some of the main mechanisms of financial systems were in fact forged in times of crises. Those changes were usually forced hands drawn to save what could be saved and hopefully to prevent the occurrence of similar events in the future. We saw that institutions like central banks, deposit insurance policies, stock exchanges, and some defining laws were more cobbled up as a reaction to some acute crisis than carefully designed during calm times.

We could also observe that many of those changes made the fertile ground for future financial crises even greater in scale. Let us recall our definition of the financial crisis as *a disruption to financial markets in which adverse selection and moral hazard problems become much worse so*

that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities. In this case, every change of financial system that skews the original risk-reward relation necessary for efficient allocation and increases the information asymmetry could be put in this group. This meddling or interference of government usually takes the form of saving the entities that should fail based on their performances, all based on a higher goal of preventing the crash.

Although this role of a lender of last resort has the benefit in the form of preventing the financial crisis, it has its price. The same can be said for the institution of deposit insurance. With introducing these two safety nets, the financial system was fuelled with inefficiency based on the moral hazard. In both cases, we have a reassignment of consequences of risky behaviour from undertakers to someone else (taxpayers in this case). That promotes risky behaviour in the long run, and it is an ingredient of the next crisis. It is a form of negative selection and in the long term does not promote the best players.

From this historical overview, we saw that the very basic mechanisms in our financial system (in the year of 2017 we have to talk about global financial system due to real-time interconnection) were in fact coined in financial crises²⁶:

- FED first in 1792, then in 1907,
- Bailout in 1792,
- New York Stock Exchange in 1792
- Big banks in Britain in 1825 and
- Deposit insurance policy in 1933.

²⁶ This is from the angle of U.S. and U.K. because we wanted to depict the global financial system and crises that shaped it, but similar analysis could be done for many other bigger countries as well.

This list could be much longer if we would get another approach and start with a mechanism finding the crisis when it was conceived, but this is enough for the point.

There is also one important role of the financial regarding financial system. Namely, it was shown that one of the key ingredients that lead to crisis is the existence of parallel banking or lending sector that is lightly regulated and leads the risky behaviour. We had discount houses during 1857 crisis in Britain, trust companies during 1907 in the U.S. and hedge funds, investment banks, money market funds, derivatives, and securitization markets in 2007-2008 crisis, all growing to have more than significant role in the funding of crises. Regarding this part of the economy, crises act as a form of purgatory, because in every crisis we again realise that some levels or risk are unsustainable and get things in more restrictive condition. Finally, the crises introduced the wall between commercial and investment banking twice, in 1933 with Glass-Steagall Act and 2007 with Dodd-Frank Act (Volcker rule).

Common patterns and denominators

The reason why we presented such a thorough overview of different financial crises throughout the history is to show similarities in patterns, behaviours and to derive common denominators. We could see that most of them share the common structure, have euphoria moments followed by desperation, have their fraudulent heroes and that in most cases before the bubble bursts, it is inflated during the prolonged period of prosperity. We can trace that in most cases some new investment opportunity emerged before the crisis. It could be exotic tulip bulb, a railroad connecting new territories, car or complex financial instrument. What is definitive is that during the euphoria phase markets become detached from its long-term equilibrium state and fundamentals and then they slingshot back when panic and despair replace euphoria. This behavioural dimension was the reason why some journalists used expression “markets with bipolar disorder” during the recent crisis.

Economic theory assumes that people are rational beings who can correctly understand and price risks. A financial contract is the essential medium of economic interaction, and it assumes that both parties understand it and that both sides will obey their obligations. Both assumptions became pretty much invalid during the times of speculation when everyone wants to join the wave surfing, and they detach from reality and sound investing. Speculation also fuels fraudulent behaviour because greed often explodes after a portion of the market already earned money.

The **asymmetric information** literature which looks at the impact of financial structure on economic activity focuses on the differences in information available to different parties in a financial contract. **Frederic Mishkin** used the spread between high- and low-quality borrowers

to analyse the history of financial crises from this perspective. The following important facts emerged from his study (Mishkin F. S., 1991):

- Financial panics always occurred after the onset of a recession
- Stock prices declined, and the spread between low- and high-quality bonds rose before the onset of a recession
- Many waves of panic seem to have features of a liquidity crisis
- The onset of many panics followed a major failure of financial institution, which was often resulting from financial difficulties of a nonfinancial corporation
- The most severe crises were associated with severe contractions and
- The stock market crash was not always a major factor in creating a crisis.

The asymmetric information approach managed to provide a better explanation on crises than monetarists', and it was shown that the broader view is possible. Lastly, they pointed out the importance of the dual effect of the lender-of-last-resort role of the Central Bank since it might encourage too much risk taking.

After going through hundreds of crises going back centuries, using **qualitative** approach **Charles Kindleberger** determined that crises share common patterns and sequence of events described in the financial instability model of Hyman Minsky. In essence, the more things look healthy and prosperous, the more leverage and speculation is in the game, eventually resulting in a highly vulnerable system that tends to crash under some unexpected event in a glorious fashion. As we can recall from previous chapters, Minsky claimed that in a time of prosperity and the case of some new economic opportunity (*displacement*), more and more companies partake in speculative and Ponzi financing fuelled by the increase in credit supply.

Kindleberger managed to derive a sequence of crises in Figure 5:

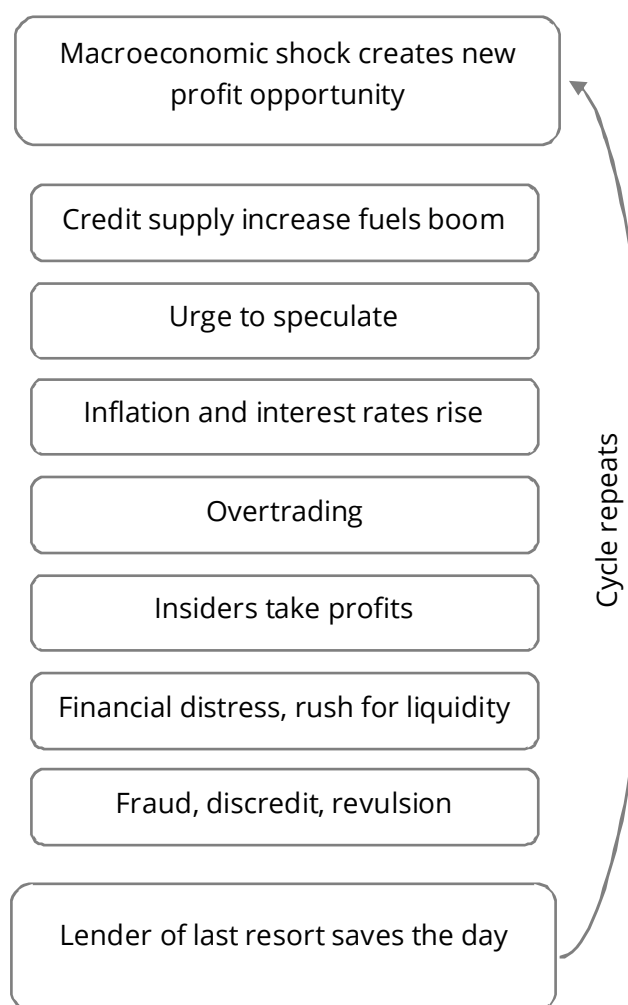


Figure 7: Hyman Minsky's model of financial crisis cycle;
Source: Adapted from (Kindleberger, 2005)

Macroeconomic shock is often a new invention, discovery of a new land, construction of a new canal or end of the war. When things prosper, banks are increasing the credit supply (in previous times this was done through non-banking lending sector as well) and that increases overall leverage and risk. On the peak, better informed players cash in putting the pressure on price and scaring the herd. In panic banks are retrieving with their money support and faced with special kind of a *trolley problem*, central banks play their forced hand and offer the last resort.

In contrast to Kindleberger's qualitative approach, after gathering the most comprehensive dataset related to the history of financial crises²⁷, Carmen M. Reinhart and Kenneth S. Rogoff took very different and **fully quantitative** approach that resulted in their praised book "*This Time is Different: Eight Centuries of Financial Folly*". Their dataset comes from the massive database that encompasses the entire world²⁸ and goes back as far as 12th century China and

²⁷ This extensive dataset is available at www.carmenreinhardt.com and it is intensively used in this work as a basis for most of the charts.

²⁸ Total of 66 countries representing about 90% of global GDP in 1990.

Medieval Europe (Reinhart & Rogoff, 2009). They had to develop a very quantitative definition of crises based on thresholds²⁹ and later continue with a more qualitative definition based on events. The first important insight from their work is that simply **every calm period in history is followed by default** and they identified five peaks³⁰. This insight is the basis for their main finding: *“This time is different”* feeling is one of the reasons for crises.

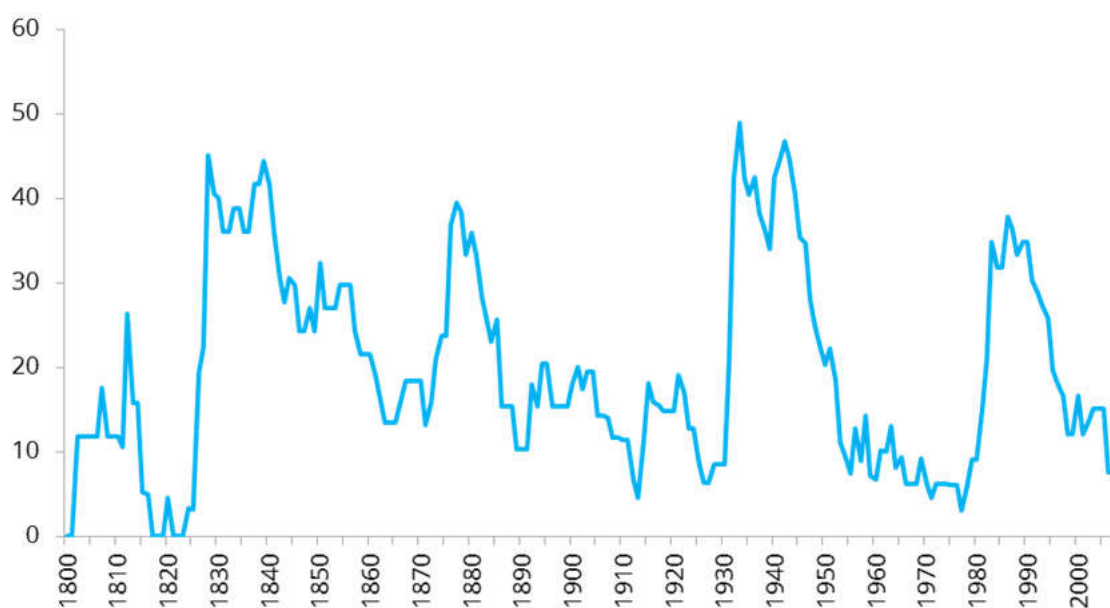


Figure 8: Number of countries in external default or restructuring, unweighted, 1800-2008
Source: www.carmenreinhardt.com

By this view, we deal with five “varieties” of economic crises: external default, domestic default, banking crises, currency crashes, and inflation outbursts. Regarding common patterns in financial crises, they found out that historically, periods of high international capital mobility have repeatedly produced international banking crises (Reinhart, 2012).

²⁹ They used 40% threshold for inflation crises and 25% for currency crashes.

³⁰ First one is Napoleonic War, followed by period 1820-1840 where nearly half of the countries in the world were in default. Third episode starts in 1870 and lasts for two decades. Fourth begins with Great Depression and ends in early 50s. Last one represents emerging markets crisis during 1980s.

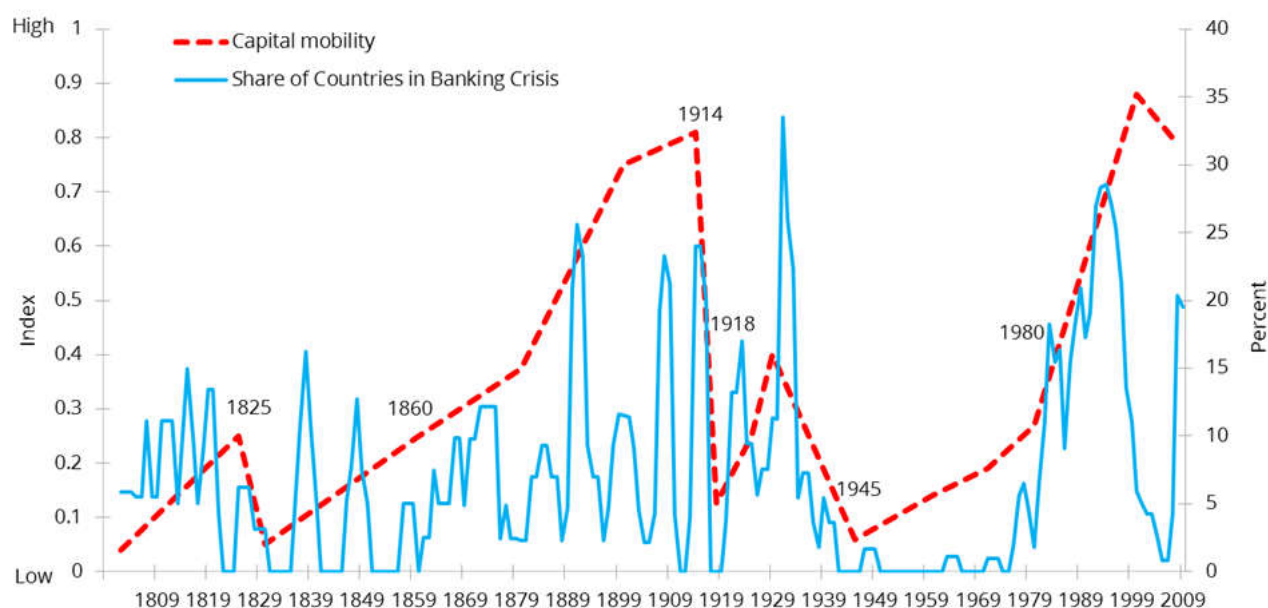


Figure 9: Capital mobility and the incidence of banking crises: All countries, 1800-2008

Source: www.carmenreinhardt.com

Having so good information basis, Reinhart managed to identify common quantitative indicators that can be used to predict crises:

- Large capital inflows
- Sharp run-ups in equity prices
- Sharp run-ups in housing prices
- Inverted V-shaped growth trajectory
- Market rise in indebtedness

Large capital inflows and market rise in indebtedness are the most important indicators that follow almost all crises, and the finding goes hand in hand with Kindleberger's view.

Apart of identifying indicators that can be used to predict the financial crisis, this analysis brought additional results in outlining which factors can amplify the magnitude of crises in case of occurrence.

Here is the full list of shared amplifiers that can influence boom-bust cycle (Reinhart, 2012):

- Pro-cyclical macroeconomic policies,
- Hidden debts (implicit guarantees),
- Overvalued currencies,
- Poor regulation,
- Even worse supervision,
- Outright fraud and
- Myopic credit rating agencies

Paramount insight is that financial liberalisation almost always precedes the crisis by creating lending possibilities and that inadequate supervision can worsen the situation because often it leads to a riskier lending attitude. In the end, outright fraud is also one of natural components in every crisis and the time when the prevailing opinion is that this time is different, that our financial systems are better and that we are smarter is the best time for fraud to flourish.

Possible remedies

In this chapter, we will discuss some mechanisms of financial systems that were developed through the history as well as contemplate about new ones that could be designed with the idea of easing the effects of and especially preventing the occurrence of the next crisis. In essence, if all crises express some similar patterns, then some general approach to solving them should also be available.

Monetarist angle

Monetarist narrow approach to the definition of financial crisis emphasises the role of a **bank run** on the money supply contraction and effects on an economy. They advocate government intervention only with the goal of bank run prevention. There are two primary mechanisms of bank run prevention, central bank as a **lender of the last resort** and **deposit insurance policies**.

In modern times, virtually every country has established central bank authority to prevent and minimise shortages of liquidity. We have numerous examples when central bank intervened with additional cash and saved the day. Most of them also developed some deposit insurance agency or fund. While both mechanisms managed to fight off the imminent bank runs and prevent new one, they created moral hazard problem that makes the future crisis more intense. On the one hand, banks are acting less responsibly feeling safe from the bank runs that could close them and on another hand borrowers now do not make choices of deposit bank based on their reputation or capital structure, but rather on the interest rate offered alone. One good example of the latter was the Icesave case during the second half of the

2000s, when British and Dutch savers forewent their domestic banks and opted to deposit their money in a newly founded branch of Icelandic banks, feeling safe behind the deposit insurance schemes (and eventually lost it).

The problem here is that both mechanisms skew the very basis of risk-reward relation by transferring risk from investing party (that should bear risk because they expect reward) to the taxpayers (that don't have any reward in case of a positive outcome). That is the reason why some economists are proponents of the view that **every panic should be left to solve by itself**. "Let it burn out" approach claim that if we provide cover for speculators today, they will act even more recklessly in the future thus further skewing the risk-reward relation and in fact directly hurting healthy parts of the economy.

Maybe the most striking example describing this stance was the view of Andrew Mellon, United States Secretary of the Treasury in the period of 1921 to 1932. He even thought that panic was not altogether a bad thing. Advising President Hoover, he said (as per Kindleberger, 2005):

"It will purge the rottenness out of the system. High costs of living and high living will come down. People will work harder, live a moral life. Values will be adjusted, and enterprising people will pick up the wrecks from less competent people."

The attitude is in line with the work of Herbert Spencer, who developed ideas of Social Darwinism and *survival of the fittest*. This quote wraps it up in a few words:

"The ultimate result of shielding men from the effects of folly, is to fill the world with fools."

While it was difficult to object these rather thoughtful remarks, the opposing view claims that although it would be good to purge the system of bubbles and manic investments there is a

high risk that panic would cause deflationary spiral and it would wipe out safe investments as well, and that non-speculators will be left out funding for their projects as well.

Solutions from the scope of Minsky approach

One of the main characteristics of Minsky's view on the financial crises is that they are inherent and that the period of prosperity is the birthplace for the next crises. This is the case because of the debt structure changes during the prosperous times and the overall risk increases. Therefore the main solution would be **de-risking the system** and **follow-up supervision** during the calm times. This is in line with the policy response to the 2007-2008 crisis. If we manage to direct the economy to stay in the low-risk mode when the hedge financing is prevailing form of indebtedness.

After failures of supervision that were involved in the creation of the 2007-2008 crisis, it is clear that monitoring system should be regularly updated to keep in touch with the ever-changing financial system and more than creative players on the market. The inherent instability is the very reason why the supervision should be constant and up to date. Both principles were incorporated in the Basel II guidelines and the Dodd-Frank Act, legislative frameworks that will define the near future of the financial systems.

One critical component of every anti-crisis policy should be the **procession of fraudsters**. We have shown that in every crisis we can find the traces of mega-fraud. The problem is when the system forgets about processing the parties that were involved in scams or mischiefs like it happened in the U.S. during the last crisis. It is more than harmful for the future of financial system to promote risky behaviour and outright fraud with the lack of legal actions or mild

sentences. There is an omnipresent feeling that the system is rigged and that it awards the fraudulent activities of the financial elite. This feeling leads to the loss of trust in the financial system, and that was the reason why more and more people are willing to trust blockchain, which is a *trustless system*, without crooked bankers and politicians. Failure to include the ethical side in the development of financial system simply leads to a path of a new crash, usually stronger.

One of the possible solutions could be raising awareness and **promoting the proper due diligence** before investing or lending. We could observe that lax lending and underwriting rules were the core of many crises. Furthermore, the investors should bear their part of the responsibility for skipping the due diligence process.

Lemons and plumbs – initial setting for solutions based on Information Asymmetry approach

In his pioneering paper on asymmetric information, George Akerlof was using the used cars market as a perfect example for a representation of his idea (Akerlof, 1970). In short, sellers have better information than buyers about cars sold. Sellers possess all information about cars, and they know their real value, while buyers only know the average of value. Because buyers are not aware of the quality of the car, they are ready to pay only the average price. Moreover, because the average price is only achievable, there is a question why would anyone sell a car with above-average quality (called *plumbs*, in contrast to below-average quality cars or lemons)? This issue leads to the exit of higher quality cars from the market, thus lowering further the average perceived value for used cars and buyers are willing to pay even less than

before. As an ending result, we have a situation where only a few lemons are traded³¹, and the market is considerably smaller than it could be.

The idea of the difference between potential market and market for lemons can be easily related to effects of the financial crisis as a disruption to financial markets because the economy operates at the way lower level than it could. We will try to draw some parallels even further.

The used car market was also a good example how the information asymmetry problem was in fact solved (or at least lessened significantly). Namely, after the above-described situation on the market, there were some institutional moves to make the information more symmetric and improve the market in general. Probably the most important step was the introduction of odometer – the device for recording the distance travelled by car. Introduced in 1925 as a standard for all cars, the odometer reading represents the most important piece of information about particular used car and directly affects its value, meaning that the price is adjusted for the number of kilometres travelled. Used car market is no different from financial markets in one crucial segment: it is full of crooks as well. Odometer fraud is the illegal practice of rolling back odometers to make it appear that vehicles have lower mileage than they do. The problem is that odometers are under the control of sellers. It is determined that 450,000 vehicles are sold each year with a false odometer reading In U.S. only, resulting in a cost of over \$1bln annually to car buyers. In the UK, the estimated cost is £500m.

That is the reason why governments decided to qualify odometer tampering as a serious felony. In U.S., Federal Odometer Act from 1972 made it a federal felony and in UK criminal offence after 2008. It goes without saying that this did not stop fraud fully, but it managed to

³¹ That's why Akerlof call it in the paper topic "the market for lemons"

reduce the number of frauds and made reading more trustworthy and increased the symmetry of information. A further step was the introduction of a rule that odometer reading and recording in books is required on every sale, then they made it compulsory on every year during technical checks. All this narrowed the space for potential benefits from tampering and therefore lessened the tampering practice. Almost all modern cars have some data recorders installed (similar to black boxes in aeroplanes) that record data on vehicle performances, speed, braking and other information related to crashes or safety in general. A photogenic example is Tesla that on their models collect information on service history, speed, location, battery use, charging time, braking, starting, acceleration and stopping times, air bag deployment and even radio and horn use. When the information about used car takes purely quantitative, digital form, without any interpretation, it is easy to prove that used car was driven with care and that it represents real plumb.

This trend of digitalization is called *Internet of Things*³² and represents hot market currently in development. After equipping almost all vehicles, devices in the home and our environment, the information basis will be of such quality that the space for information asymmetry will be significantly limited. Probably the most telling fact about the success of lowering information asymmetry is the fact that used car market is thriving, in value equalling and in the number of cars sold three times bigger than the new car market. However, these benefits come at a high cost in the form of privacy concerns.

³² The Internet of things (abbreviated as IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.

We will try to develop the idea that in the same manner, that the increase of information symmetry can help prevent financial crises as well and have substantial benefits for markets in general.

Lemons and plumbs from the financial system perspective

Following the analogy from the previous chapter, it is expected that the proper approach for preventing financial crises would be to develop mechanisms to decrease the information asymmetry. Starting from the very beginning, the good informational basis is necessary for proper risk pricing. We could observe that opaqueness of complex financial instruments was one of the key reasons behind the financial crisis of 2007-2008. Furthermore, financial institutions developed an overly complex network of relations, implicit guarantees and off-balance-sheet accounting that forced the governments to bail them out. The to-big-too-fail policy put additional moral hazard on the markets, and we have seen how it blew up.

Therefore, we conclude that one of the measures for preventing financial crises should be a **system-wide increase in transparency**, with the goal of reducing the information asymmetry and harmful consequences of adverse selection and moral hazards on the markets. We will describe how technology can help significantly in this goal by presenting the exciting features of the **blockchain**.

An important way how financial markets can solve the information asymmetry is the use of **high-quality collateral**. It reduces the consequences of adverse selection or moral hazard because it reduces lender's loss in the case of default. If it is of good quality, then the fact that

there is asymmetric information between borrower and lender is no longer as important as the loss incurred by the lender if the loan defaults is substantially reduced (Mishkin F. S., 1994).

Banks and financial intermediaries have an important role in the reduction of information asymmetry. They are well suited to solve many of the adverse selection and moral hazard problems inherent in the market. Their KYC (Know Your Client) procedures offer them excellent information basis, and they can use it to screen good borrowers from bad borrowers almost costless and easily. Another way is that banks usually develop longer-term relations with clients and leverage that position to further decrease information asymmetry in those loans.

Another valuable tool that is useful in this scope is the use of **restrictive covenants** in loan agreements. By introducing additional conditions to be met, so that loan agreement is processed, the bank can significantly lower the space for both, adverse selection and moral hazard problem. Namely, covenants usually grant the bank the right to declare the whole loan due if some of them are broken, and this repels borrowers having risky projects. Also, covenants are in force during the loan duration, and they influence borrowers' actions in a way to make a moral hazard less attractive. This all emphasises the role of banks and other financial intermediaries in the process of getting funds from savers to borrowers having the best investment projects, thereby increasing economic efficiency.

The role of the central monetary authority is vital as well. It should be focused on a timely reaction through the mechanism of lender of last resort. The emphasis is on *timely* because the main idea is that actions should **decrease the uncertainty** and thus prevent the development of panic. It is of utmost importance, from this perspective, that general public and investors feel safe knowing that the central bank will help and prevent the crash of the

financial system. It is proven that in cases of bank panics the information asymmetry is drastically increased through the reduction of banking activities. On the other hand, adverse selection occurs because in panic investors withdraw their funds from healthy banks as well, causing them to fail. In this case, the important thing is that central monetary authority leverage this move and get full access to all information in the troubled financial institutions. That will allow necessary level of information on borrowers and much better understanding of the problem.

An additional role that came to focus recently is the **prevention of false news**. In our time, news spread instantly, and market reactions are also real-time. In the case of increased uncertainty, it is crucial that there is a mechanism of false news filtering and also, that there is a vocal source of high-quality information that will calm the markets. We had experienced that even the implicit content and interpretations of Fed's statements can have a tangible impact on the markets.

Lastly, from the perspective of the information asymmetry theory, every government should promote transparency and enforce it in legislation related to the financial system. If nothing, many monsters described in this work are less scary and easier to solve promptly after being dragged on a daily light.

Un-blinding the capital

Walter Bagehot, the British economist and journalist, wrote in 1856 that *"financial panics occur when the "blind capital" of the public floods into unwise speculative investments"*. Usual ingredient in every crisis is the inflow of ordinary, common people that adds more fuel to already

speculative market. In these cases, we have a special kind of information asymmetry. Blinded by a desire to earn more and to escape their grim reality, they often risk more than they should or even everything they have. We already explained that right information basis is necessary for adequate pricing of risk but in this case, they simply don't even understand the risk nor the market mechanisms they are using. In this instance, the problem is not the lack of information, but the lack of knowledge.

There is at least two possible way how this issue could be solved because there are at least two sides involved in the problem. The seller side is better informed and knowingly uses the advantage over the financially uneducated buyers. It is a common thing to see nowadays advertisements promising easy money from investing, either in FOREX trading, binary options or similarly exotic-sounding activity. The very concept behind is motivating uneducated and inexperienced part of the population into investing. The best time for these activities is when the last crisis does not resound so loudly in heads and news. Target population usually didn't lose money yet, and it is easier to fuel their greed with success stories. However, one of the solutions would be a strict government overview and **restrictions on selling side in these activities**. Their motives are not sincere, and the consequences are always on the expense of buying side. Here, information asymmetry is purposely misused. In a similar way that we use when we sell some products that are hazardous to our health, we should mark risky and potentially harmful financial products. Every step in **making the risk more transparent** could bring benefits on a global scale.

Another, more profound and long-term solution would be to increase the general knowledge of all parties involved, especially what we call here "blind capital". It should be a matter of concern that a big portion of the population does not know enough about the very fabric of

our financial system. **Financial knowledge** should be regarded as an important **part of functional literacy**. If our school systems fail to provide a good basis to understand the economy, relations, mechanisms in the financial system and, speaking on the topic, the history of the financial crises, then our societies are creating a cannon fodder for the next financial crisis. In case that most of the population have enough financial literacy to understand the system, financial products offered and if they can understand and hopefully price the risk, the ground for the next financial crisis will not be as fertile as before.

The introduction of financial knowledge as a part of functional literacy could have additional, at least equally important goal. It could have significant positive influence on the quality of democracy. Financial knowledge would lead to better understanding of the political system, and it would be much harder to trick voters with false promises. There is an apparent crisis in democracy and a great division in societies around the globe.

Current policy responses

We have witnessed a broad financial deregulation in the decades preceding the financial crisis of 2007-2008. After the crisis, it was evident (once again) that the financial system contains unsustainable levels of systematic risk and that implicit guarantees made things much worse. After realising that the imminent de-risking and deleveraging is needed, the policy response took form in two major acts:

- The Dodd-Frank Act in the U.S. and
- Basel III requirements globally.

Every discussion on possible responses to financial crises in 2017 should contain at least a short overview of these policy responses.

The **Dodd-Frank Wall Street Reform and Consumer Protection Act** (the full name) represents the most comprehensive overhaul of the U.S. financial system since the Great Depression. Signed by President Obama in July 2010, it contains several provisions related to capital requirements for the banking sector, and it can be viewed as well-intended attempt to tame the propensity of the financial sector for the financial crisis and eventual bailout by taxpayers.

Basic ideas of the Dodd-Frank Act are:

- Identification and regulation of systematic risk,
- Proposal of an end to too-big-to-fail policy,
- Granting the Fed authority over all systematic institutions and full responsibility for preserving financial stability,
- Limitation on emergency federal assistance to individual non-bank institutions,
- Reinstallation of a limited form of Glass-Steagall (the Volcker rule), and
- Regulation and transparency of derivatives market.

Furthermore, it effectively prohibits the use of credit rating agencies in the process of new capital requirements implementation. This is a response to overemphasised role and a huge failure of credit rating agencies during a 2007-2008 crisis. The exact replacement for their role is still not in place, and that could postpone benefits of this legislation.

The important step forward is the full reform of the derivatives market with the goal of greater transparency of prices, volumes and exposures. The same approach is applied to the shadow banking system institutions. The so-called Volcker rule addresses the issue of moral hazard

caused by government guarantees because they lower the cost of riskier banking activities that can make a problem in the cyclical economy.

Basel III is a comprehensive set of reform measures, developed by the Basel Committee on Banking Supervision, to strengthen the regulation, supervision and risk management of the banking sector. These measures aim to:

- improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source,
- improve risk management and governance, and
- strengthen banks' transparency and disclosures. (Basel Committee on Banking Supervision, 2012).

It introduces higher capital standards and the Basel Committee called it the *“core of the global financial reform agenda”*. It is a follow-up of the capital requirements in the Basel II, and it requires more of the higher quality capital than Basel II. It does it by:

- increasing the regulatory capital ratios,
- narrowing the definition of capital, and
- requiring additional capital buffers.

Basel III requires a capital conservation buffer on top of the capital requirements set in the regular capital ratios. This capital buffer should be build up during stable and prosperous times, and it serves easier survival in the crisis periods. It must be in the form of common equity Tier 1 and banking institutions may reduce this buffer during the time of crises, but that invokes greater constraints on earnings distribution (both dividends and compensation payments).

Furthermore, Basel III recommends a countercyclical buffer that would be in use only when there is excess credit growth resulting in a system-wide risk build-up.

For the first time, in this iteration of Basel Accords, the minimum leverage ratio is introduced. It is designed as a simple, transparent, non-risk based leverage ratio that is calibrated to act as a credible supplementary measure to the risk-based capital requirements (Basel Committee on Banking Supervision, 2010).

The crisis of 2007-2008 showed that liquidity risk is as important as a capital risk. To promote short-term resilience of a bank's liquidity risk profile, Basel III developed two new ratios for financial institutions to follow:

- *A liquidity coverage ratio (LCR), and*
- *A net stable funding ratio (NSFR).*

A liquidity coverage ratio is a ratio of high-quality liquid assets (cash, government securities, etc.) to the bank's cash outflows over a 30-day period during a severe system-wide shock and it should exceed 100%. A net stable funding ratio is the ratio of the available amount of stable funding (capital, longer term liabilities and stable short-term deposits) over bank's required amount of stable funding (assets held multiplied by a factor representing the asset's liquidity). It should also exceed 100%.

Both policies (Dodd-Frank Act and Basel III) were introduced with a phased approach, by allowing some time for implementation and adjustments of the financial sector and by-laws. There are some overlapping jurisdictions and conflicting requirements, but in both cases, the intent is to promote a more resilient financial sector. The important difference is that the Basel III framework for risk assessment of some types of securities still relies heavily on the rating

published by rating agencies. Furthermore, capital requirements and leverage restrictions are stricter in the Dodd-Frank Act. However, it is expected that they will converge eventually if the financial sector does not manage once again to trick the system.

Blockchain - transparent and distributed transaction ledger and much more

After losing trust in banks and financial systems after the financial crisis of 2007 because of serious currency debasement, omnipresent fraudulent activities and complete lack of transparency in financial institutions, the world was introduced to cryptocurrencies as a new means of payments. **Bitcoin** was the first successful implantation of a distributed cryptocurrency, designed around the idea of using cryptography to control the creation and transfer of money, rather than relying on central authorities. It is still the most popular and most valuable cryptocurrency in use. The underlying technology for crypto-currencies is called the **Blockchain**. Conceptualised by Satoshi Nakamoto³³ in 2008 as a distributed and transparent public transaction ledger for Bitcoin, technology itself is a blend of several existing technologies: distributed systems, hashing functions, peer2peer networks, public-private key cryptography and cryptographic signatures. Technology-wise, this is more than enough for the scope of this work, and we will focus on the possible problems in financial systems that the use of blockchain technology can hopefully solve by explaining its core characteristics.

First characteristics that we are interested in is that blockchain transaction ledger is **immutable**, meaning that it cannot be altered after it is created. Numerous frauds took place because books could be modified, and many transactions left unrecorded because entries were deleted without trace. In simplest terms, blockchain represents a chain of time-stamped blocks of transactions that cannot be altered and each block has its digital fingerprint. The blockchain is *"a truth machine preserving one universally accepted version of history, one immutable sequence of events"* (A Crypto-Decentralist Manifesto, 2016).

³³ Pseudonym used for a person or persons that published a paper "Bitcoin: A Peer-to-Peer Electronic Cash System" and developed Bitcoin on top of it.

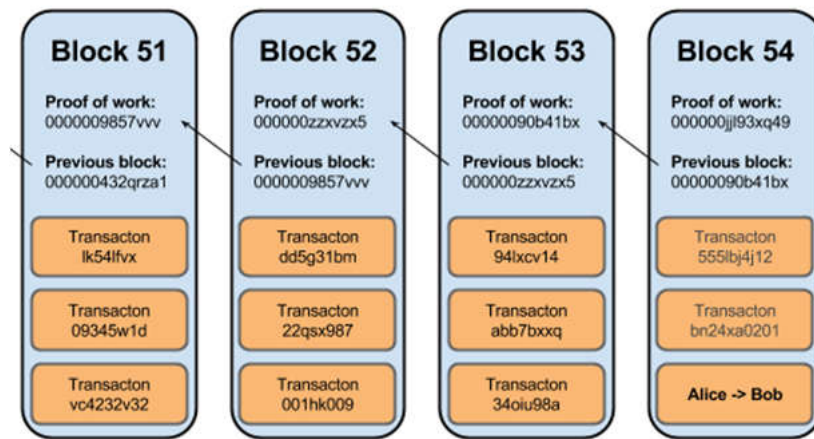


Figure 10: How Blockchain works

In the world of Bitcoin, each block represents a transition, but it could store any digital data allowing the much wider application. This immutability is an essential part of every system that is designed to record transactions in a fair and transparent way, and it could be very useful in **preventing future frauds** which are an essential ingredient of almost all financial crises.

Second characteristic of the blockchain is that it runs on decentralised and distributed network. Because the copy of the ledger is distributed to all nodes on the network, it makes it **fully public and transparent**.

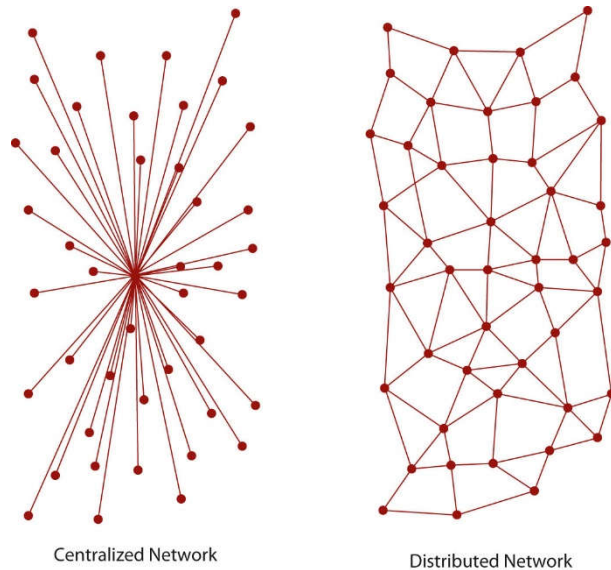


Figure 11: Network topographies

Because Blockchain is a distributed ledger, **everyone knows the exact location of all assets at all times**. This feature is a stark contrast to the case of Lehman Brothers where after the bank had gone bankrupt, it took years to realise where all assets are and who the owners are.

Most of current payment-processing systems are based on centralised networks and in the case of hacker attack³⁴ there is only one point of attack, elevating the risk of system failure. In the case of distributed networks, a global set of peers who operate based on consensus govern the system, so there is **no central point of trust or failure**. They are **very hard to hack** because security is built-in in the technology itself in this case.

Cryptocurrencies based on blockchain offered one more benefit over traditional currencies. Namely, **currency debasement** (used a long time ago in the form of metal coins shaving and then by printing money without underlying precious metals and later with an electronic increase of money in supply) is **not possible** due to a restrictive algorithm that restricts a total number of currency units available.

Another characteristic interesting from the perspective of lowering information asymmetry is that blockchain is developed as a **trustless system**. We already explained that banks have an important role in decreasing information asymmetry by acting as a kind of an escrow or trustee agent. After numerous described frauds and mischiefs, the very trust that they should provide was shaken. In a trustless system, there is no need for trusting the bank the role of an escrow agent. Because all data is shared with the whole network and secured with a cryptographic key, there is no need for it, and by a paradox, the trust is greater (and information asymmetry lower) in the trustless system. Later we will show that everything is not as perfect as it sounds in the trustless world.

As already explained, blockchain is the underlying technology for Bitcoin and similar cryptocurrencies. The beauty of it is that we do not need to use it only for recording money

³⁴ Unfortunately we have to talk about hacker attacks as a part of our digital time, something that eventually will happen in more and more cases.

transactions. Any form of the asset can be recorded, leading to the fact that any record for any asset can be implemented with blockchain technology thus getting all benefits from it. It is easy to imagine that every physical asset that we buy (let's say mobile phone, laptop or a car) gets own unique ID on a blockchain. That way we could get an immutable and fully automated system for recording any change in the asset ownership.

In late 2013, a 19 years old Russian named Vitalik Buterin wrote a pioneering paper named "Ethereum White Paper" in which he laid the ground for something even bigger. Namely, he observed that we could hypothetically use the blockchain to store and execute computer programs. The paper was a framework for Ethereum, a blockchain-based platform that supported self-executing contracts (Spode, 2017). The introduction of smart contracts meant that by adding programming capabilities to the blockchain ledger, we could program and automate entire corporations on the blockchain, without a need for trust or people involved.

Although hard to define precisely, the **smart contract** is *"a term used to describe computer program code that is capable of facilitating, executing, and enforcing the negotiation or performance of agreement (i.e. contract) using blockchain technology. The entire process is automated can act as a complement, or substitute, for legal contracts, where the terms of the smart contract are recorded in a computer language as a set of instructions"* (Blockchain Technologies, 2017).

By removing human component from the process, with the assumption that human factor is the source of corruption and misconduct, and implementing the rules of the game in the computer code (instead of legal code), we could get transparent organisations with clear rules know to everyone who understands the code.

It is evident that blockchain technology can significantly lower the information asymmetry and in some way prevent the occurrence of future financial crises. However, there are some obstacles. Firstly, this is technology in the development and mostly driven by computer enthusiasts. There is a significant amount of support by large financial organisations (central banks, banks, consortiums, and governments) that do not want to be left out from this exciting technology wave, but the things are still developing. There is a great concern about compatibility with the current legal system because smart contract and blockchain operate in a legal vacuum (at least from the perspective of our current legal system). Current systems still cannot process the inherent anonymity that is still inherent and built-in in the blockchain. Our banks have strict rules on client identification (usually known as Know Your Client or KYC rules), and some processes cannot be easily programmed because they require judicial action.

Is this time different? – Financial crisis in digital age

After going through the history of financial crises and drawing the similarities and mechanisms behind them, it is time to ask ourselves, **is it maybe different this time?**

The key feature of modern time is the extraordinary influence of the technological progress on the speed in which we are living. Fifty years of exponential growth were relying on Moore's law. That exponentiality led some observers to claim that we will encounter the end of history (Francis Fukuyama) or that the time speeds up around us (Paul Virilio).

We have already stated that one of the components of every financial crisis is the innovation. In the second step of innovation, when it becomes accepted more widely, it is often the case to experience massive capital inflow based on higher profit rates. That inflow often leads to the increase in prices that fuels speculation which again inflates the bubble. Now we are experiencing that technology is the very fibre of our world economy and it continues to be more and more important. We are on the verge of several critical technology applications, from blockchain, quantum computers and machine learning to Internet of Things and it is yet to see how the convergence of these technologies will influence our lives and reshape the financial system.

Let us contemplate our question from the beginning of this chapter by analysing events that are at the core of what should change our financial system. Based on the work of Vitalik Buterin and advertised as the way how the Internet should work, **Ethereum** is an open-source, public, blockchain-based distributed computing platform featuring smart contract

functionality that came live in July 2015³⁵. Another description from its makers is a censorship-proof planetary scale computer, where users stay in control of their funds and personal data (Ethereum Foundation, 2017). It is powered by ether (ETH), the digital cryptocurrency that is used for transactions on Ethereum. The point with smart contracts is that we can choose almost any web service and transfer it to blockchain or even develop entirely new types of projects.

The kind of application that is we interested now is a **decentralised autonomous organisation** (DAO). DAO represents a leaderless code-based organisation that is run through smart contracts, without the need for the interference from humans. The most famous DAO was called simply “The DAO”, and it was launched in May 2016 with the idea of providing a new business model for organising both commercial and non-profit companies. It got into history as the world’s largest crowdfunded campaign by getting almost \$150 million worth of ETH from about 11,000 people. For many computer enthusiasts that put their ether in it seemed like a perfect asylum from the crooked organisations run by humans. They believed that with their investment they bought a stake in the virtual hedge fund that would invest in other virtual companies. All the rules were written in code, and they did not have to worry about the misconduct of The DAO’s employees, managers or lawyers because there were none of them. When one shareholder proposes an idea of investment by putting it online, all they needed to do is to look at the code and decide whether to buy or not and if the decision gets a consensus, it is adopted.

On top of it, they did not have to trust the courts or police or attorneys for enforcement of contracts because the contracts did it themselves. Simply, if DAO shareholders vote for a

³⁵ It is also a first blockchain platform that offers Turing-complete functionality, necessary for development of full range of applications.

contract, it is executed automatically (Spode, 2017). We should remember that these are trustless systems that do not need a third party to enforce the trust. In the defining whitepaper for the DAO, it was stated that it should address problems seen in crowdfunding:

“On the one hand, [crowdfunding] has made it easier for small contributors to invest in large projects, and it has also made it possible for entrepreneurs to receive financial support that might not have been easily available in the past.

On the other hand, small investors remain vulnerable to financial mismanagement or outright fraud, and because they have a small stake in a venture, they may lack power to identify problems, participate in governance decisions, or to easily recover their investment.”
(Jentzsch, 2016)

It sounded like a perfect platform, where everything is transparent, secure and decentralised representing the world of future opportunities. The very basic idea of The DAO was:

“An organization that’s self-governing and not influenced by outside forces: its software operates on its own, with its by-laws immutably written on the blockchain, not controlled by its creators.” (Tual, 2016)

At the end of May 2016, the paper was published stressing out some vulnerabilities in the DAO’s code. By June 14th, the fixes have been proposed, and they were waiting for approval by members of The DAO, and it was said that the patch would come on June 19th. However, on June 17th some **unknown party managed to hack The DAO** using stated vulnerabilities in code (or speaking in terms of DAOs – in law). The hack happened in front of the eyes of other users who did not have a way to stop it. The attacker leveraged a bug that was allowing to withdraw multiple instances of ether from the single amount of The DAO token. In plain

language, it would be the same if someone would rob the bank by giving October monthly salary slip more than 14,000 times to the bank clerk and then receive 14,000 of salaries because that is written in bank's rules. Within a couple of hours, the thief managed to transfer more than 3.6 million ETH (more than third of a total number) into separate, child DAO. At that moment the value of stolen ether was around \$53 million.

By the rules of the DAO, when exiting the investment fund (the DAO), the users need to wait 27 days before withdrawing money, and this allowed the most influenced players in The DAO some time to think about the solution. This was the moment when things got interesting. Namely, while in the real world we would call this hack operation – heist or theft, it was not against the code of the DAO. However, no one wants to be ripped off, so the main players (the most influential was Vitalik himself) proposed the so-called *soft fork* on June 18th in order to lock all ether inside the DAO. Soft fork means that the code will be rewritten and used in future (to prevent future mischiefs). The second option was to implement so-called *hard fork*, to return all ether to their owners and to use new code from the previous moment in time. The hard fork is in confrontation to the core postulates on which the blockchain is based: immutability and non-censorship. As soon as the soft fork was proposed, the attacker sent a carefully worded message to the community:

"To the DAO and the Ethereum community,

I have carefully examined the code of The DAO and decided to participate after finding the feature where splitting is rewarded with additional ether. I have made use of this feature and have rightfully claimed 3,641,694 ether, and would like to thank the DAO for this reward. It is my understanding that the DAO code contains this feature to promote decentralization and encourage the creation of "child DAOs".

I am disappointed by those who are characterizing the use of this intentional feature as “theft”. I am making use of this explicitly coded feature as per the smart contract terms and my law firm has advised me that my action is fully compliant with United States criminal and tort law.

...

A soft or hard fork would amount to seizure of my legitimate and rightful ether, claimed legally through the terms of a smart contract. Such fork would permanently and irrevocably ruin all confidence in not only Ethereum but also the in the field of smart contracts and blockchain technology. Many large Ethereum holders will dump their ether, and developers, researchers, and companies will leave Ethereum. Make no mistake: any fork, soft or hard, will further damage Ethereum and destroy its reputation and appeal.

I reserve all rights to take any and all legal action against any accomplices of illegitimate theft, freezing, or seizure of my legitimate ether, and am actively working with my law firm. Those accomplices will be receiving Cease and Desist notices in the mail shortly.

I hope this event becomes a valuable learning experience for the Ethereum community and wish you all the best of luck.

Yours truly,

‘The Attacker’ ” (An Open Letter To the DAO and the Ethereum community, 2016)

Very vocal discussion followed within Ethereum community about whether to bailout the situation or to stay firmly with philosophical ideas of the blockchain. On July 20th 2016, the majority of the DAO adopted the hard fork, and the ethers were returned to their original owners. This enraged the part of Ethereum community that decided to stay with the original

code, now re-dubbed as “Ethereum Classic”. In their view, the hard fork undermined the very idea of Ethereum, to bypass all the human factor meaning corrupt bureaucrats, politicians, CEOs and lawyers. *“The code was supposed to be the law. If you didn’t see the weakness in the software, that was your problem, since the software was publicly available”* (Spode, 2017).

Seen on its own, the move was reasonable. It represented a one-time fix for a one-time problem. On the other hand, it weakened the trust in the Ethereum as a foundational infrastructure for other projects with a vision of a more agile society. In a trustless universe, it is a question who and when can harm the immutability of the system. We cannot resist the urge to draw a parallel with Alexander Hamilton and his bailout in 1792. While wanting to develop a better financial system with a well-intended mission, both (Hamilton and Buterin) made a move that set a precedent and to save the day, they managed to stain the prospects for future generations to come.



Figure 12: Familiar pattern. Bitcoin price chart, as of May 28 2017

Source: blockchain.info

Conclusion

In this work, we tried to depict a specific *circulus vitiosus* that exists between the financial system and crises it accommodates sometimes. We saw that many mechanisms of the current financial system were forged in furnaces of crises and that some changes in the financial system introduced with the idea of preventing the crises managed to prepare a fertile ground for crises of even greater scale. Apart from going through history by centuries, around the globe by countries, through economic theory by approaches, we also made a journey to the digital world, all with the goal of deriving proper conclusions and filtering out similarities.

We saw that introduction of safety nets like bailouts and deposit insurance brought moral hazard and *instead of the riskless system we got reassignment of risk*. These mechanisms transferred risk from the private sector to the taxpayers thus skewing the basic risk-reward relation, essential for motivating parties to long-term and rational behaviour.

We also saw that resulting omnipresent fraud pressed one part of the economy to withdraw and start their own, digital world based on a trustless system and immutable truth. However, the aftermath of The Dao hack, the project a decentralised autonomous organisation without human interference, *instead of the trustless system offered us reassignment of trust*. Now instead of policy makers and bankers, we should trust programmers and their code.

In the end, we managed to draw so many parallels and similarities in this work that the only answer to the question *"is this time different?"* could be:

"We will see, but it looks very familiar."

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