Bits and Bytes of Financial Regulation: The Regtech Environment

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Abstract

Since 2008, banks have spent more than €342 billion on settlements, enforcement actions, and fines, and until 2020 according to Reuters this value is expected to rise to €400 billion. As a result, technological solutions were implemented to help financial institutions deal with the increasing compliance burden and regulators addressing the constant difficulties of enforcing and monitoring regulatory requirements to limit risks and promote financial stability. This led to the emergence of a whole new movement in the Financial Industry: Regulatory Technology or Regtech. The aim of this paper is to explain the Regtech environment in the financial sector. We highlight how technology can help financial institutions dealing with risky behavior and regulatory demands in the most efficient and cost-effective way.

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Introduction

Crises trigger adaptation processes, we readapt ourselves with new attitudes and behaviors. The 2008 Global Financial Crisis produced new problems and challenges, forcing upon us a shift of paradigm to avoid a similar downfall in a near future. Until 2008, the financial sector was enjoying a decade of benign economic conditions, only disrupted by a decline in economic activity in the early 2000s. Banking conditions seemed very reassuring with six consecutive earning records for the industry's top players from 2001 to 2008 (Klein, 2017).

Public and the private sectors greatly underestimated the risks that we were facing. The economic boom that occurred in the first 2000's massed to a significant build-up of risks. The banking agencies did not recognize the full extent of these risks, and the regulatory framework did not provide adequate safeguards for financial stability. Markets and regulators had to discover that they failed to recognize one risk, "systemic risk" (Klein, 2017).

The activities of financial institutions operating under pre-crisis rules fueled the housing bubble and contributed to the collapse of the financial system. Disproportionate use of financial leverage, inadequate liquidity, securitization of large volumes of poorly underwritten mortgages and the growth of an opaque network of credit derivatives backing those securitizations (Klein Aaron, 2017). The confluence of these factors led to the need for taxpayer's bailouts on an unprecedented scale (Klein, 2017).

Countries paid a high price for not recognizing the magnitude of risks faced in the pre-crisis years through the weakness in the banks' regulatory frameworks (Klein, 2017). But even after the global financial crisis, risky behavior persisted, and the eternal cat and mouse game carried on with the London Interbank Offered Rate and the currency market manipulation scandals or the Commodities Exchange gold and silver future markets spoofing scandal.

Since 2008, banks have spent more than €342 billion on settlements, enforcement actions, and fines, and until 2020 this value is expected to rise to €400 billion (Reuters, 2017). To further put things in perspective, on the whole, the industry spends between €900 million to €1.3 billion a year on compliance-related costs and the number of regulatory worldwide changes a bank has to deal with every day has increased from 10 in 2004 to 185 today (Reuters, 2017). That amounts to a regulatory change that has to be interpreted and implemented every 12 minutes (Reuters, 2017). But not only the cost side is at stake, Quinlan and Associates, a Hong Kong-based financial services consultancy firm, estimated that risky behavior had erased $850 billion in profits for the top 50 global banks since 2008.

Increasing compliance costs and regulatory requirements made the use of innovative technologies a natural and promising solution not only for financial institutions but also regulators: as such we are now at the advent of the Regtech revolution (Arner, Barberis, and Buckley, 2017). Regtech is the management of regulatory demands within the financial industry through technology.

Powered by artificial intelligence, machine learning, deep learning, and advanced analytics, institutions can now structure unstructured data (attachments files, the content of web searches, emails, corporate chats, etc.) to fully comprehend the true context of all types of communications and prevent insider threats of doing considerable damage. Regtech can help financial institutions deal with the evolving compliance demands and conduct risk, which exposes them to severe reputational losses and fines.

This study provides a detail discussion of how technology can help financial institutions deal with risky behavior and regulatory demands in the most efficient and cost-effective way. We highlight how long and complex the process of adaptation to technology can be. We explain how technological advances are changing the financial landscape at an unforeseen rate, offering opportunities but also creating risks. While Fintech is inherently financial in its focus, Regtech has the potential for application in a wide range of contexts making this study relevant to many other settings, such as environmental compliance monitoring or tracking the global location of airliners on a real-time basis (Arner, Barberis, and Buckley, 2017a).

Innovation and Financial Regulation

The launch of the electronic calculator in the early 1960s and the ATM in 1967 marks a period of digitization in Finance. SWIFT, the Society for the Worldwide Interbank Financial Telecommunication, which provides protocols to enable communications between domestic digital payment systems, was established in 1973, followed soon after by the collapse of Herstatt Bank in 1974, a privately held German bank that went bankrupt due to wrong bets in the direction of U.S. dollar in a famous incident that illustrated the risks of international finance (Arner, Barberis, and Buckley, 2015). German regulators forced closure on the bank on 16:30 in Germany which in turn was 10:30 in New York, as a result the bank ceased operations between payment times and the counterparties did not receive their respective U.S. dollars payments, coining an alternative term to settlement risk known as Herstatt risk[1] (Arner, Barberis, and Buckley, 2015).

This event proved that with markets becoming increasingly global, local regulations were ineffective to address the trials of international finance. As a result, the collapse of Herstatt Bank served as the catalyst for the first major regulatory initiative: the establishment in 1975 of the Basel Committee on Banking Supervision of the Bank for International Settlements (BIS) (Arner, Barberis, and Buckley, 2017b).

The historical background of financial regulation is in its essence a story of regulatory initiatives in response to a crisis. An example, is the financial liberalization and deregulation of the 1970s followed by the Latin America debt crisis in the early 1980s (Arner, Barberis, and Buckley, 2017 a). The Latin America debt crisis and the growing concerns on deteriorating capital ratios of main international banks became the driver for the first Basel Accord on capital adequacy in the late 1980s (Arner, Barberis, and Buckley, 2017a). This liberalization process, followed by crisis, and then a reactive regulatory response demonstrates the unfortunate cyclical nature of regulatory reform given that prevention should be its core focus.

"The year 1987 marked a new period of regulatory attention to the risks of international finance and its intersection with technology" (Arner, Barberis, and Buckley, 2015: 10). A major market crash occurred. "The "Black Monday" stock market crash showed that markets around the world were interlinked through technology in a way not seen since the 1929 crash" (Arner, Barberis, and Buckley, 2015: 10). Stock markets fell deeply in Hong Kong, Australia, Spain, United Kingdom, New Zealand and the United States becoming the largest one-day percentage decline in the Dow Jones Industrial Average[2], an index that aggregates 30 large publicly traded companies in the United States. Although until today there is still no agreement on the causes of the crash, the theory is that the crash was caused by "program trading"[3] (Arner, Barberis, and Buckley, 2015).

The reaction led to the introduction of a variety of financial regulatory instruments, particularly in electronic markets, to control the speed of price changes ("trading curbs" also called as "circuit breakers") thus preventing speculative gains and dramatic losses (Arner, Barberis, and Buckley, 2015).

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[1] Alternative term to settlement risk with particular reference to foreign-exchange transactions.

[2] Saturday, December 12, 1914, is sometimes erroneously cited as the largest one-day percentage decline of the DJIA. In reality, the ostensible decline of 24.39% was created retroactively by a redefinition of the DJIA in 1916.

[3] "Program trading" involves pre-set computerized buy and sell orders, and so when stock prices drop to a certain level, this would trigger automatic selling by computer programs, which would then trigger more price drops, triggering more sales and eventually resulting in our first major coordinated global market crash.

It also led securities regulators around the world to begin working on mechanisms to support cooperation, in the same way that the 1974 Herstatt crisis and the 1982 Latin America debt crisis triggered greater cooperation between bank regulators on international finance (Arner, Barberis, and Buckley, 2015: 11).

Further, the underlying framework for a single market in the European Union established by the Single European Act (1986) and the financial liberalization in the United Kingdom, combined with the Maastricht Treaty (1992) and an ever-growing quantity of financial services Directives and Regulations from the late 1980s, set the structure for the complete interconnection of the European Union financial markets by the early 21st century (Arner, Barberis, and Buckley, 2015).

Financial institutions expanded in scope and scale, culminating in huge conglomerates, grouped companies that provide services in at least two different financial sectors (banking, securities, insurance), leading the path for a much more interconnected financial market (Arner, Barberis, and Buckley, 2017a). This took place mainly due to mergers and acquisitions, with the merger of Travelers and Citibank to form Citigroup in 1999 becoming quintessential (Arner, Barberis, and Buckley, 2017a). This specific deal is attributed by some as the start of the deregulation period that led to the 2008 Global Financial Crisis, because Citi became such a diversified financial services enterprise in 1998, it was legally incompatible with the GlassSteagall Act of 1933, the legislation that established the Federal Deposit Insurance Corporation (FDIC) and forbade banking entities from acting as both a commercial bank and an investment bank or broker (Verschoor, 2009).

TABB group's report (2017) analyses this issue as many of today's large banks are the product of multiple mergers over the last 30 or so years, reflected below on Figure 1. They are saddled with complex and redundant legacy infrastructure that may not have been fully integrated.

Figure 1: US Bank Mergers 1996 to 2009. Source: "TABB Group"
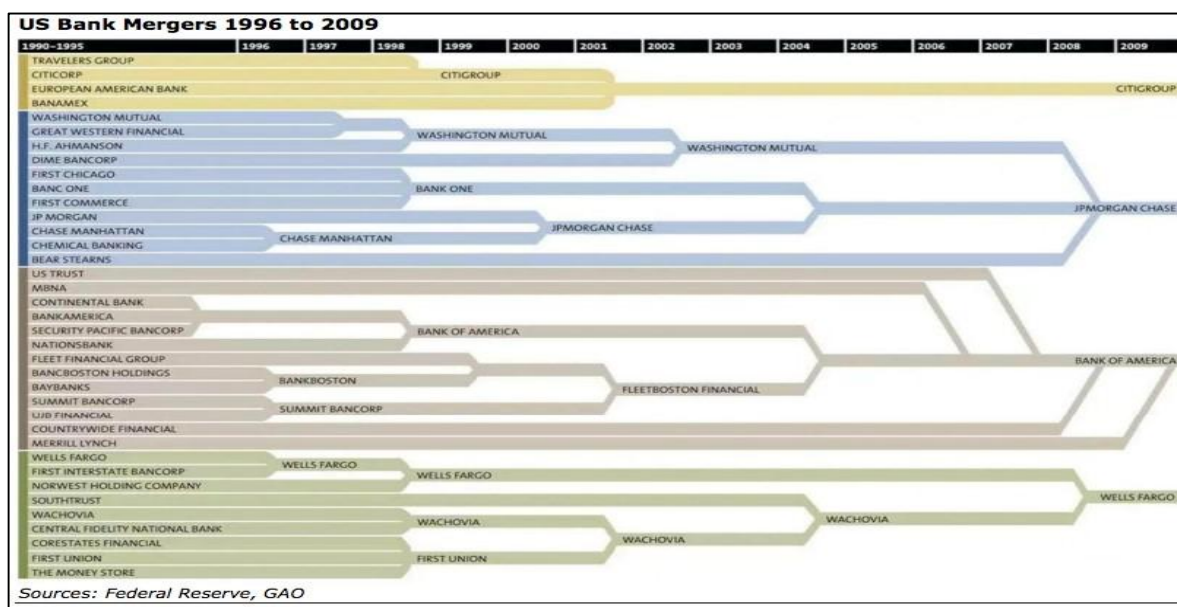
As institutions increased their cross-sector and jurisdictional scope, they also faced many new regulatory challenges. According to Arner, Barberis, and Buckley (2016), the first iteration of Regulatory Technology appeared through the 1980s and 2000s risk and management teams with the combination between quantitative finance and information technology reflected itself in the Value At Risk (VAR) systems in financial institutions. Software systems developed by developed by J.P Morgan, subsidiaries of Reuters and other vendors were part of a set of tools that enabled participants in the financial markets to estimate their exposure to market risk (Risk Metrics Technical Document, 1996). The issue was that the sector, including regulators became overconfident with the aptitude of this quantitative IT framework for risk-management purposes, as it was shown by the heavy reliance of the Basel II Capital accord on these risk-management systems for financial institutions (Arner, Barberis, and Buckley, 2016 a).

The 2008 Global Financial Crisis

Prior to the 2008 Crisis, regulatory approaches to financial innovation were framed as "restricted" or "permissive".

Arner, Barberis, Buckley, and Zetsche (2017) suggest that while crises might be more common in more permissive systems, over the medium to long term the benefits in terms of growth and development outweighed the costs of periodic crises.

The efficient market hypothesis states that markets will price assets with all the information available and therefore parties can make decisions on how to efficiently allocate their resources.

This hypothesis led to a general consensus for market-based approaches to financial regulation, even though it is based upon a number of perfect market assumptions, such as costless information, no transaction costs, that investors have homogeneous expectations and are rational. In theory, these ideas would therefore lead towards efficient financial markets and proper support of the overall economy (Arner, Barberis, Buckley, and Zetzsche 2017).

The issue was that even before 2008, it was known that information is not costless, there are transaction costs in acquiring information or enforcing transactions in markets, and that investors don't have homogeneous expectations. Although regulation would be used to help markets function in a better way, the 2008 crisis and the billions of dollars spent in bailouts highlighted a much bigger problem which is called systemic risk (Lin, 2016). Comparable to the 1929s and 1930s Great Depression, the collapse of an individual Financial Institution caused the collapse of the entire financial system, which resulted in an economic collapse.

"In the wake of the 2008 Crisis, the dominant permissive paradigm has of necessity been subject to reconsideration, with the regulatory pendulum going from one extreme to the other" (Arner, Barberis, Buckley, and Zetzsche 2017: 49). Market efficiency could be increased by innovation, thus delivering new solutions to old problems, including financial exclusion and the quality of consumer decision-making to make markets global complete with improved risk-sharing. Although, as seen with derivatives and securitization, financial innovation can bring new risks, due to their characteristics they are also indispensable to risk transfer and financial management purposes (Arner, Barberis, Buckley, and Zetzsche 2017).

It was in the Post-Global Financial Crisis environment that Regulatory Technology developed to the stage it's in today. Increasing compliance costs and regulatory requirements made the use of innovative technologies a natural and promising solution not only for financial institutions but also regulators (Arner, Barberis, and Buckley, 2017a).

Post-Crisis Reforms

"From 2008 up to approximately 2016, regulatory requirements at the international level, such as the United States and the European Union, were dominated by the necessity to reregulate the financial system, to prevent future financial crises or at least to put in place new regulatory frameworks which would have prevented or alleviated the 2008 Crisis" (Arner, Barberis, Buckley and Zetzsche 2017: 49).

And as crises and scandals become bigger, so do the regulatory responses to them. For example, the Glass-Steagall Act of 1933, which was implemented following the Great Depression, only ran 37 pages. Contrary, Dodd-Frank, the United States bedrock law to prevent a future financial breakdown contained 848 pages with other thousands of additional rules (and still much more forthcoming, according to Lin, 2016).

"It has been estimated that it would take businesses over twenty-four million workers' hours to comply with the demands and requirements of the Dodd-Frank rules. Also, Dodd-Frank's "Volcker Rule" relating to risky proprietary trading[4] alone is contained in 964 pages, including an 893- page preamble. This specific segment involved 18,223 comments and 1,238 days of rulemaking" (Lin, 2016: 167).

As such, the overreliance in lengthy regulations led to massive compliance costs across the industry, not only for the regulated but for the regulators, as the increasing regulatory complexity requires greater granularity, precision and frequency in data reporting, aggregation and analysis (Arner, Barberis, and Buckley, 2016).

Examples are shown in the case of capital and liquidity regulations under Basel III, stress testing and risk assessments or the reporting requirements imposed on Over the Counter derivatives transactions resulting from Group of 20 (G20) and Financial Stability Board (FSB) agreed approaches in the context of United States Dodd-Frank or the European Union European Market Infrastructure Regulation (EMIR) (Arner, Barberis, and Buckley, 2016).

According to Reuters, the number of regulatory changes a bank has to deal with every day has increased from 10 in 2004 to 185 in 2015. That amounts to a regulatory change that has to be interpreted and implemented every 12 minutes. "The European Union's Markets in Financial Instruments Directive II (MIFID II) runs into 30.000 pages and 1.5 million paragraphs, making it an immense task to understand the directive" (The Irish Advantage, 2018: 9).

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[4]The practice of banks trading for themselves rather than for clients.

According to the London-based Regtech council in the five years following 2012, more than 50.000 regulations were published across the G20. Traditional compliance tools were and are still ill-equipped to deal with this regulatory surge (The Irish Advantage, 2018: 9).

This complex and fragmented regulatory framework displayed across markets has given rise to additional compliance burdens (Arner, Barberis, and Buckley, 2016).   Global policymakers push for similar post-crisis reforms, but requirements and rules for implementing these can be similar or very different, overlap and contradict, which led to the financial sector turning to Regtech for optimizing compliance management (Hill, 2016).

The Global Financial Crisis damaged banks' profits and competitiveness, and the consequent regulation drove compliance costs to record highs while simultaneously restricting credit. (Arner, Barberis, and Buckley, 2017b: 6). Reported by Let's Talk Payments, "the annual spending by financial institutions on compliance is estimated to be in excess of US $70 billion." (Arner, Barberis, and Buckley, 2016: 389). Since 2008, banks have spent more than €342 billion on settlements, enforcement actions and fines, and until 2020 this value is expected to rise to €400 billion (Reuters, 2017).

But not only the cost side is affected by misbehavior, according to a study by the World Economic Forum performed in 2012, on average more than 25 percent of a company's market value is directly attributable to its reputation. Quinlan and Associates a Hong Kong-based financial services consultancy firm estimated that risky behavior had erased $850 billion in profits for the top 50 global banks since 2008 (Reuters, 2017). In a highly connected world for customers, operations, supply chains and internal and external stakeholders, reputations can be jeopardized with just a few keystrokes (Deloitte, 2016).

But even after the Global Financial Crisis, risky behavior persisted, and the eternal cat and mouse game carried on with the London Interbank Offered Rate and the currency market manipulation scandals or the Commodities Exchange (COMEX) gold and silver futures markets spoofing[5] scandal. The race between evolving compliance demands and conduct risk continues exposing organizations to severe reputational losses and fines.

As a result, countless reviews have been implemented to assess how financial institutions managed risks today. Most reviews showed weak governance and lack of a robust risk and control environment. Financial institutions failed to demonstrate that those accountable for bringing in risks clearly understand the importance of the unmitigated exposure their institutions are currently facing. In addition, those in charge of overseeing such behaviors were equally unaware and ill-equipped (Price Waterhouse Coopers, 2018).

These findings prompted a re-examination of the 'three lines of defense' within financial institutions: 1st Line of Defense (Management controls and internal controls measures), 2nd Line of Defense (Compliance, Risk Management, Financial controllers and Inspection) and 3rd Line of Defense (Stakeholders with respect to risk issues and the responsibility/ accountability to provide effective oversight of the enterprise's risk profile) (Price Waterhouse Coopers, 2018: 3). This will be important to understand the supervision framework for the in-company project.

Regulatory Technology: Regtech

The first time the term Regtech was coined is attributed to Professor Philip Treleaven of the University College London, one of the authors of Fintech Futures – a report produced by the United Kingdom's Government Office for Science in 2015 (Management Today, 2018).

According to Arner, Barberis, and Buckley (2017b), Regtech refers to technological solutions that streamline and improve regulatory processes.

As we saw in the previous sub-section, after the Global Financial Crisis, regulatory demands increased substantially. The amount of data regulators requested supervised entities to disclose was reached all-time highs. As a result of this, and previous risky behavior, rising compliance costs and regulatory fines became a big concern in the finance sector. At the same time, developments in data science (Artificial Intelligence and Deep Learning) were allowing structuring of unstructured data and data analytics tools were enhancing the efficiency of supervisory tools. Thus, Regtech emerged (Arner, Barberis, and Buckley, 2017a).

According to the Spanish international bank BBVA, financial industry Regtech focuses on:

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[5] The practice of placing orders in the market with the intention to cancel these orders prior to their being filled. The practice is used to ramp prices and give false impressions of market depth.

"The automation of manual processes and the links between steps in analytical/reporting processes, the improvement of data quality, the creation of a holistic view of data, the automated analysis of data with applications that are able to learn during the process, and the generation of meaningful reports that can be sent to regulators and used internally to improve key business decision making" (Arner, Barberis, and Buckley, 2017a: 389).

It stands for a holistic approach, which provides a more accepting and technological financial regulatory culture, with a flexible and forward-thinking framework and new or revised regulation centered on technology (Transatlantic, 2017:5). Regtech was firstly known by a few firms as a "trendy expression" within the Fintech world in 2015. Nevertheless, it has existed as a separate space since 2010, which has unmistakably developed in the course of the most recent years and pulled in a great deal of attention from the financial services industry (Alvarez and Marsal, 2018).

According to Alvarez and Marsal report (2018), from 2010 to 2016, Regtech built up a strong establishment inside the Fintech world, focusing on complex new regulations, litigation and regulatory remediation areas faced by banks and overall reduction of costs of compliance. An estimated over 300 Regtech firms were launched up till 2016.

A start-up phenomenon rose with the need to develop rapidly. Regulators were also searching for new approaches that helped to implement regulations as efficiently as possible (Alvarez and Marsal, 2018).

A case-study by Watson Financial Services, IBM, 2017 where IBM OpenPages software was deployed to enhance risk and control assessment workflows for HypoVereinsbank resulted in 33% of reduction in personnel requirements due to better use of existing resources.

Regtech not only offers banks the potential for massive cost savings in meeting their compliance obligations, but it can also offer the opportunity for regulators to perform their functions more effectively in close to real-time (Arner, Barberis, Buckley, and Zetzsche 2017: 52).

Regtech firms deal with information in a way that was never seen. Data collection, monitoring, analysis and reporting evolved into a completely new industry. This was fundamentally driven by advances in big data technologies. The firms that propelled in this period managed upcoming regulations like Payment Services Directive (Open Banking), Markets in Financial Instruments Directive II (MIFID II), Fourth Money Laundering Directive (4MLD) and General Data Protection Regulation (GDPR). By far most solutions conveyed were utilizing models around Software as a Service (SaaS) also known as software on demand and open Application Programing Interfaces (APIs) which can be thought of as a simpler way for developers to interact with different kinds of software, a protocol that allows institutions to access and retrieve information from other institutions operating software, systems or libraries in an automated way (Alvarez and Marsal, 2018).

The regulatory market is flooding with data, and as a result the whole lifecycle of policymaking, enforcement and supervision is ready for disruption with the use of cutting-edge technologies. According to Arner, Barberis, and Buckley (2016), while our financial system is moving from Know-Your-Customer standards to a Know-Your-Data approach, an altogether new regulatory paradigm that will manage everything from advanced digital information to data sovereignty, similarly should advance.

While Fintech and Regtech can be confused, from a market dynamic point of view, Fintech's development can be mainly attributed to a bottom-up movement led by start-ups and IT firms. Whilst Regtech has developed as top-down response to institutional demand (Arner, Barberis, and Buckley, 2017a). On an early phase of Regtech, start-ups focused more on the technology to drive compliance use cases and were less acquainted with the subtleties and regulatory complexities in a holistic way, which proved a significant challenge for banks wishing to work with them (Alvarez and Marsal 2018).

Presently, Regtech firms are expected to team up with banks and regulators to exhibit their contributions far more rapidly and as these advance from specialty suggestions to more extensive and consistent recommendations, they become in far more need of help from regulators (Alvarez and Marsal, 2018).

Financial institutions are progressively applying technology to meet the demands of regulators, reduce compliance costs and avoid regulatory fines, particularly upon large financial institutions in developed markets arising from new post-crisis regulations.

On the other side, regulators are confronted with the need to use technology to address the constant difficulties of enforcing and subsequently monitoring increasing regulatory requirements and are faced with developing regulatory approaches that do not hinder development and innovation while still limiting risks to consumers and financial stability (Arner, Barberis, and Buckley, 2017a).

As an example of regulatory innovation, the Securities Exchange Commission Market Information Data Analytics System (MIDAS) allows to readily perform analysis of thousands of stocks for over periods of six months to a year, involving 100 billion records at a time (Milken Institute, 2018).

Working for both sides of the fence, start-ups should be persistent in dealing with bureaucracy and long-lasting sales cycles. According to Alvarez and Marsal (2018), they need to enhance their regulatory insights and show unambiguously how their answers can enable the financial institutions and regulators to perform their jobs better than before.

Regtech can therefore help: regulators creating solutions that can cater to specific requirements; industry associations for the development of standards; financial institutions to test new solutions for cost reduction, compliance improvement and shareholder interest protection; Fintech and Information Technology providers to offer integrated products. So indeed, Regtech has the potential to transform compliance across the financial services industry (The Irish Advantage, 2018).

Despite the experiences of the Crisis, financial and technological innovation matters deeply, and regulators need to perform a balancing act between preserving stability, protecting consumers, and promoting innovation (Arner, Barberis, Buckley, and Zetzsche 2017).

The Institute of International Finance (2016:3-4) list some of the technologies with potential to help on easing the compliance burden whilst increasing efficiency and effectiveness:

- Machine learning, robotics, artificial intelligence, big data analytics and other improvements in computerized analysis and thinking create sizable possibilities when applied to compliance. Data mining algorithms based on machine learning can organize and analyze large sets of data, even if this data is unstructured and of a low quality, such as sets of emails, pdfs and spoken word. For surveillance and monitoring advances in Data Science technologies like Natural Language Processing or Sentiment Analysis could interpret the language and the opinions expressed on a piece of text to determine the writer's attitude towards a particular topic, product, etc. Other uses for Data Science technologies could be for example Automated Fraud Detection, by identifying suspicious patterns in credit card transactions or even market abuse techniques;

- Improvements in cryptography lead to a more secure, faster and more efficient and effective data sharing within financial institutions, most notably for more efficient risk data aggregation processes. Data sharing with other financial institutions, clients and supervisors could equally benefit;

- Biometric is already allowing for large efficiency and security improvements by automating client identification which is required by know-your-customer (KYC) regulations;

- Distributed Ledger Technology, well known for Bitcoin, could in the future allow for the development of more efficient trading platforms, payments systems, and information sharing mechanisms in and between financial institutions. When paired with biometrics, digital identity could enable timely, cost efficient and reliable customer identification (KYC) integrated with Anti-Money-Laundering (AML) related rules;

- Application programming interfaces (APIs) and other systems allowing for interoperability in accessing and retrieving information could for example, lead to pre-determined reporting of data to regulators;

- Shared utility functions and cloud-based computing could allow financial institutions to pool some of their compliance functions on a single platform, allowing for performance and efficiency gains.

Emerging technologies will surely play a critical role in future-proofing Regtech solution (The Irish Advantage, 2018). Alvarez and Marsal report (2018:7) classified the following Regtech digital use cases for financial institutions:

- Regulatory compliance: Gathering regulatory intelligence, mapping policies, compliance governance and automated data sharing with regulatory authorities;

- Risk management. detect market risks, monitor employee conduct for suspicious behavior and protect data from numerous cyber risks;

- Financial crime: monitor financial transactions in real-time to detect fraud, market abuse, money-laundering or terrorist financing activities;

- Identity management: Know Your Customer (KYC) procedures, anti-money laundering sanctions and anti-fraud screening.

One of the main requests for financial institutions is Regtech solutions capable of multivector analysis, with interoperability, and specific supervisory guidelines for the product's architecture (Enriques, 2017) placing compliance as a competitive advantage and not purely a cost (Wyman, 2018).

Alvarez and Marsal report (2018) collected data from 401 Regtechs, 49 Traditional vendors and 352 start-ups, and concluded that only 4% play in conduct risk and 2% on Surveillance. A Verizon report on data breach investigations conducted in 2018 showed that 77% of data breaches are a result of insiders.

Although cyber-crime also plays a big role, internal data breaches have been one of the biggest threats for institutions so far, like a former National Security Agency (NSA) contractor showed the world. As a result, and if no prevention measures are taken, this number is surely expected to rise.

For how many banks they've worked with, 38% of start-ups answered with 2 to 5 clients, 27% answered 10+ clients and 17% answered 1 client, being that most were in Proof of Concept deployment model. The main challenges for the start-ups are the long bureaucracy and sales process, too many silos across the banks, lack of new digital solutions by large tech vendors and difficulty understanding new regulations.

For the type of engagements, 80% were Proof of Concept while the underlying technologies were 65% data analytics and AI, 25% robot process automation (RPA) and 20% distributed ledger technology (DLT). 91% of Regtechs have only done Proofs of Concept with banks. On average, Regtechs see a shorter duration of 1-3 months in getting a Proof of Concept approval from banks after a qualified meeting. Proof of Concept approval to Proof of Concept completion stage takes a bit longer and is in the order of 3-6 months. The last stage of converting a Proof of Concept into an actual sale of products, custom solutions or services seems to take the longest and is said to be in the order of 3-9 months.

The Regtech markets directory published in 2017 a white paper that analyzed the Regtech market stated that before the financial crisis fewer than 68 products addressing regulatory needs had been introduced to the market. Rising 135% from 2007-2011 and 158% from 2012-2016, with 68 new products in 2016 alone. KPMG noted in their pace of Fintech Q2 2017 report that: "Regtech investment and deal volume continued to gain strength in Q2 2017 with a mid-year total of $591 million invested across 60 deals. Regtech investment has already exceeded 2015's annual results and is on pace to surpass 2016's record. Deal volume is also on track to exceed 2014's peak high of 106 deals."

Similarly, CB Insights European Regtech map notes that: "...since 2013, private Regtech companies have raised approximately $4.96B in disclosed equity funding across 585 deals globally (CB Insights, 2017). While the US leads in Regtech deals and funding, countries in Europe collectively account for 18% of global Regtech deal share. Europe has been a hotbed for early-stage Regtech start-ups with a focus on solutions for the financial services industry." They go onto predict a total of $1.29bn of new Regtech funding by the end of 2017" (Regtech Markets Directory, 2017: 6) and the global demand for regulatory, compliance and governance software is expected to reach $118.7 billion by 2020 (Medici, 2016).

A Moody's Analytics survey from April 2018, (122 responses from compliance, technology and finance sector professionals) showed that 63.1% of respondents think that the Regtech budget will increase in the next 2-3 years. Also, the Dow Jones / SWIFT Global AML survey showed that 59% of the respondents say technology has improved their anti-money laundering (AML), know- your-customer (KYC) and sanctions requirements (Dow Jones / SWIFT, 2017)

Failure on the part of market participants to adapt to the newer digitalized infrastructure presents a business risk that may separate winners from losers in the coming years. As well, failure to adapt to a more automated regulatory compliance process may leave participants with platforms ill-suited for the current regulatory framework (Armstrong, 2017: 6).

Finally, it will be interesting to see how the cat-and-mouse game between supervisor and supervisees will evolve. Mice will know that thanks to Regtech, cats have improved their ability to detect law breaches. "But there will always be grey areas wherein to test the effective reach of the law" (Enriques, 2017: 8).

Explaining and Preventing Manipulation

As described above the story of financial regulation is cyclical. Electronic communications are of extreme importance for any institution, they can serve as prevention and evidence of risky behavior. Before the 2008 crisis a JP Morgan manager told his employees to stop putting mortgage related stuff in writing, as a package of old, cast-off mortgages with serious issues (about 40% of the borrowers were blatantly lying about their incomes on applications) was packaged and sold as a low-risk security (Business Insider, 2014). Although this was a very wrongful act it serves as example to how this manager was aware that himself and JP Morgan could be traced by communications.

Emails, telephone calls, and electronic chats were a crucial part of the evidence amassed in the LIBOR[6] (London Interbank Offered Rate) investigations and other FX rate fixings worldwide. If the rates are low, it means there is confidence in the system and lenders will get their money back. If rates are high, it means the whole system maybe on the verge of a meltdown. If determined in an untruthful way, it could be an incentive for lowering the rate to falsely show stability and/or to inflate derivative profits.

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[6] LIBOR is the London Interbank offer rate, average of the interest rate that banks are lending to each other.

This rate is used as a benchmark for determining interest rate for various debt instruments, mortgages, corporate loans, government bonds, credit cards and student loans in various countries. As such, the LIBOR manipulation scandal had big implications "robbing Baltimore and other cities of millions of dollars in returns on investments such as interest-rate swaps" – themselves risky financial instruments that big banks force cities to use in order to fund transit systems, schools, water works, and other city services. (Public Banking Institute, 2012).

For the purposes of understanding this risky behavior a UBS trader in another exchange told his broker via chat: "If you keep 6s (the six-month Japanese Libor rate) unchanged today… I will do one humongous deal with you … Like a 50,000-buck deal, whatever," according to the Zurich-based bank's December 2012 settlement with the regulator. "I need you to keep it as low as possible … if you do that … I'll pay you, you know, 50,000 dollars, 100,000 dollars … whatever you want…" (Bloomberg, 2013).

In 2013 a group of traders were caught manipulating the currency market, basing their efforts around the 16:00 London WM/Reuters currency fix" which determines the rates for different currency pairings. Banks usually make a profit with their client orders by buying a currency in the market at a lower rate than the rate it uses to sell to clients (Whistle-blower security, 2014).

Traders can manipulate this fix rate to make some illegal profits, and in this case, they used chat rooms to share information about impending client order flows, which are supposed to be kept confidential. Goldman Sachs, Barclays, Deutsche Bank and UBS are now collaborating with the regulators (Alper and Ridley, 2012). Calling online chatrooms as "The Bandit's Club" and "The Cartel" and bragging about their fixes within the chats, shows that big banks traders not only poorly behaved, but did it with pride (Forbes, 2015).

Even Bloomberg reporters were participating in multi-firm chatrooms (e.g. Bloomberg chats, ICE chats, Reuters chats) and they are forbidden to participate in client chat rooms on the company's terminal (Bloomberg, 2013).

Michael DuCharme, head of foreign exchange and business growth and development at Seattle-based Russell Investments, which oversees about $246 billion, said in a Nov. 18 interview, before the UBS announcement that it was banning the use of multi-firm and social chat rooms. "If the chat rooms contribute to the collusion, then I think that can be worked around. I don't know if banning that avenue would be sufficient." (Bloomberg, 2013). Which raises a very good question following the ban of multi-firm chatrooms on several institutions following the scandals. Is it really the mean of communication that's at stake or is it a deeper conduct issue, blind profit-seeking nature of employees and employers.

Between 2008 and 2015, 16 traders from at least four major financial institutions defrauded the Commodities Exchange (COMEX) gold and silver futures markets mainly by spoofing the markets (tricking the markets into thinking there's more demand than actual). Postspoof chats show us again, the abusive nature of this behavior: Trader 1, "so glad I could help…got that up 2 bucks… that does show u how easy it is to manipulate so[me]times" (Doctors, 2018). The Commodity Futures Trading Commission and the Department of Justice are investigating and charging this case.

Even the blow-up of the Chicago Board Options Exchange (CBOE) Volatility Index (VIX) in February 2018 led to an alleged whistle-blower writing a letter to the SEC through his lawyer alleging the CBOE Volatility Index, a key measure of market fear, is subject to potential manipulation, and that it could be causing nearly $2 billion in annual gains and losses to investors. The Financial Industry Regulation Authority (FINRA) was reportedly looking into alleged manipulation of futures on the VIX and CBOE volatility index, according to The Wall Street Journal (CNBC, 2018).

Below, Figure 2 presents a sample market legislation and the incidents of misconduct 1985 to 2016:
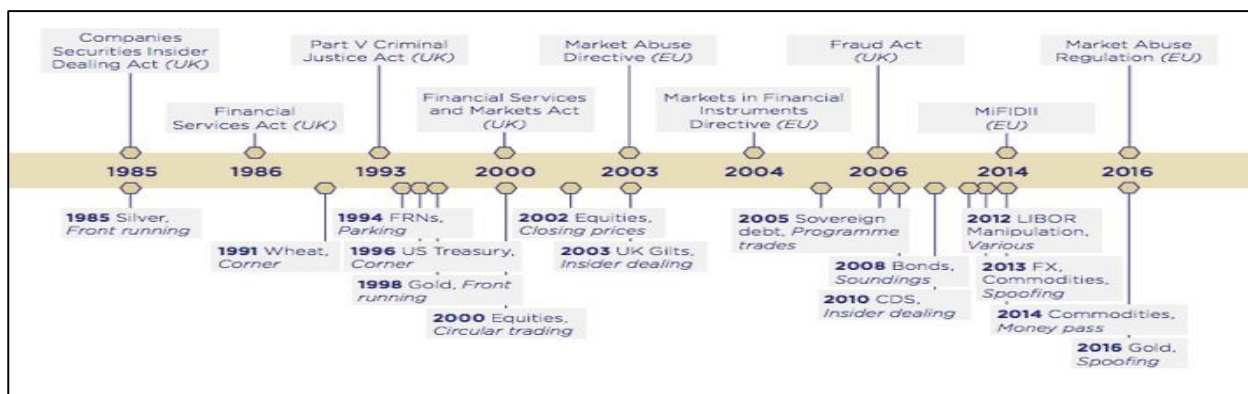
Figure 2: Sample Market Legislation and the Incidents of Misconduct 1985-2016. Source: "FICC Markets Standards Board Annual Report"

As shown, manipulation is therefore fundamentally an issue of intent, but how does one prove intent? By noticing unusual trading patterns and crossing them with communications that prove that same intent.

How much could be prevented with the right tools in place is just one of the many questions that regulatory technology tries to tackle.

Technological advances like Cloud Computing, Big Data Analytics, Machine Learning and AI not only allow for lower compliance costs but also for increased efficiency in spotting and processing compliance breaches. Data mining algorithms based on machine learning can organize and analyze large sets of data, even if this data is unstructured and of a low quality, such as sets of e-mails, pdfs and spoken word.

The benefits of an advanced surveillance tool can save millions in regulatory fines, and bring clients trust with it. And trust is worth many millions more.

One of the biggest challenges in systems is reducing the number of false alerts generated by surveillance systems, either by Natural Language Processing, Lexicon based or Anomaly detection. Solutions capable of multi-vector analysis are one of the main objectives when searching for the right surveillance Regtech solution. Programs can be trained with historical data, and be used to detect abnormal patterns and trends.

As stated above the rise of electronic communications scandals in the financial industry has FINRA's attention to how institutions are monitoring and recording them. Just FINRA's fines on electronic communication cases have more than doubled, from $2.7 million in 2008 to $6.2 million in 2015 (Electronic Communications Compliance Survey Report, 2016). The Financial Industry Regulation Authority is a self-regulatory organization of the securities industry, it's not a regulator, but its powerful and important for the industry. The Series 24 License provided by FINRA also known as the general securities principal, allows the holder to supervise many areas of an investment bank and grants the responsibility to review communications of associated persons[7] (FINRA Rule 1011), this is important to understand the concept of Supervisor during this in-company project.

FINRA itself has deployed cloud storage and computing, big data analytics, machine learning and natural language processing to enhance its market surveillance and other regulatory functions (FINRA, 2018). Nevertheless, while FINRA is aware of limitations (e.g. number of false alerts in surveillance systems) its rules require firms to maintain reasonable supervisory policies and procedures related to supervisory control systems in accordance (e.g. FINRA Rules 3110 and 3120; FINRA, 2018). This includes having reasonable procedures and control systems in place for supervision and governance of Regtech tools, including supervision of AI-based tools and systems (FINRA, 2018).

Computer programs trained with historical data may in fact be used to look for suspicious patterns and trends in current data, or identify future patterns and trends. But to be really effective the institutions lines of defense as defined in the literature review, need to coordinate efforts. In the case of electronic communications, the 1st Line of Defense is responsible for identifying the issue whereas the 2nd Line of Defense is also responsible for leading the escalation process that follows.

Conclusion

We discuss the disruptive impact of technology in regulatory compliance within the financial sector. We document the history of financial innovation and the impact of the 2008 Global Financial Crisis to the development of Regulatory Technology. In the aftermath of the crisis regulatory requirements have dramatically grown and technological advances have grown in parallel creating a Regtech environment.

Banks are paying out billions of dollars in fines, penalties, and settlements for misconduct and fraud situations. We describe and explain how technology can help financial institutions put in place the appropriate supervisory tools to support a strong ethical and compliant culture. Industry participants must align in order to build a safer environment for everyone, but safer doesn't mean threat free.

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[7] The term "Associated Person" means: (1) a natural person registered under NASD Rules; or (2) a sole proprietor, or any partner, officer, director, branch manager of the Applicant, or any person occupying a similar status or performing similar functions; (3) any company, government or political subdivision or agency or instrumentality of a government controlled by or controlling the Applicant; (4) any employee of the Applicant, except any person whose functions are solely clerical or ministerial; (5) any person directly or indirectly controlling the Applicant whether or not such person is registered or exempt from registration under the FINRA By-Laws or NASD Rules; (6) any person engaged in investment banking or securities business controlled directly or indirectly by the Applicant whether such person is registered or exempt from registration under the FINRA By-Laws or NASD Rules; or (7) any person who will be or is anticipated to be a person described in (1) through (6) above.

It would be unrealistic to think that we could completely eliminate every single threat, but as this study shows, we can surely partner with technology and do our best efforts to prevent and minimize their risks. Although our discussion is focused on the financial sector, understanding how technology can be used to adjust for growing regulation and safety needs is extremely relevant for a number of sectors, such as environmental and communications sectors.

Bibliography

Alper, Alexandra and KirstinRidley. (2012). "Barclays Paying $453 million To Settle Libor Probe",Reuters, June 27th. Alvarez and Marsal (2018). "Regtech 2.0".
https://www.alvarezandmarsal.com/sites/default/files/Regtech_2.0_report_final.pdf.

Armstrong, Patrick.(2017). "ESMA Regulatory Technology: Reshaping the Supervisor-Market Participant Relationship". Europlace Financial Forum, Paris, July 12[th,]

Arner, D. W., Janos Barberis, and Ross P.Buckley. (2017a). "FinTech, Regtech And the Reconceptualization of Financial Regulation". Northwestern Journal of International Law & Business 37: 371-413.

Arner, D. W., Janos Barberis, and Ross P. Buckley. (2017b). "FinTech and Regtech in a Nutshell, and the Future in a Sandbox". *CFA Institute Research Foundation* 3: 1-20.

Arner, D. W., Janos Barberis, and Ross P. Buckley. (2016). The Emergence of Regtech 2.0: From Know Your Customer To Know Your Data". *Journal of Financial Transformation*44: 79-86.

Bloomberg (2013)."Trader Chat Rooms Part Of Bigger Problem". https://business.financialpost.com/investing/trader-chat-rooms-part-of-bigger-problem. November 28th. CB Insights (2017). "Regtech Market Map". https://www.cbinsights.com/research/Regtech-regulation-compliance-market-map/.

Deloitte (2016). "Reputation Matters, Developing Reputational Resilience Ahead of Your Crises". https://www2.deloitte.com/content/dam/Deloitte/at/Documents/risk/deloitte-ukreputation-matters-june-2016.pdf.

Doctors, Silver. (2018). "Here's Just How Easy and Pervasive It Was (Is) To Manipulate The Gold & Silver Markets". http://investingchannel.com/article/455995/Heres-Just-How-Easy-And-Pervasive-It-WasIs-To-Manipulate-The-Gold--Silver-Markets#.W9N2TktKjIU. April 10th.

Dow Jones and SWIFT (2017). "2017 Global Anti-Money Laundering Survey".

Enriques, Luca (2017). "Financial Supervisors and Regtech: Four Roles And Four Challenges". Revue Trimestrielle de Droit Financier 53.

FINRA. (2017) "Regulatory Notice: Supervision of Electronic Communications". https://www.finra.org/sites/default/files/NoticeDocument/p037553.pdf.

FINRA.(2017) "*Technology Based Innovations for Regulatory Compliance* (Regtech).

Hill, Eleanor. (2016) "Is Regtech the Answer To The Rising Costs Of Compliance?".http://www.fx-mm.com/50368/fx-mm-magazine/past-issues/june-2016/Regtech-risingcost-compliance/.

Klein, Aaron. (2017). "Financial Regulation: A Post-Crisis Perspective". *The Brooking Institution*, Washington D.C.

Lin, Tom. (2016). "Compliance, Technology, And Modern Finance". *Brooklyn Journal of Corporate, Financial & Commercial Law*: 159-182.

Management Today. (2018). "How Regtech Is Changing Banking". https://www.managementtoday.co.uk/Regtech-changing-banking/futurebusiness/article/1492799. September.

Medici. (2016). "Strategic Analysis of Regtech: A Hundred Billion-Dollar Opportunity". https://memberships.gomedici.com/research-categories/strategic-analysis-of-Regtech-abillion-dollar-opportunity.

Milken Institute. (2018). "Regtech: Opportunities For More Efficient And Effective Regulatory Supervision And Compliance". https://assets1b.milkeninstitute.org/assets/Publication/Viewpoint/PDF/RegtechOpportunities-White-Paper-FINAL-.pdf.

Public Banking Institute. (2012). "Material Responsibility: What The Banks Did To Baltimore". http://www.publicbankinginstitute.org/material_responsibility_what_the_banks_did_to_b altimore.

Tabb Group (2017). "Financial Markets: Embracing Regtech".
https://hollandfintech.com/wp-content/uploads/2017/12/Tabb-Group-Report-FinancialMarkets-Embracing-Regtech-April-2017.pdf.

Transatlantic. (2017)."The Future of Regtech For Regulators: Adopting A Holistic Approach To A Digital Era Regulator".https://www.innovatefinance.com/reports/future-Regtech-regulators-adopting-holisticapproach-digital-era-regulator/.

Verschoor, Curtis. (2009). "Did Repeal of Glass-Steagall For Citigroup Exacerbate the Crisis?". *Strategic Finance Magazine*.

Zetzsche, Dirk Andreas,Ross P. Buckley, Douglas W. Arner, and Janos Barberis (2017). "Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation". *Fordham Journal of Corporate and Financial Law* 23: 31-103.