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INSTITUTO UNIVERSITÁRIO DE LISBOA

REGULATORY SANDBOX: ORIGIN AND RISE IN A TEXT METRIC PERSPECTIVE

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Master in Business Economics and Competition

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Department of Economics

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Para a minha mãe, para o Luís Miguel e para a Carolina, que estão sempre a meu lado.

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Resumo

O sandbox regulatório corresponde a uma ferramenta de regulação e supervisão promissora para a inovação de produtos, processos, serviços e modelos de negócio. Consequentemente, diversas jurisdições a nível mundial iniciaram e implementaram projetos de *sandbox* para promover e incentivar a inovação sob requisitos de supervisão. Esta tese explora o tema utilizando metodologias de mineração de texto e análise de sentimento para identificar tendências, direção e perceção do fenómeno *sandbox*. O conjunto de dados analisado engloba 91 artigos publicados no *Financial Times* entre 2006 e 2023. As principais conclusões indicam que o *sandbox* regulatório é amplamente reconhecido como um mecanismo intersectorial vantajoso, utilizado por empresas e formuladores de políticas para alcançar estabilidade económica e inovação sustentável, e que se encontra frequentemente associado a sentimentos positivos. Este estudo adota uma abordagem original que aprimora a compreensão e o progresso neste campo de investigação, fornecendo conhecimento sobre a evolução do conceito e conceção pública, e fornecendo orientação para académicos, legisladores e partes interessadas.

Palavras-chave: Sandbox regulatórios; Regulação; Políticas de inovação experimental.

Sistema de Classificação JEL:

- K230 Indústrias Reguladas e Direito Administrativo;
- O31 Inovação e Invenção: Processos e Incentivos.

Abstract

Regulatory sandboxes present a promising regulatory instrument for innovative products, services and business models. In response, several jurisdictions around the world started and implemented sandbox projects to increase and instigate innovation under supervision requirements. This thesis addresses the subject through text mining and sentiment analysis methodologies, to discover its tendencies, future path and the readers' judgement over time. The created dataset encompasses 91 articles, published in the Financial Times between 2006 and 2023. And the key findings indicate that regulatory sandboxes are a popular cross-sectoral mechanism for companies and policymakers, to pursue economic stability and sustainable innovation, and have mostly positive associated sentiments. This study takes an original approach that enhances understanding and progress in this field, delivering insights into the evolution of the concept and public judgement, and providing direction for researchers, legislators and involved stakeholders.

Key-words: Regulatory sandbox; Regulation; Experimental innovation policies.

JEL Classification System:

- K230 Regulated Industries and Administrative Law;
- O31 Innovation and Invention: Processes and Incentives.

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List of Acronyms

- AI Artificial Intelligence;
- CEO Chief Executive Officer;
- CMA Competition and Markets Authority;
- Defi Decentralized Finance;
- DTL Distributed Ledger Technology;
- EU European Union;
- FCA Financial Conduct Authority;
- Fintech Financial Technology;
- FT Financial Times;
- ICO Internacional Combat Organization;
- Idf Inverse document frequency;
- IoT Internet of Things;
- IPR Intellectual Property Rights;
- OECD Organization for Economic Cooperation and Development;
- UK United Kingdom;
- US United States;
- NGOs Non-Governmental Organizations;
- NPL Natural Language Processing;
- R&D Research and Development;
- RegTech Regulatory Technology;
- SEC Securities and Exchange Commission;
- SupTech Supervisory Technology;
- Tf Term Frequency;
- VC Venture Capital;
- WHO World Health Organization.

CHAPTER 1

Introduction

Historically, the UK Financial Conduct Authority (FCA) developed the first regulatory sandbox in 2015, inspiring many countries to adopt similar initiatives in the years that followed (Jenik & Lauer, 2017). Regulatory sandboxes are structured testing environments for innovative products, services or business models, created and overseen by a qualified governmental entity and providing a controlled but authentic atmosphere for experimentation (Deprez, 2023). According to the OECD (2023), there are currently around one hundred sandbox projects across the world, including privacy and Fintech initiatives.

Although regulatory sandboxes present a promising solution for a stable relationship between innovation and regulation, their success and accomplishments' efficiency remain the subject of debate. News can transform and revolutionise the expectations of their readers, being the primary source of current information. Financial-themed news are massively produced daily and the unstructured data may hold significant details that affect the economic agents' actions.

Unlike the existing literature, this study aims to introduce and employ a more comprehensive approach to analyse regulatory sandbox tendencies and its future path, through text mining and sentiment analysis. The generated expertise can provide significant knowledge and value-added information about the topic, to facilitate the decision-making process for sandbox associates, contributors and participants, and ultimately, foster a more innovative and well-regulated financial ecosystem.

This thesis intends to present regulatory sandboxes as a forward-looking regulatory mechanism established on innovation and experimentation grounds, and respond to the following research questions:

- 1. What is the rationale behind regulatory sandboxes?
- 2. How has the judgement about regulatory sandboxes evolved in the last years?

We apply an encompassing bibliometric, content and sentiment analysis to textual unstructured data, using the Financial Times (FT) newspaper as the data source, for its status as one of the world's leading business news organisations (Strauß, 2023), to quantitatively analyse the word-based information and to find the stakeholders' general sentiment about our topic over time.

Our study starts the state-of-the-art outlining essential concepts like innovation and regulation, follows to rationalize experimental innovation policies and its instruments and, finally, introduces regulatory sandboxes to the debate, with its evolution, characteristics and

present knowledge. The methodology has several sections, like the approach, source of the collected material, data acquisition and identification process, and data processing. The main purpose of Text Mining and Natural Language Processing (NPL), an approach we refer here in short as "text metrics", is how to quantify the core and theme of textual information, which is reason for the selected methodology (Kalamara et al., 2022; Silge & Robinson, 2017). The final chapter has a descriptive data analysis, presents and discusses the empirical results produced by the used strategy.

CHAPTER 2 Theoretical framework

2.1. Innovation

Innovation generates employment, economic and revenue advances, as well as life quality enhancements and competition, reasons why entrepreneurship strategies have been implemented all over the world. Many modern economists acknowledge that the key to improving countries' long-term living standards and economic growth is not accumulating wealth or savings but innovation itself (Atkinson & Ezell, 2012).

A straightforward definition of innovation can be "the successful exploitation of new ideas" (Georghiou & Harper, 2011, p. 247) and for that purpose, firms try to comprehend and recognize existing market needs and their drivers. The OECD (2005) in its landmark Oslo Manual Third edition distinguishes between four kinds of innovation – organisational, marketing, product, and process. This operationalisation of the concept draws on the early Schumpeter contribution and the tradition that followed it (Fagerberg et al., 2005).

Incremental innovations occur when companies improve pre-existing features, but radical innovations supersede prevailing practices, models, products, or procedures (Pelkmans & Renda, 2014). For this matter, innovation is not merely the technology and science's successive evolution, but the integration of capabilities and successive learning progress. Open innovation identifies it as an interface process among companies and external sources, their ecosystem and key actors, such as suppliers, research institutes and rival firms (Georghiou & Harper, 2011).

Sharma et al. (2022) consider innovation outcomes are explained by institutional quality and other determinants like market size, openness, purchasing power, provision of public goods and foreign direct investment. The referred institutional quality includes the rule of law in terms of property rights protection, the enforcement of intellectual property rights (IPR), the country's specialization in high-tech sectors and highly qualified human resources endowment.

The presence of market failures, i.e. circumstances in which market forces are not conducive to socially optimal outcomes, like with public goods, abuse of market power, externalities, and information asymmetries, create the necessity for innovation policies and regulation (Malanowski et al., 2021; Pelkmans & Renda, 2014). However, the acknowledgement that systemic failures also block up-and-coming innovation has grown over the past years (Georghiou & Harper, 2011).

2.2. Regulation

Regulation can be defined as an attempt or the strategic efforts to accomplish outlined ends, with goal-oriented and problem-focused characteristics. Despite the set of available governance techniques and control methods employed by public and private players, the emphasis on defined goals attaches regulation to the traditional and instrumental notion of law enforcement (Haines, 2011). Regulating often implicates complex actions where the supervisor entity gets the firms' information and monitors their performance to assess the ruling policies' functionality, compliance, and potential deviations (Baron & Besanko, 1984).

Blind (2012) distinguishes three types of regulations – economic, social, and institutional – and identifies the following compliance costs and incentive outcomes (Table 2.1.). Balancing the positive and negative effects bellow, the regulation of competition, price with flexible prices, public enterprises and natural monopolies with deregulation, environmental conservation in the long run and IPR have optimistic net effects. Consumer and product safety and product liability policies have slightly positive but ambivalent results. The regulation of market entries has a negative net effect, so as workforce protection but less. The various combinations of those guidelines and their execution bring in different outcomes.

Regulation for innovation, in the spectrum of law and economics, believes in the welfare benefit originated by innovation and recognizes its market failures and the legal instruments to solve those issues (Butenko & Larouche, 2015). Though, it is essential to establish that regulation can produce obstacles for firms to innovate if unreasonably heavy or dilatory in adapting to the emerging environment. When driving innovation, regulation delivers essential requirements like IPR, funding structures, consumer protection and competition policies, that generate important stability for potential investors and key actors, promote modern procedures and techniques and define new benchmarks (Rosemberg et al., 2020).

When firms make bold promises about new products, services and business models, applying supportive regulation and appropriate regulatory methods can mitigate the stakeholder's fluctuation of extravagant expectations. This phenomenon occurs for three reasons: moderation of the market failures and the influence of potential loss of trust through disappointment, combined with a sturdier market value for the viable supervised developments entering the market in initial maturity stages (Fáykiss et al., 2018).

Type of regulation	Target	Negative incentive effects	Positive incentive effect
	Competition	Restricts collaboration in Research and Development (R&D) projects.	Ensures innovation investment benefits.
Economic	Price	Incentives to innovate decrease with the imposition of price caps.	Minimum prices secure minimum turnovers and prevent monopoly pricing.
	Market entries	Forbids probable innovative newcomers to enter the market.	Narrows the competition for incumbents.
	Public enterprises and natural monopolies	Marginal cost pricing, due to high prices and low profits, blocks the investment in R&D.	Encouragement to gain productivity under the rate of return regulation.
	Environmental conservation	Inhibits innovation and generates compliance costs.	Stimulates the development of new environmentally friendly products and procedures, e.g. environmental technologies, by establishing temporary market entrance barriers.
Social	Workforce protection	Inhibits innovation and generates compliance costs.	Produces incentives to improve labour safety processes, creating monopoly earnings and temporary market entrance barriers.
	Consumer and product safety	Inhibits innovation and generates compliance costs.	Enhances consumer perception of new products and their widespread adoption by fostering incentives for innovation.
	Product liability	Excessive responsibility diminishes the motivation to innovate and bring innovative products to the market.	Enhances consumer perception of new products and their widespread adoption by fostering incentives for innovation.
Institucional	IPR	Hold back the development, for instance through patent thickets, the dissemination of new products and technologies, and the option to pursue further. Generate extra in R&D investmen short-term mono enhancing R&D through technologies, how disclosure.	Generate extra incentives for R&D investment by preserving short-term monopoly rights and enhancing R&D effectiveness through technological know- how disclosure.

Table 2.1. - Compliance costs and incentive outcomes of regulations.

Source: This thesis. Based on Blind (2012).

The capability to remain relevant towards technological advances is crucial and challenging for policymakers because technological processes driven by innovation and digital transformation can outdate existing regulations and disrupt market structures. Original products and procedures that breach sectoral and jurisdictional borders change the way industries operate and challenge the general regulatory paradigm (Alaassar et al., 2020; Rosemberg et al., 2020). The complex relationship between regulation and innovation requires some balance because it is desirable to have stable systems with ground rules that protect consumers and instigate competition, but also have disruptive innovations that may support the economy's growth and address other important subjects (Rosemberg et al., 2020).

Regulation is based on assumptions about reality, and with a fast-paced technological environment, laws are expected to get behind occasionally. Still, government players create and implement strategies to minimize regulatory disconnection, which refers to the gap between the present regulatory landscape and the appearing revolutionising innovations (Butenko & Larouche, 2015), evaluating relevant details and determining *what*, *when* and *how* they should intervene (Fenwick et al., 2016). Keeping regulation up to date lowers regulatory uncertainty, making the jurisdiction more appealing to technology pioneers, developers and potential investors (Truby et al., 2022).

Blockchain, artificial intelligence and the Internet of Things (IoT) are recent cases of the most disruptive data-driven developments and technologies in the digital domain, diffusing within distinct areas. Similar advances are appearing in several other sectors like the pharmaceutical, mobility and environmental, pushing existing boundaries that demand the policymaker's constant awareness, anticipation, and flexibility (European Commission, 2023).

2.3. Experimental Innovation Policies

Delivering innovation allows companies to stay competitive and produces societal value, but the shocks can often be unpredictable (European Commission, 2023). After thoroughly evaluating the available knowledge about the topic, experiments can deliver innovation agencies and government players unique prospects to adapt, improve and check new tools and designs to support firms, industries, citizens, and consumers (European Commission, 2022).

Experimentation is profoundly rooted in history and has been used over the years by several science disciplines, such as biology, physics, psychology, medicine and economics (McDermott, 2002). Currently, policy and law experiments are designed to create evidence-

based laws, build alternative setups to develop anticipatory policies, enforce market regulation methods, improve competition guidelines and promote technological advances and scientific innovations (Ranchordás, 2021).

Experimental innovation strategies require close collaboration between regulators and nongovernmental players, due to their inside knowledge about the field and existing innovation barriers. These strategies combine assessment and monitoring during the diagnostic, policy design and execution phases, improving the public costs projected to support innovation. Experiment-based policymaking thrives when there is a large potential to discover and improve, i.e., with new or rising innovation grounds (Dutz et al., 2014). However, when operating with this kind of trials and experiments, to conceive new policies and investigate new concepts, willingness to learn, high levels of openness and risk-taking tolerance must be present (European Commission, 2022).

Experimentation spaces induce regulatory learning by collecting organized and systematic evidence to adjust or establish essential measures and policies (top-down), safeguarding, simultaneously, competition improvements at a level playing field. The purpose of regulatory learning is also to acquire expert knowledge about possible opportunities and risks of rising innovation in a testing environment (bottom-up) (European Commission, 2023). Figure 2.1. represents essential experimentation tools, envisioned to fine the breach between innovators and regulators.



Figure 2.1. - Experimentation tool "decision tree" by main focus. Source: European Commission (2023, p.7).

Innovation agencies, government players and interested firms can employ the decision tree above, according to their needs, to appraise, plan and organise experimentation trials. When investigating a phenomenon or a hypothesis, applying multiple research methods provides greater certainty in consensual results (McDermott, 2002). To this end, the combination of applied information science, technological data analysis and experimentation tools delivers vast datasets and valuable extracted insights that enable risk-based and real-time responses to potential gaps. Following the reasoning, policy experimentation becomes a dynamic process driven by current data, and policymakers can monitor and refine their strategies based on empirical results (Attrey et al., 2020).

Despite the application of other experiments, one progressively popular instrument of safeguarding regulatory cooperation, flexibility and adaptability has been the regulatory sandbox (Attrey et al., 2020).

2.4. Regulatory and Supervisory Technology

Regulatory Technology (RegTech) uses digital skills and sophisticated technology breakthroughs for companies to comply with established policies and guidelines (European Banking Authority, 2021). In other words, is a subcategory of Financial Technology (FinTech) that helps provide regulatory information and requirements more proficiently. Supervisory Technology (SupTech) is also a subsection of FinTech but uses ground-breaking expertise to back supervision procedures. Therefore, RegTech and SupTech are essential tools that enhance the certified authorities' analytical data processing and supervisory reporting (European Commission, 2020).

Following Appaya et al. (2020), RegTech has four approaches that can be assembled into the following groups: *Test and Learn* – Market-driven tactic where regulators develop and customize structures for single business cases to operate in a ring-fenced but live system; *Wait and see* – Regulators choose to monitor and perceive innovation trends by far and intervein after, if necessary; *Regulatory laws and reform* – Regulators improve existing laws/ licenses or present new ones, responding to the ground-breaking business models designed by the concerned companies; and *Innovation facilitators* – The certified authorities intend to encourage experimentation and innovation using methods like Innovation Hubs, Regulatory Accelerators and regulatory sandboxes.

2.5. Regulatory Sandboxes

Regulatory sandboxes demonstrate the fundamental link between innovation and regulation (Guio et al., 2024). Recognising this relationship is essential because countries face increasing pressures to regulate diverse technologies and innovative solutions. Such instruments provide a platform that promotes the dialogue between policymakers and innovators, an important interaction that should be stimulated.

2.5.1. Evolution of the concept

Initially, sandboxes were designed to be isolated environments for software assessment and testing, minimizing potential risks to the operative system. This background evolved and adapted to at least two purposes, data spaces, also named operational sandboxes, and regulatory ones. The first official regulatory sandboxes were used by regulators in the financial industry to check compliance and the need to adapt or modify some procedures. For that purpose, policymakers customized the software settings to test the new Fintech companies (Datasphere Initiative, 2022). The relevance and recognition of this modern regulatory reform development allowed its expansion and application in several other industries and sectors (Johnson, 2023).

Currently, regulatory sandbox is a wide notion that sums up new emerging regulatory regimes. The definition depends on the created system and corresponding jurisdiction, but it is mainly a legal setup made for companies to provide services or products temporarily, to a narrow number of clients or customers in a regulatory-controlled environment (Knight & Mitchell, 2020). According to the Council of the EU, in a commission staff working document about regulatory learning from the Secretary-General of the European Commission, Deprez (2023), regulatory sandboxes are structured testing environments for innovative products, services or business models, created and overseen by a qualified governmental entity and providing a controlled but authentic atmosphere for experimentation.

These experiments apprise forthcoming regulation by being a rule derogation and holding the players responsible for conducting actions they cannot normally engage in (Schittekatte et al., 2021). The regulatory approach fosters a contained and conductive scope to innovate under supervision requirements, drops innovation costs, decreases entry barriers, and grants the regulatory entities necessary insights before legislating (Makarim & Mahardika, 2020). The tests look for an equilibrium between regulation and innovation and seek to understand if certain technologies can be accessible to customers on a larger scale, without endangering safety, markets or important social principles (Guio et al., 2024).

The operationalization of a regulatory sandbox contrasts from other regulatory methods because it is meant for specific companies and uses a case-by-case analysis in force for a limited period. Furthermore, it allows the regulators to monitor and review the attendant firms' activity, increasing transparency and providing know-how. Course correction and fast learning are the main benefits to the involved institutions because of the quick adjustments and sequential implementations that boost public interest (Knight & Mitchell, 2020). Though, conducting sandbox tests also involves risks, like competition issues generated by potential advantages for the sandbox participants, deficient selection of candidates because of the environment's limited capacities and accountability matters if the trial fails (Jenik & Lauer, 2017).

2.5.2. Characteristics

Regulatory sandboxes contrast in goals, like growth and innovation or minimizing risk and regulatory compliance strategies; in a narrow or broad scope, working on specific topics or wider themes that concern whole sectors and economies; and in scale, by the geographic reach and stakeholders involved (Datasphere Initiative, 2022). The sandbox goals are usually categorized into policy-focused, product or innovation-focused, cross-border and thematic. However, these objectives are not mutually exclusive (Appaya et al., 2020).

Policy-focused sandboxes use the procedure to assess policies or specific regulations. Product or innovation-focused sandboxes allow companies to check the market viability of new business models by dropping the entry cost to a regulated marketplace and encouraging innovation. Multi-jurisdictional or Cross-border ones assist the companies' cross-border operations while trying to decrease arbitrage and get the regulators' collaboration. Finally, Thematic sandboxes pretend to accelerate the adoption of a particular innovation, product, policy, or the development of a subsector, focusing all the efforts on that intention. Mostly, these sandboxes' goals aim to improve the firms' ability to scale quicker on a regional or global basis and harmonize cross-border regulation (Appaya et al., 2020).

When scrutinizing, as stated by Datasphere Initiative (2022), these goals depend on strategies and national contexts, diverging in: *Regulatory leeway* – When low, the sandbox mainly clarifies and discusses regulatory compliance. The incentive for firms to join the sandbox and innovate increases as this element gets higher. It also raises potential threats for consumers, sectors, or the economy because regulations are postponed temporarily; *The direct*

impact of regulatory discovery – Sandbox findings can be used to produce regulatory modifications, growing responsiveness, and regulatory adaptability, but might benefit the participant firms; and *Incentives for companies to participate* – Numerous incentives attract sandbox entrants, developing innovation and competition. The risk stands in the ineffective or unequal allocation of resources and infringement upon industry-specific existing regulations.

In some jurisdictions, distinct regulators manage different sandboxes, mainly in countries where the qualified authorities regulate separate financial services areas, for instance, capital markets and banking. The simultaneous procedures stimulate innovation but require lots of expertise and interagency coordination because they may intersect existing flaws and overlap both sectors' regulations. Cross-border sandbox coordination allows firms to acquire dimension, scale, and other benefits, like joint licensing agreements (Appaya et al., 2020).

According to Rosemberg et al. (2020) many players take part in the regulatory sandboxes' ecosystem, such as:

- Knowledge contributors and innovators Established firms, market entries and startups. With the alignment of competition law as purpose, only licensed companies can conduct sandboxes, while other firms that provide technology or additional assets can participate in trial or project implementing groups. Sandboxes contribute to the cooperation and association of many entities that support R&D projects. Partnerships strike among industries, private and public investigation institutes, and academia;
- Government figures and regulators Ministerial departments and executive agencies that monitor, supervise, instruct and guide regulated companies;
- Consumers Regulatory sandboxes encourage the consumers' participation. Those agents choose to join or are informed that a specific product or service is being tested in a sandbox setting. Consumer safety precautions are incorporated in the sandbox requirements; and
- Civic institutions and Non-Governmental Organizations (NGOs) These agents can feature significant stakeholders, providing control over ethical insights and representing end users.

For a regulatory sandbox to work as anticipated, it must accommodate prevailing market demands, i.e. have a working established business background, though it may expand later, engaging other interested firms (Appaya et al., 2020). Regarding eligible and suitable projects or ideas, regulatory sandboxes pursue services, products and business models with conceivable social and economic paybacks that fit political needs and legal barriers that require adjustments.

Provision comes in the shape of regulatory extensions and assurances; guidance, assistance, and expertise; direction and facilitation (Rosemberg et al., 2020).

Concerning the procedures and structure plan of a regulatory sandbox, Jeník & Duff (2020) distinguish six key steps to trail before implementing this regulatory experimentation tool: Stating the owner entity of the sandbox (specific department of an institution); Defining support. It is essential to establish advisory committees or hire specialists when necessary because the sandbox team is unlikely to have all the know-how needed to run the experiment; Assigning appropriate amounts of funds and resources; Planning inner procedures, like designating response times, tasks, and accountabilities; Guarantee external stakeholders' sync by defining engagement strategies and conferring with peer supervisors that have contiguous or overlapping jurisdiction; and creating support stations to clarify companies that want to gather information about the sandbox process or ask about their eligibility.

Testing ideas are usually suggested by sandbox applicants and case-by-case reviewed by the sandbox owner. The testing plan must be clear and complete, i.e., describe the general cost and timeline, precisely pinpoint *what*, *how* and *why* it is being trialled, specify target and success benchmarks, threats and mitigating procedures, workforce and their obligations, and finally, guidelines to engage and report to the supervisor entity (Jeník & Duff, 2020).

2.5.3. Present

Despite the range of the current sandbox models, as the notion and its execution evolve, most still trail the FCA's blueprint and design, specifying key objectives, eligibility (e.g. entities that operate underneath the authority of the regulator, incumbents/start-ups, and products/services), conditions regarding precautions, menaces and other limitations, time-bounded schedule for applying and for sandbox tests, costs partition and supervisors' alignment afterwards. Fruitful tests may result in numerous outcomes but the companies' most wanted payoff is the complete or personalized authorization to run the innovation in the market (Jenik & Lauer, 2017).

The European Commission (2023), with the end of 2021 as a reference point, stated that the European Union (EU) had forty cases of existing regulatory sandboxes, plus seven sandbox experiments in configuration and implementation and fifteen other experimentation processes related to regulatory sandboxes. Figure 2.2. illustrates this distribution per Member State.



Figure 2.2. – Project distribution per Member State. Source: This Thesis. Based on European Commission (2023, p. 33).

The expertise extracted from sandbox experiments remains limited, particularly because this development in regulatory reform is relatively new and needs permanent evaluation. Nevertheless, preliminary findings show that there is no universal, standardized, one-size-fitsall sandbox system and that regulatory experiments perform more effectively and express better results as components in a holistic strategy, working toward long-term goals within delineated policy agendas (European Commission 2023). Studies also show very positive results for generating economic and business growth, higher confidence and certainty for companies (Guio et al., 2024).

CHAPTER 3 Methodology

3.1. Approach

Text data mining can be defined as the statistics and machine learning implementation of algorithms and techniques to unstructured textual information, aiming to find valuable patterns (Hotho et al, 2005). It allows the assessment of large volumes of textual data and extraction of insights from unstructured text sources such as newspaper articles, social media posts, and more (Mhamdi et al., 2018). In the last years, text mining has proved to be useful analysing newspaper headlines and detecting fake news (Bharadwaj & Shao, 2019; Hossain et al., 2021).

The exponential growth of digital data, over the past years, directly implied the need to study its inherent knowledge and information. Intending to analyse large amounts of textual data text mining gained relevance, allowing the extraction of significant expertise or patterns from unstructured text, e.g., file collections. The general procedure consists of gathering scripted documents from the projected sources, processing the dataset, applying text mining techniques, analysing the script and, finally, discovering new inputs about the topic (Gaikwad et al., 2014).

Text Mining methods can be successfully employed in various domains, including academic and private uses. For academics, supports the analytical-qualitative data understanding, the study of sociology and language (Kwartler, 2017). For private entities, is essential in fields like data science, computer science, and information retrieval, playing a significant role in analysing social media content, web data, and customer service complaints (Wang et al., 2022). Ultimately, text mining can be helpful to any data-driven decision-making process with text inputs, (Kwartler, 2017). For example, using text as data to outline the development of 5G-related studies (Mendonça et al., 2022) or investigating the "editorship phenomenon in Innovation Studies" (Santos & Mendonça, 2024). Concerning health industry data and the exploitation of discourse analysis, Santos et al. (2023) published an article about WHO initiatives and their influence on scientific speech about nontransmissible disorders incorporating bibliometric methods. These approaches are a step to a higher order of analysis in which discourse articulation as a whole is considered (Costa, 2020).

NLP is a field of linguistics and computer science that studies the interface between human language statements or words and computer inputs. This process intersects with computational

linguistics grounds and is regularly considered a smaller, more specialized, area of study within artificial intelligence. NPL designs techniques for computers to comprehend and execute natural language expressed commands (Kumar, 2013).

In social and behavioural sciences, it is fundamental to understand public sentiment, because it helps to evaluate public opinion, capture new trends and establish how society feels towards certain themes or events. Academics, journalists, and policymakers can resort to that material to bias public dialogue, preferences and discover public opinion tendencies (Ingale, 2023). Sentiment Analysis, similarly known as Opinion Mining or Opinion Analysis, distinguishes and obtains subjective evidence presented in textual data, through Text Mining and NPL. This procedure can determine the authors' mood, judgement, evaluation of certain aspects and the document's polarity, with positive or negative classifications (Wankhade et al., 2022). There are many sentiment analysis techniques, as described in Figure 3.1. This study's methodology focuses on a lexicon-based approach, a popular method used by analysts around the world that classify sentiments (Miazga & Hachaj, 2019).



Figure 3.1. - Sentiment analysis techniques. Source : Medhat et al., (2014, p. 1095)

The dictionaries based on the English vocabulary are created to evaluate emotions or opinions in textual data. The *AFINN* lexicon is a dictionary-based method with 10 results that assigns the individual word's sentiment within positive and negative indicators that range from -5 to 5. The graded sentiment values offer a more detailed script analysis in contrast to binary sentiment lexicons that only deliver positive and negative results (Silge & Robinson, 2017).

This lexicon is pre-defined but can be extended or adapted to fit specific needs and requirements.

3.2. Source

The FT is a business, world-affairs and politics newspaper, founded in 1888. It is considered to be one of the world's leading news organisations, an outlet for business communication to place strategic corporate, financial and economic messages (Strauß, 2023). This international company issues predominantly in the UK and only English-speaking communities' writing and thinking about regulatory sandboxes will be directly recorded in our research. Nevertheless, the distribution of this media outlet is sufficiently large to assume its scope transcends national borders (Steiner-Khamsi et al., 2018), since reaches 1.25 million subscriptions¹. For this reason, it is expected that the content analysis of the FT publications bears interesting results concerning the business-oriented readership.

Financial journalism and broadcasting are a dedicated field of journalism that focuses on covering, analysing and interpreting economic, monetary and business news (Raimondo, 2019). This type of journalism writes about a wide range of related topics (including market trends, company earnings, mergers and acquisitions, economic policies, financial regulations, and personal finance recommendations) to offer reachable and impartial business informs, increase media trust and improve financial-related literacy (Knowles & Schifferes, 2020).

3.3. Data acquisition and identification

An original dataset was built by searching the keyword "regulatory sandbox" in the FT website and extracting the returned items. We assembled a total of 91 documents, with 97.620 words and 507.409 characters that covered a timespan of 17 years (between 2006 and 2023). The publications timeline chart can be visualized in Figure 3.2.

¹ h**ps://aboutus.ft.com/careers/what-we-do/subscriptions



Figure 3.2. - Number of publications per year. Source: This Thesis. Based on www.ft.com

Most articles were published in 2016 or 2018, emphasising the 4th quarter of 2018 with ten pieces. Until 2021 the regulatory sandboxes' mention in the FT decreased but since then boosted, reaching 11 pieces at the end of 2023.

The selected pieces in FT can be classified into multiple genres according to its online platform. Although only 89 of the 91 extracted pieces were categorized, as described in Figure 3.3., the analyses below encompass all the articles. The two unclassified articles have the following titles, "Australia publishes draft laws on enhanced fintech sandbox" from 2017, and "Vilnius on the up as fintechs prepare for Brexit" from 2020.



Figure 3.3. - Articles' volume by genre. Source: This Thesis. Based on www.ft.com

Most publications correspond to *news*, *opinion articles* and *newsletters*. However, according to the FT's Editorial Team, reached out through the company's Customer Care and Help Centre, the classification of articles into specific genres is largely determined by the editor's discretion and is dependent on its subjectivity. The interaction with FT's Editorial Team can be found in Appendix A. Due to the limitation described, Table 3.1. defines each genre as we find appropriate for consideration.

Genre	Description
News	Reports of current events, factual information and developments to the audience, aiming to update the readers about significant occurrences, issues and local, national or global events (Jaakkola, 2021).
Opinion	Articles that provide personal views, arguments and perspectives of the author about particular topics. These pieces are characterized by their subjective nature and target to influence the audience, stimulating the debate and shaping public beliefs through persuasive writing (He & Rahim, 2019).
Newsletters	Printed or electronic files that contain information concerning the latest activities of an organization, announcements, detailed updates and material about precise themes and subjects of interest to a particular group of people. It is usually sent periodically, via mail or email (Cambridge University Press, n.d.)
News-in-dept	Specialized form of reporting that involves comprehensive and thorough coverage, that goes beyond standard news press, to provide detailed analysis, complex insights and context. Depth is considered to be one of the top-quality elements in journalism (Lacy & Rosenstiel, 2015).
Special Reports	Items that deliver reliable scrutiny of the main concerns for global business, industry and finance, being an important tool for decision-makers to carry out informed business assessments (Financial Times, 2024).
Deep Dive	Meticulous examination of an issue (Cambridge University Press, n.d.). Therefore, by conducting deep dives the writers can discover new angles, test existing assumptions and provide profound insights into complex matters.
Features	Assemblage of journalistic genres that entertain and connect people emotionally, with individual experiences, associated with current events of public interest (Steensen, 2017).
Transcripts	Exact writing record of spoken communication, in speeches, interviews and dialogues. This genre aims to capture the writing record of the exact words spoken by individuals (Erdal, 2009).

Table 2.1. - Genre classification.

	Communication addressed to the editor on any subject that may be relevant to the journal's readership.
T attans	These documents act as the reader's voice, with comments on previous publications and reviews or
Letters	benefit to publish small case reports that may contribute to the literature about the matter (Tierney et al.,
	2015).
	Journalists employ research tools and methods that seem the most appropriate to their work, aiming to
Research	reach significant conclusions (Machill & Beiler, 2009). Research pieces have meaningful findings that
	add value and credibility to the content.

Source: This thesis

3.4. Data processing

The developed research and pursued study required having a consolidated dataset. Aiming to accomplish the projected objective and corresponding investigational questions, the methodology followed six major steps (Figure 3.4.).



Figure 3.4. - Methodological process. Source: This thesis.

The first stage consisted in searching the theme in our online source (FT platform), using "regulatory sandbox" as keyword and retrieving 92 results. The extraction to *.pdf* files was carried out in the last trimester of 2023, to include full year information. Here, we disregarded an audio piece, remaining with 91 items. When assembling the data, we familiarized with its content and collected some meta information, such as the titles, date of publication, genre and journalist. After validating the information in terms of quality, it was necessary to create the ultimate dataset, clean, standardise and organize the text into a *.csv* format document. This document was designed to load in the *R* Software, had seven variables (Table 3.2.) and 91 lines, each article corresponding to an observation.

Table 3.2. - Format of the document loaded in R.

Nr.	Title	Subtitle	Text	Genre	Date	Year

Source: This thesis

In order to work with the organized data in the ultimate dataset we followed "tidy" data principles, which allow effective data handling and manipulation (Wickham, 2014). This process states a structured set-up for datasets, where columns link to variables, rows to observations and each category of observations create distinct tables. However, to manage the content, text mining often includes pre-processing steps like document selection, tokenization, stop-word removal, stemming, Luhn cut and weighting (Eler et al., 2018). Tokens are meaningful units of text, like a single word or n-gram, and tokenization is the splitting process of the document into tokens to analyse them separately (Silge & Robinson, 2017). Stop words, are irrelevant and unworkable terms like "the", "of", "to" and so forth (Schofield et al., 2017). The stemming step extracts a word's prefixes and suffixes from its root, the Luhn cut excludes terms with frequencies under specified thresholds and weighting employs techniques like tf-idf (term frequency - inverse document frequency), diminishing or amplifying a word's impact (Eler et al., 2018). These steps turn the raw data into a lighter, less noisy, clean dataset, removing inconsistencies.

The required pre-processing steps in this specific methodology were the document selection in the 3^{rd} stage (Data Assemblage) and, after loading the corpus in *R*, tokenization, stop-word and isolated alphanumeric characters removal in the 5^{th} one (Model Framing). The pre-processing steps are illustrated in Figure 3.5., listed chronologically. At the end, with "tidy" text, the tables exhibited one-token-per-row formats (Silge & Robinson, 2017).



Figure 3.5. - Pre-processing steps flowchart. Source: This thesis.

The model was framed with code to identify the main trends and developments, related topics and classify the polarity of the selected pieces, as well as the polarity of the classified genres. The article-based sentiment indicator distinguished the positive and negative pieces and the categories that expressed more feelings. After repeating the modeling techniques as many times as necessary, the final stage of this methodology comprised the analysis and elaboration of a full report with the main conclusions about the research.

CHAPTER 4 Empirical Results and discussion

The number of publications in the FT highlighted existing peaks which could be related to the FCA regulatory sandbox project, since the tests were carried out between 2016 and 2019 (Butor-Keler & Polasik, 2020). Also, early in 2018, more than 20 jurisdictions were administering regulatory sandbox projects or investigating this new concept (Makarim & Mahardika, 2020). The latest years under analysis showed a growth trend about the subject in the FT. The increase of interest in blockchain, cryptocurrencies, computing, and AI, and the need to regulate these digital technologies with significant potential, brought regulatory sandboxes to the debate (Obeng et al., 2024), because they offer more dynamic and efficient approach, compared to conventional regulatory frameworks, for fast developing technologies (Guio et al., 2024).

4.1. Term frequency

We conducted a thorough analysis of the 91 pieces retrieved to identify the predominant themes within the discussion. To achieve this, we utilized a term frequency technique to examine the frequency of words across the collected texts. By applying this method, we were able to pinpoint and highlight the 15 words referred more than 150 times, in total across all the articles. These frequently occurring words are illustrated in Figure 4.1. arranged in descending order.





The words "company" (n=526), "financial" (n=424) and "fintech" (n=416) are the most frequent ones. They are directly related to the topic we are addressing, because regulatory sandboxes emerged in the financial sector to test the new fintech companies (Datasphere Initiative, 2022). It is also quite interesting to see "bank" bringing the idea of more interest because banks play a crucial role in the financial sector and the overall economy. The "uk" unigram is quite expected since the FT is UK-based and covers many publications about its economy, politics and government administration, for example.

Following the term frequency method described above, Figure 4.2. shows a panel with the 10 most mentioned terms and their application in each period. The panels are organized in alphabetical order and are helpful to visualize individual observations over time, highlight patterns, trends and significant changes.



Figure 4.2. – Panel of the most referred words per year and evolution of the term. Source: This thesis

Although every word in Figure 4.2. emerged in multiple periods, "company" and "regulatory" were the only ones to appear in every examined year. The incidence of the word "bank" in the FT articles declined over time due to the diversification of financial services, the gradual shift from traditional banking and because regulatory sandboxes started to be trialled in several other sectors. The latter also explains the trajectory of "financial" and "fintech". The term "startup" exhibited a peak in 2018, because investors and governments were showing strong interest in the global start-up ecosystem growth. For example, Southeast Asia's tech hubs were competing to become the next Silicon Valley, to the wave of ancillary services start-ups that focused on payments, advertising tech and logistics, their mentors, some investors and support institutions (Appendix B – Number 70). Also, in this year, Arizona turned out to be the first US state to establish a fintech regulatory sandbox for start-ups (Appendix B – Number 7). If we consider publication year, the most recurrent word was "crypto" in 2022 (n = 120). This term gained particular relevance in 2022 dropping by more than half the next year (n=53). Cryptocurrencies and stock revenues are significantly affected by the investor attitude, predominantly in periods of geopolitical complications, since the assets' market price may not correctly reflect its true value. In 2022, the Russia-Ukraine war increased investors' interest in digital currencies due to existing geopolitical risks and traditional financial markets' distress (Chowdhury & Humaira, 2024). This increased interest sparked regulatory concerns regarding volatility and consumer protection.

Extending the analysis from single words to bigrams, because many text mining results are established on word associations and co-occurrences, it was necessary to tokenize the data into consecutive pairs of words and remove the observations where either of the arguments was a stop word. Figure 4.3. illustrates a model of relationships between sets of words, frequently occurring bigrams, mentioned more than 30 times in all the articles, arranged in descending order.



Figure 4.3. - Most referred bigrams in the corpus. Source: This thesis

The most scripted sequence of words, i.e. bigram, in the corpus were "financial services" (n = 82), followed by "chief executive" (n=62) and "regulatory sandbox" (n=53), the title and main subject of this thesis. Besides the expected bigrams in the results, it was important to further analyse why the name "Jemima Kelly" appeared that many times. The source is an article published in 13th of September 2022, a transcript dialogue where Jemima is the journalist (Appendix B – Number 3). Hong Kong (n=32) is broadly recognised as a major global financial hub, with an advanced and sophisticated financial services sector that plays a crucial role in the Asia-Pacific region and beyond (Xie et al., 2024). For this reason, it is the theme of several articles in the dataset.

The following chart, generated to visualize the most frequent bigrams and its evolution, consists of 10 facets, each representing a pair of consecutive words. Figure 4.4. shows how the frequency of bigrams has varied over the years, highlighting which terms were more prevalent during certain periods. It is useful for understanding trends and the relative importance of different concepts over time.



Figure 4.4. - Panel of the most referred bigrams per year and evolution of the term. Source: This thesis

Regarding the 10 bigrams above, the only term that appeared without exception was "chief executive" to present or mention CEOs from specific companies or establish links during the pieces (e.g. chief executive of the Organization for International Investment, Association of the British Pharmaceutical Industry or bitcoin investment firm Bitstocks). The name "Jemima Kelly" was only selected because of the transcript dialogue written in 2022. However, her name slightly appears in other journalistic pieces. The sequence "venture capital" stands out for 2018. Venture Capital (VC) evolved as an essential intermediary in financial markets that pursue high-risk but potentially rewarding and profitable projects, funding small companies (like start-ups) and firms that struggle to gather resources (Gompers & Lerner, 2001). These results align with the data for "startup" in 2018, presented in Figure 4.2.

In sets of documents about a common topic, the most frequent words may not be distinctive in the text. For this matter, it is also important to study the term's inverse document frequency (idf), that reduces the weight for regularly casted-off words and increases it for the ones that are less recurrent in a dataset. This approach, combined with tf, can determine the words incidence in the extracted documents, adjusted for how rarely are written, the tf-idf (Silge & Robinson, 2017). According to the Zipf's law, words appear in a systematic frequency distribution, being inversely proportional to their rank within the frequency table (Piantadosi, 2014; Silge & Robinson, 2017). The application of Zipf's word frequency law in natural language to the FT corpus can be visualized in Figure 4.5. on logarithmic scales.



Figure 4.5. - Application of Zipf's law. Source: This thesis.

The coefficients (-1.1307) for Intercept and (-0.8606) for log10(rank), in the log-log form of Zipf's law provide a thorough description of the word frequency distribution. The intercept gives the logarithm of the scaling constant, while the slope indicates the rate at which frequency decreases with rank, both crucial for accurate language modeling and analysis. Our plot has a constant negative slope, and the results are similar to the nature of the power-law distribution that Zipf's law describes. The slope is negative because as the rank (r) increases, the frequency (f) decreases, which indicates a predictable pattern in word frequency distribution.

Calculating tf-idf aims to find important words that are not too recurrent in the group of FT's publications. Extremely common words, i.e. words that appear in all the extracted documents, have a null idf and consequently the tf-idf is zero. These indicators will be higher for words that occur in fewer articles. Following the tf-idf strategy, Figure 4.6. assembles the most distinctive words in the dataset, i.e. they are specific to some years making them unique for their occurrence.



Figure 4.6. - Most important words in the dataset per year. Source: This thesis

Many words in the corpus and in the tf-idf figure stand for personal names, which were disregarded in the analysis. However, it is important to explain some acronyms and other terms, like "SEC" in 2006 that stands for "Securities and Exchange Commission". The 2013 article discusses a conceptual model for a "design sandbox" as a training tool for companies, not for regulatory agendas. The year 2016 laid the foundation for blockchain's growing adoption, setting the juncture for the cryptocurrency boom of 2017. This development, associated with the original Bitcoin notion, generated a new, universal expression for systems developed on the principle of enabling a decentralized database that is managed by multiple participants – Distributed Ledger Technology (DLT) (Hileman & Rauchs, 2017). "Poland" and "Polish" are relevant terms in this analysis for 2017 because, there were several polish fintech companies

established in UK post the Brexit referendum (Appendix B – Number 57). In 2018 "Vietnam's" start-up ecosystem was less mature and developed than its regional competitors, for example, Singapore and Indonesia, although the country's government was planning to transform that (Appendix B – Number 70). And, as mentioned above, Arizona turned out to be the first US state to establish a regulatory sandbox for fintech start-ups in 2018 (Appendix B – Number 7). "Defi" in 2019 means "Decentralized Finance", a development envisioned to disintermediate traditional financial organizations (Appendix B – Number 1). For 2020, the Bank of "Lithuania" issued, by the end of the previous year, e-money licenses for 64 fintechs and had around 40 additional requests under analysis. The ranking was behind the UK, with over 150 regulated fintech firms operating, but entirely ahead of other EU nations. Many fintechs were seeking to settle base in EU grounds after the UK Brexit, Revolut is an example of a British digital bank that acquired a banking licence from this European northeastern country (Appendix B -Numbers 54 and 85). In this year, a "Colombian" fintech company, named Movizzon invested in Latin American banks to fill in their gaps regarding smartphone apps (Appendix B -Numbers 15). In 2021, "Vietnamese" supply chains were struggling due to the Covid shutdown. The CEO of the largest port located in southern Vietnam referred to the Thai government's recent "factory sandbox" as an example to maintain production and reduce regulatory inconsistencies (Appendix B - Numbers 84). Also "CMA" corresponds to "Competition and Markets Authority" and "TMRW" is an app for mobile banking. In 2022 "Wyoming", a state of the US, was targeting to become one of the emergent crypto lands, enacting numerous cryptocurrency directives to design a welcoming atmosphere for virtual coins and blockchain companies (Andhov, 2021). "Inflation", "childcare" and the launch of an AI sandbox were mentioned in the UK Budget for 2023, presented by the chancellor's speech (Appendix B -Numbers 81)

4.2. Word relationships

In order to understand word relationships, we can arrange word networks, with connected node combinations (pairs or groups of words regularly written together). This helps to understand and successfully employ word combinations and enhances communication skills. Figure 4.7. shows relatively common combinations of words for all the articles in the dataset.



Figure 4.7. - Set of common word combinations. Source: This thesis.

As expected, the "financial conduct" and "conduct authority" sequences above were in fact a trigram for "financial conduct authority", which is the conduct regulator of the UK financial market companies. Venture Capital (VC) Markets are fundamental to developing entrepreneurship growth and progress, where regulation and the formal institutions interaction play important roles (Bustamante et al., 2021).

The correlation between words denotes how regularly they appear together compared to how often they are written individually. The most correlated words with "sandbox" are illustrated in Figure 4.8.



Figure 4.8. - Perfectly positive correlated words with "sandbox". Source: This thesis.

In order to facilitate the visualisation of the graph, we filtered correlation = 1, which means that all these illustrated words appear when "sandbox" is addressed. The coefficient correlation between the objects is perfectly positive. Unlike the bigrams above, the relationships in Figure 4.8. are symmetrical, not directional.

4.3. Sentiment analysis

For the purpose of demonstrating if the speech in the extracted articles was mostly positive or negative, we designed the word cloud in Figure 4.9. The polarized terms' size is proportional to its frequency and the defined cutoff, i.e. the maximum number of words presented in the word cloud, was 100 words. The most frequent negative term in the following figure was risk (n=102) and the least recurrent was break (n=8). Concerning the positive words, it was innovation (n=108) and winner (n=9).





Figure 4.9. – Positive VS Negative terms word cloud Source: This thesis.

Visualizing the qualitative data in a word cloud format indicated that positive words appeared more frequently and in greater numbers, leading to an optimistic discourse regarding regulatory sandboxes. The ratio was 43 negative terms and 57 positive ones.

The AFINN lexicon was used to calculate the global sentiment that helped build the graphics in Figures 4.10. and 4.11. The results correspond to the sum of the word's sentiment score (-5 to 5) for the given years or genres, divided by the number of publications in each group. This process standardized the sentiment analysis across different years and genres, regardless of how many articles were published each category. Values rounded to the nearest unit.



Figure 4 - Sentiment score retrieved for the years in analysis. Source: This thesis.

After its official creation in 2015, the leading sentiment towards regulatory sandboxes was identified in 2023. This year had a positive score of 122 = [411+(-289)] for 11 pieces, which led to a calculated sentiment score of 11 points. In addition, the least positive sentiment score, equal to 1 point and notorious for 2022, resulted from 309 positive and (-312) negative scores

for 16 pieces. None of the years above present negative sentiment scores for the regulatory instrument.



Figure 4.11. - Sentiment score retrieved for the genres in analysis. Source: This thesis.

Letters addressed to FT seem to be the only genre with an overall negative sentiment score (equal to -4), consequence of 36 and (-51) scores for a total of 4 publications. These documents encompass the reader's voice in response to other published articles, express thoughts and judgements, and are less factual, being more expressive and emotional than journalistic pieces. People often communicate verbally, in interviews and dialogues, with greater emphasis, reason that might explain why transcripts also seem to carry more emotions than other genres.

To obtain the contribution of each term to sentiment values the product of the word frequency and the sentiment score was calculated. The words with the largest contribution to sentiment values, according to the *AFINN* dictionary, are assembled in Figure 4.12. in descending order.



Figure 5 - Positive and negative contribution to sentiment for each term. Source: This thesis.

The words with the worse result (equal to -4) were, for example, "fraud" and "hell". Conversely, the arguments with the best score (equivalent to 5) were "superb", "thrilled" and "outstanding". These words have the largest impact in the calculated sentiment, however, the appearing words assembled the larger term frequencies.

CHAPTER 5

Conclusion

This thesis explored the complex interplay between innovation, regulation, and the role of experimental policies such as regulatory sandboxes. Innovation has been recognized as a critical driver of economic growth, employment, and competitive advantage. The regulatory landscape, while essential to safeguard consumers, maintain market stability, and foster competition, can also bring some challenges, particularly when regulations become obsolete or overly restrictive. Consequently, the emergence of regulatory sandboxes offers a dynamic framework where new products, services, and business models can be tested under controlled conditions, which benefits both regulators and sector pioneers.

Our analysis investigated this instrument from a "text metric", working with 91 FT articles over a 17-year period, and provided valuable insights into the evolving discourse around regulatory sandboxes, highlighting peaks in publication frequency that linked to key developments in fintech and digital innovation regulations. Through the application of multiple text mining techniques such as term frequency, inverse document frequency, word relationships, and sentiment analysis, this work identified the dominant themes, trends, and sentiments surrounding regulatory sandboxes in the media between 2006 and 2023.

Overall, our findings highlight that the synergy between progressive and pioneering technologies and the regulatory background is decisive for economic stability and sustainable innovation. Also, the rationale behind regulatory sandboxes is that these popular experiments of forthcoming regulation encourage companies to innovate by collaborating with policymakers who oversee and guide the process. Although the financial sector founded regulatory sandboxes, this tool transcended that area, especially for fast developing technologies, like blockchain, cryptocurrencies, computing, IoT and AI. In the last years, since its official creation and using the FT sample of articles related to the topic, we found that, globally, the judgement about this regulatory tool was positive, higher in 2019 and 2023. However, the sentiment and written discourse also depended on the genre of the articles in question. For example, letters, that encompass the reader's voice had a negative sentiment score and transcripts the top positive score.

These results enhance the increasing body of knowledge on regulatory instruments like regulatory sandboxes. For policymakers, the challenge lies in maintaining this balance – ensuring that regulations do not stifle innovation while still protecting public interest and market integrity. The insights gained from this research can help inform future regulatory

strategies, fostering more open communication and collaboration channels between regulatory bodies and innovative firms. Given the positive general sentiment of sandboxes, countries could benefit from harmonizing sandbox policies across borders, to create consistent regulatory environments for firms that operate in multiple jurisdictions and supporting global innovation. Transparent regulatory processes build trust, so public policy could explore formalising sandboxes as a permanent feature in regulatory regimes, reporting trial outcomes and ensuring that consumers are aware of the opportunities and risks associated with new technologies.

Despite the significant contributions made by this study, it has some limitations that offer potential future research lines. Our analysis only addressed English-language publications from the FT. The extension of the years under evaluation was narrow, because this development in regulatory reform is relatively new. The genre classification of the extracted articles was determined by the Editor's discretion, which is subjective. Finally, dictionary-based sentiment analysis may miss out on slang, new terms, or context-specific words and struggles with sarcasm, irony, and negations that can alter the meaning and lead to inaccurate sentiment detection. It would be beneficial to conduct studies over a longer period to track the evolution of regulatory reforms and their impact on innovation and market dynamics, working with sources that have defined genre classification criteria and explore other sentiment analysis methods, such as machine learning algorithms.

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Appendix

Appendix A – Interactions with FT Customer Service

"From: FT Customer Service [help@ft.com] Sent: 03/04/2024 07:24 Subject: FT Customer Care | Case 07713742 [ref:!00D200LryV.!500Px08ZRn7:ref]

Dear Joana,

I trust you're in good health and spirits.

- I'm reaching out to share some insights regarding your inquiry about regulatory sandboxes and our approach to categorising articles, which you mentioned could be beneficial for your thesis.
- After consulting with our Editorial team, it's important to note that the classification of articles into specific genres is largely determined by the Editor's discretion. Furthermore, the distinction between what is considered a Deep Dive or a Big Read is not strictly defined by length. Instead, it encompasses a range of factors, including the depth and breadth of the content. This flexibility ensures that even shorter pieces can be recognised for their comprehensive analysis or detailed exploration of a subject.
- *I hope this clarification meets your needs and assists you in your research. Wishing you the best in your academic endeavours.*
- In my commitment to providing outstanding service, you might receive an email inviting you to provide feedback on the assistance I've offered. Your insights are crucial for my improvement.
- Should you need further help or have any questions, please feel free to get in touch. Visit our Help Centre at https://help.ft.com, use our live chat, or call the numbers provided below. I'm here to support you.

Best regards,

Stephanie | Financial Times Customer Care".

"From: FT Customer Service [help@ft.com]
Sent: 04/04/2024 16:58
Subject: FT Customer Care | Case 07713742 [ref:!00D200LryV.!500Px08ZRn7:ref]

Dear Joana,

I've received a response from the team regarding our inquiry, and here is what they've shared:

- "We won't be able to provide this, unfortunately. As mentioned previously, these descriptions are down to the Editor's discretion and are subject to change depending on the article/desk."
- *While I hope to be of more assistance, I trust you understand the limitations we're working with. I hope this clarification is satisfactory.*

Best regards,

Stephanie | Financial Times Customer Care".

Appendix B – Database

Nr.	Title	Date
1	DeFi' movement promises high interest but high risk	30/12/19
2	A "fintech sandbox" might sound like a harmless idea. It's not	05/12/18
3	A sceptic's guide to crypto: the crypto Wild West	13/09/22
4	Abu Dhabi and Dubai put fintech first	06/10/16
5	Air safety agencies rush to draw up rules for flying taxis	03/06/19
6	An innovative yet double-edged approach to financial regulation	09/05/16
7	Arizona sandbox gives fintech start-ups a regulatory path to US	12/11/18
8	Australia publishes draft laws on enhanced fintech sandbox	24/10/17
9	Back to the classroom for tech's regulators	03/05/19
10	Bahrain fintech model offers blueprint for rest of the region	18/10/19
11	Banks adopt blockchain for mortgage valuation system	18/10/16
12	Banks will not adopt blockchain fast	14/10/16
13	Bold action needed if UK fund industry is to keep up	10/11/18
14	Can the pioneer of blockchain gaming survive the crypto winter?	05/02/23
15	Colombian fintechs fill Latin American banking gaps	07/10/20
16	Computing and life sciences to benefit from UK financial and regulatory measures	15/03/23
17	Could the UK trade more financial services with Asean after Brexit?	02/11/19
18	Creative and proactive lawyers	21/11/13
19	Crypto's collapse highlights UK policy tensions	17/05/22
20	Cryptocurrency companies forced to bank outside UK	23/10/17
21	Drones set for revolutionary flight path	18/03/22
22	EU pushes for greater market supervision with focus on crypto assets	24/09/20
23	Facebook mints Libra crypto currency	18/06/19
24	FCA considers approving blockchain businesses	21/08/16
25	FCA does big number to prove it is the font of financial wisdom	05/04/16
26	Fintech bolsters Bahrain's bid to revive finance hub status	04/10/18
27	FinTech funding given boost by chancellor	23/11/16
28	Fintech in the US is stymied by old-fashioned regulators	15/04/18
29	Fintech seeks untapped riches in b2b	28/11/18
30	Fintechs and traditional lenders do battle across south-east Asia	25/10/21
31	Fintechs eye life outside the sandbox	08/06/20
32	Five reasons why fintech has substance as well as hype	20/06/16
33	Four challenges facing new FCA boss Nikhil Rathi	22/06/20
34	Gibraltar wants to rock to ICO beat	20/03/18
35	Google probed by UK competition watchdog over Chrome browser changes	08/01/21
36	GreenSky loses a partner, a market for cyber risk, and Tencent's fintech bets pay off	20/05/19

37	Has Binance blown its chance to rule the crypto markets?	15/08/23
38	Has the blockchain hype finally peaked?	30/11/16
39	Hong Kong to create fintech 'sandbox' allowing bank experiments	06/09/16
40	Hong Kong watchdog outlines plans to regulate cryptocurrency industry	01/11/18
41	Hong Kong's Neat offers cautionary tale on fintech bank partnerships	29/04/19
42	How should we police the trader bots?	17/06/22
43	In light of SEC suing Coinbase and Binance, some memorable crypto press releases	06/06/23
44	Into the fintech sandbox of the United Arab Emirates	15/12/16
45	Invest in UK's ideas factory — there's never been a better time	28/04/17
46	Is crypto going mainstream?	09/07/18
47	Isle of Man offers tax breaks to attract workers	22/02/19
48	IT outage hits Financial Conduct Authority	24/09/16
49	Jersey standards allow for fintech experimentation	14/12/18
50	Letter: Regulators must get in the sandbox with AI innovators	22/01/20
51	Letter: Singapore treads uneasily in crypto sandbox	22/08/23
52	Letter: Singapore will have one of the strictest crypto regimes	01/09/23
53	Lithuania makes push to become Europe's fintech hub	28/11/22
54	Lithuania must balance the benefits of fintech	15/01/20
55	London fintech under pressure	04/10/16
56	Middle East makes a play for fintech glory	13/11/18
57	Polish fintech companies face Brexit dilemma	06/06/17
58	Practice of law: best practice in legal work	06/12/22
59	Putin orders government to devise cryptocurrency regulations	24/10/17
60	Regulators club together to form global 'fintech sandbox'	07/08/18
61	Regulators speed up fintech plans as Covid spreads	02/11/20
62	Roblox's China ambitions risk falling flat	20/11/21
63	Silicon Roundabout trumps Silicon Valley	23/10/18
64	Singapore banks become a hotbed for 'fintech'	06/05/16
65	Singapore keen on initial coin offerings	15/11/17
66	Singapore start-up Sea opts for US listing	24/05/17
67	Singapore swings to the fintech beat	19/11/17
68	South Korea pins hopes on start-ups to power economic growth	31/01/19
69	Southeast Asia ready to embrace blockchain	05/12/17
70	Southeast Asian tech hubs race to become the next Silicon Valley	29/10/18
71	Tech breakthroughs are still coming	24/03/22
72	Tech platform SquareBook aims to entice more companies to list	25/07/19
73	Telehealth apps rise in south-east Asia because of doctor scarcity	17/09/18
74	Ten pioneers of new legal thinking: from access to justice to spin-off ventures	07/06/18
75	The FCA wants to have its cake and eat it, sandbox edition	25/10/17

76	The Lex Newsletter: regulation red in territorial tooth and claw	09/06/23
77	The lifecycle of a fintech startup	04/02/16
78	The UK needs to lead in securities tokenisation	06/07/23
79	The UK's dream of becoming a 'science superpower'	05/01/23
80	Time to change rules at Hotel California	23/11/06
81	UK Budget 2023: the chancellor's speech in full	15/03/23
82	UK regulators are the most fintech friendly	12/09/16
83	UK to overhaul funding of research and development post-Brexit	22/07/21
84	Vietnam's supply chains struggle to shake off Covid impact	30/11/21
85	Vilnius on the up as fintechs prepare for Brexit	03/01/20
86	Warsaw, Tallinn and Prague harbour fintech-hub ambitions	23/11/17
87	Why European fintechs struggle to make it in the US	14/03/22
88	Why fintechs are flocking to Lithuania; Pixpay and the digital natives; RBS launches Bó	02/12/19
89	Why Google thinks we need to regulate AI	20/01/20
90	Why the UK joined the race to woo the crypto industry	28/04/22
91	AI presents a 'Brexit opportunity' for Britain but there are risks	14/12/23