Regulatory sandboxes in developing economies

An innovative governance approach

Armando Guio

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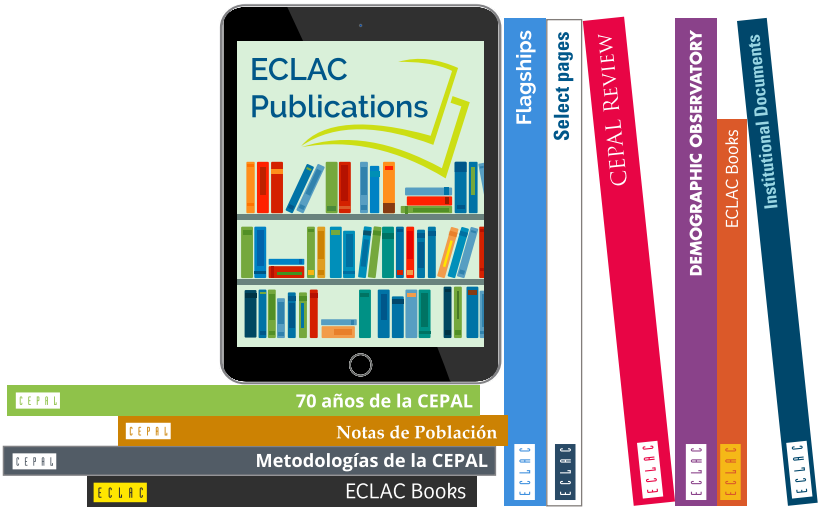

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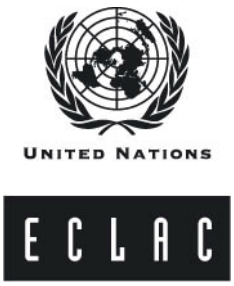

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Introduction

In 2023, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Economic Commission for Latin America and the Caribbean (UN-ECLAC) began focusing on regulatory sandboxes and their impact on low- and middle-income countries. Regulatory sandboxes, increasingly recognized for their importance due to the emergence of disruptive technologies like artificial intelligence, 5G, and cryptocurrencies, offer a method for authorities and governments to gain a deeper understanding of these innovations and contemplate the regulatory adjustments required. Furthermore, sandboxes serve as valuable tools for policymakers, providing concrete evidence to inform the development of policies and standards.

Regulatory sandboxes, initially pioneered by financial authorities in high-income countries, have expanded globally, with notable implementations even in developing regions. This widespread adoption raises a critical question about their effectiveness: Are these tools delivering tangible benefits across the diverse economies where they've been established? This question is particularly pertinent, given the growing enthusiasm for investing in regulatory experimentation. Despite the interest, there's a noticeable gap in comprehensive analysis concerning the development of these innovative spaces and the outcomes they've achieved, especially in low- and middle-income countries.

This report represents an initial effort to gather comprehensive information on the development of regulatory sandboxes and the valuable insights they offer. It critically examines their impact, with a focus on assessing their viability and effectiveness in supporting innovation in low- and middle-income countries, given the significant investment and resources such endeavors demand. Policymakers, international organizations, and national authorities contemplating the establishment of regulatory sandboxes in new sectors and technologies may find this report particularly useful, as it aims to provide actionable guidance and lessons learned from existing projects.

This work adds significant value by providing insights into the development and impact of regulatory sandboxes in low- and middle-income countries, an area previously underexplored. Drawing on firsthand accounts from public officials directly engaged in these initiatives, this report diverges from

existing literature, which predominantly focuses on the financial sector within high-income contexts and often only covers developments up to 2021. We extend our heartfelt thanks to the authorities and individuals who generously supported this research, offering their time for interviews and contributing valuable knowledge to this comprehensive study.

This report outlines key lessons for regulators planning or initiating regulatory sandbox projects. It introduces a novel tool that enables governments and authorities to evaluate their preparedness for these initiatives, drawing on insights from this study. The tool assists policymakers in deciding whether to pursue regulatory sandboxes immediately or to first build essential capabilities before launching a comprehensive regulatory sandbox.

I. Methodology and selection of countries

One initial step in this project was to pinpoint regulatory sandboxes that could yield pertinent insights and lessons, particularly focusing on those implemented in low- and middle-income countries. The selection aimed at experiences offering comprehensive data and evidence about their design and outcomes. To achieve this, we established specific criteria to systematically evaluate the array of sandboxes, ensuring they met our research objectives:

- State of development: it was essential to consider experiences of regulatory sandboxes in various stages of development. In this way, sandboxes were identified that were in a state of design or implementation or that had already been operating for several years. This diversity allows learning from different points in time and understanding specific challenges in the design or implementation of such a project. Only focusing on sandboxes that have already been implemented may result in information being collected that focuses specifically on implementation challenges when the design process of these sandboxes has been shown to be critical. Several of these projects have not progressed beyond this stage given the challenges they have faced from design to implementation.
- Representation of diverse regions: one key objective of this study was to analyze regulatory sandbox initiatives from various countries worldwide. By examining a diverse array of cases, we aimed to uncover not only the unique challenges faced locally but also those common issues that cut across borders. This approach enabled us to identify pervasive challenges related to the conceptualization and application of regulatory sandboxes, shedding light on aspects that transcend specific countries and regions.
- Existing documentation: this work is also based on documentation available about these sandboxes. The available or provided documentation on the studied cases was helpful to confirm that the regulatory sandboxes analyzed exist and not that they are projects or announcements that have not materialized. It is possible to identify that several governments have made announcements about the development of regulatory sandboxes. However, many of these projects have not gone beyond announcements. There are several

reasons for this to happen, whether it is the change of government that causes these projects not to continue, changes in government priorities, or a lack of resources.

Thus, a critical point of this research was the selection of countries with proven experience and a concrete effort to design this type of regulatory experimentation project.

Countries selected: based on these criteria, the regulatory sandboxes selected for this project were the following:

A. Bermuda

Bermuda's energy regulatory sandbox is part of the country's Economic Recovery Plan, and it's designed to encourage developers of renewable energy technologies to test their projects in Bermuda and increasing access to these products for locals. This sandbox is intended to explore renewable energies for the country while also encouraging investment and aiding the local economy, by encouraging companies pursuing innovative technologies to do their business in Bermuda. Technologies tested in the sandbox parameters that result commercially viable and affordable for the country will be considered as potential replacements for traditional energy technologies that operate in the island (*Sandbox Regulations and Seabased*, Government of Bermuda).

A project that is expected to benefit from this sandbox is the 40MW wave energy park that the Swedish ocean developer Seabased plans to develop. This project is the first of its kind in the Caribbean and will be built a few kilometers offshore from Bermuda's St George's Island, north of the archipelago and is projected to supply 10% of the country's energy. Seabased's CEO has explained that the regulatory piece is just as important as the technological innovation for projects like this one (Jones, 2023). Seabased intends to become the first Blue Energy Company to build, own, and operate Wave Power Parks across the globe. They use buoys on the ocean surface to generate grid-suitable electricity from stable, reliable ocean waves, using innovative technology to create a "complete wave-to-grid solution" (Wave Power Parks, SEABASED).

B. Brazil

Brazil's National Data Protection Authority (ANDP) decided to implement an AI regulatory sandbox because it can allow better enforcement of data protection laws and regulations within AI systems; it can strengthen ANDP's position as an AI regulation entity in the country; and it can prevent and diminish information asymmetries by allowing policy makers to have access to advanced AI systems. Hence, ANDP's research and decision-making processes can become evidence based. It is also a timely sandbox, given that the Brazilian congress is in the process of debating Bill 2338/2023, which will regulate this technology and establish an AI supervision authority.

ANDP made a conscious choice to include machine learning technologies and generative AI in the sandbox to better understand these emerging technologies through actively engaging with them. The regulatory sandbox allows ANDP to test the risks that ML technologies and generative AI present and manage and mitigate these risks, while fostering innovation at the same time. While Brazil already has laws in place to protect data privacy and users from automated decisions that can affect their lives —namely article 20 of the LGPD (Lei Geral de Proteção de Dados)— there are certain limitations of this law that prevent achieving algorithmic transparency. The regulatory sandbox should help the ANDP understand the limitations of this law and inform Congress' decision regarding Bill 2338/2023 (Participa + Brasil - Regulatory Sandbox on Artificial Intelligence and Data Protection in Brazil).

C. Colombia

Colombia has an AI regulatory sandbox project that is heavily based on a fintech regulatory sandbox project previously implemented in the country. Both projects were selected to get a complete understanding of the development of regulatory sandboxes in this country. The Superintendence of Finance (SFC) created laArenera (theSandbox), which is a framework provided by this government entity for testing technological innovations applied to financial services, the stock market or insurance, in a controlled and supervised space. From new apps to new business models, companies can test financial services and products within this controlled space. This space allows the SFC to maintain a balance between adequate regulation aimed at comprehensive supervision of supervised entities, the prevention of crisis situations, the illegal exercise of financial activity and the promotion and support of new technological advances applied to financial services. The sandbox is integrated with an innovation hub within the SFC to support the implementation of new technologies within the fintech space (innovaSFC, 2020).

In the case of the AI sandbox developed by the Superintendence of Industry and Commerce (SIC), it is a preventive, supervised and temporary experimentation space, created to support those developing AI technologies from the design stage to create collaborative compliance solutions to personal data protection standards. The regulatory sandbox is aimed at international and Colombian companies and the support provided by the data protection authority to create collaborative compliance solutions to data protection laws is non-binding. The main goal of the SIC is to support AI projects so that they are not only scientifically or economically successful, but also friendly and respectful of the rights of individuals with respect to the collection, storage, use or circulation of their information (Superintendencia de Industria y Comercio, *Sandbox,* 2021).

Individuals or companies proposing a project for the sandbox must fill out a questionnaire where they indicate the type of project (ecommerce, advertising, marketing), the main objectives of the project, what makes it an innovative AI project, the expected main benefits of the project and why it is a good fit for the sandbox. Participants must also indicate whether they have experience working with AI and if they have similar projects currently operating in other territories. The questionnaire also requires potential participants to share what kind of data their AI project uses, including whether they use the data of minors or if the data used will be from individuals inside or outside of Colombia (Superintendencia de Industria y Comercio, *Formato de aplicación,* 2021).

D. Kenya

Kenya created the Capital Markets Authority Regulatory Sandbox for testing of capital market related products, services, and solutions. It is also aimed at projects that are mostly in the development stage, allowing for tweaks and edits before launching to public markets. It is designed to allow the Capital Markets Authority to learn in real-time about fintech innovations and make evidence-based decisions, while keeping a close eye on integrity risks, financial stability, and investor protection.

To be eligible for the sandbox a company must be incorporated in Kenya or licensed to do business within the jurisdiction; it must offer an innovative product, service, or solution that is not clearly addressed by existing legislation. Interested entities must fill out an application form and if approved, they can begin to test their project, without a guarantee that following the testing period they will be allowed to operate within the Kenyan jurisdiction (Kenya Capital Market Authority, 2023).

E. Malaysia

Malaysia launched a regulatory sandbox in 2016, hosted by Bank Negara Malaysia, to facilitate innovation within the financial sector. The sandbox was designed to allow fintech solutions to be tested within certain regulatory flexibilities accompanied by safeguards to preserve financial stability, integrity of transactions, ensuring fair business, and protecting treatment of consumers. The sandbox was designed with a risk-proportionate forward mindset, which considers factors of potential risks to manage them, while minimizing regulatory burdens for financial providers. The Bank manages licenses, approvals, and registrations to manage said risks (Bank Negara Malaysia, 2023).

The following graph summarizes the activities that have taken place within the sandbox already and the impact it has had in Malaysia:(Bank Negara Malaysia, 2023). Interested participants must identify whether their project is wholly or partially incompatible with regulations, standards, or laws administered by the Bank, and ensure that their proposed solution or product acts within the Bank's regulatory purview. They must provide evidence as to the innovative quality of their project through demonstrating its functionality, usefulness, or which gaps within the financial market it aims to fill or services it seeks to improve. For this, it may be useful to compare their solution to other less efficient and innovative ones available in the market. The project must also have a demonstrable business model and sufficient readiness to be tested within the regulatory sandbox.

The Bank also has a Regulatory Sandbox Framework readily available for interested participants to go through once they decide to apply. The sandbox process itself has three stages, beginning with the application stage. During this stage, applicants submit a completed application form along with relevant supporting documentation. Applicants receive a decision within 15 working days and if approved, they move on to the second stage, which is the preparation stage.

Here, admitted participants prepare for testing through collaborating with the Bank to determine eligible testing parameters, implement risk management and safeguards, and set key performance indicators to measure success or failure, among other matters. The next and final stage of the sandbox is live testing, during which participants test their product or solution in the live market within a period not exceeding 12 months with the necessary exemptions from relevant regulations. Participants provide regular reports of their progress and prepare for next steps, whether that be scaling their product to continue if successful or organizing an exit with minimal impact to customers if unsuccessful (Bank Negara Malaysia, 2023).

One of the main methodologies to develop this report and collect relevant information was to conduct interviews with the main authorities that have worked on the selected regulatory sandboxes. These interviews provided detailed insight on how each of these sandboxes were developed, the main motivations for their development, the teams involved, and the lessons that each of these authorities have been learning.

Rather than understanding what a sandbox is and how it works, the focus of this report is on how sandboxes have been developed in low- and middle-income countries and how they can achieve better results and be more efficient. To this end, a questionnaire was prepared containing questions that can be divided into five sections:

- Description of the regulatory sandbox: at this stage, the interviews aimed to gather initial descriptions of regulatory sandboxes, focusing on their defining features, objectives, and the specific challenges they aim to tackle. This approach not only provided insights into how authorities perceive and articulate their projects but also allowed for a comparison with existing documentation on these initiatives. Intriguingly, the interviews uncovered diverse interpretations among entities regarding the essence and key attributes of a

regulatory sandbox. This variety in perspectives highlights a notable lack of consensus on the fundamental nature and operational guidelines of sandboxes, underscoring the nascent stage of development for this regulatory instrument.

- Resources and team required for regulatory sandbox development: understanding the resources allocated and the organizational structures established by governments for regulatory sandboxes was a crucial aspect of this investigation. This encompassed not only the financial investments made by governments but also the composition and expertise of the teams tasked with implementing these projects. Interviews shed light on the varied approaches to these investments, revealing a range from dedicated sandbox units to minimalist two-person teams. Gaining this insight is pivotal for comprehending the factors that motivate authorities to invest in sandboxes and the specific resources committed to these endeavors. Moreover, this information lays the groundwork for exploring potential correlations between the scale of investment and the outcomes achieved by the sandboxes.
- Challenges in the design and implementation of regulatory sandboxes: one of the most important goals of the interviews was understanding the challenges that authorities face when developing the regulatory sandboxes. There are specific challenges from the initial design of these projects and in their subsequent implementation. The interview questions aimed at finding out how these authorities have managed to overcome these types of challenges, but also how they continue to face many challenges, even after years of leading these projects. Identifying these challenges was fundamental as a potential learning experience for other countries interested in these types of projects and the impact they can have. It was also important not only to explore that the challenges lie in access to resources, but also in the development of a culture of experimentation and the ability to drive innovation in the regulatory field.
- Lessons learned by policy makers and regulators: another large part of the interviews focused on the lessons learned by officials during the development of their projects. In this sense, the questions delved into the type of lessons that these entities have learned, either in the design, implementation, or development of these projects. This led to some interesting recommendations for other policymakers that will be presented in the report.
- Recommendations to other entities interested in sandbox development: in several of these interviews there was a final space to reflect on the elements that these authorities would share with their peers in other countries interested in this type of innovative methodology. Many of these authorities wished to share their experiences with other entities around the world, since they considered them valuable and believed that they would facilitate similar processes for others. Likewise, it was clear that there are many opportunities for knowledge exchange, to avoid working in isolation on these challenging projects. Given the innovative nature of these projects, those responsible for these initiatives are often seen as innovators but also as people who come to change the status quo of regulatory agencies. This can lead them to feel isolated even within their own governments, so they find it valuable to be able to generate community and work actively with others who have been in that position.

In addition to the interviews, documentation and information from the selected countries was collected, together with literature related to the latest development of regulatory sandboxes. In this way, it was possible to select more than 60 documents to complement the information collected in each of the interviews, which provided a theoretical and conceptual framework for this work.

The development of literature around regulatory sandboxes has increased at an accelerating pace, both in terms of case identification and academic proposals on the subject. All of this is still a work in progress and sandboxes continue to generate sustained attention.

II. Conceptual framework and research areas

To effectively analyze regulatory sandboxes globally, it's essential to start with a clear understanding of the concept. Instead of proposing a new definition, this section aims to elucidate the existing concept, tracing its evolution and evaluating its influence on the approaches adopted by low- and middle-income countries towards regulatory challenges.

As we delve deeper, it becomes apparent that defining a regulatory sandbox and pinpointing its key features is an increasingly complex task. The lack of a universally accepted definition, coupled with the diverse implementation strategies across various projects, signifies that the concept is continuously evolving.

A. Defining regulatory sandboxes

Since the development of the first regulatory sandboxes, one of the first efforts has been to have a clear definition of what they are. This is a complex task and has become more difficult in the last few years. As described below, this was a term that was first used by the software sector and has been translated to the regulatory space. This kind of translation usually tends to be problematic and can create some misunderstandings.

In the context of cybersecurity, experts understood sandboxes as "controlled playgrounds" where code or applications can be tested in an effort to observe how they will behave without affecting the network within which they are operating (*What is a Sandbox?*, 2021). Like in a real-world sandbox where children can play, build, and destroy without damaging the world around them, a digital sandbox allows for experimentation within a confined space, and these spaces are often used in cybersecurity to test out suspicious or unknown attachments. If the code tries to control the server or replicates itself, or behaves in any other potentially harmful behavior, researchers can identify it as malicious and act accordingly. Sandboxes are also used by developers to test applications or updates before mass deployment (*What is a Sandbox?*, 2021).

This concept generated interest in supervisory bodies in developed countries, which were interested in bringing it to the regulatory world. The UK's Financial Conduct Authority has proposed the following definition for regulatory sandbox following the cybersecurity conceptualization: "a 'safe space' in which businesses can test innovative products, services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in the activity in question" (PYMNTS, 2022).

This means that the original concept of a regulatory sandbox leads to an entity being able to test a product, just as a new software is tested, but under a flexible regulatory environment. In this way, the sandbox derived from the software industry differs from a regulatory sandbox in that in the regulatory sandbox the testing can go further, since products can be put to controlled use even if they do not strictly comply with the rules that cover several of these innovations.

Undoubtedly, regulatory sandboxes have been a reaction of regulators to strike a balance between regulation and innovation. Rather than banning some innovations that may have positive and desirable social outcomes, these tests seek to understand whether products can be offered on a larger scale without jeopardizing markets, safety, or fundamental social values.

Nonetheless, definitions have varied, such as the one published by the European Commission. For this entity, regulatory sandboxes are tools that allow testing and experimentation of innovative products, services, or businesses while supervised by regulatory entities for a set time (European Parliament, 2022). Under this definition, a regulatory sandbox is simply a space for technological innovation in which the regulator is included. This leads to a fundamental question that lies at the heart of understanding regulatory sandboxes: What exactly is the subject of experimentation within a sandbox—is it the technology itself, the regulatory framework, or a combination of both?

Clearly, this question is essentially about what a sandbox is, how it has historically been approached by the international community, and how specifically the countries interviewed have addressed this issue. The complexity of this scenario is that it cannot be said that there is a single, exhaustive definition of a regulatory sandbox. However, a regulatory sandbox is a space in which rules or interpretations of rules are tested in the light of a technological innovation. In this way, it is essential for a regulation to be subject to experimentation and thus for that regulation to be made more "flexible". Without this element, sandboxes seem more like innovation spaces where a regulator is invited, or spaces to provide legal advice where the regulation remains unchanged. What is truly revolutionary about regulatory sandboxes is that they also subject the regulation to experiments, or at least aim to achieve this objective.

According to Stanford University scholars, it's essential for regulators to understand innovation from a benefit and risks perspective, to create accurate policies and norms that don't hinder these benefits, while protecting consumers and financial systems. A regulatory sandbox is a space that can reduce this uncertainty, and the more narrowly this sandbox is defined, the better the boundaries (Quan, 2019). Outdated regulations that are struggling to catch up with new technologies cause uncertainty among innovators, which can cause harm both when products operate without knowing their regulatory boundaries, or when products cannot operate due to risk-averse regulators being unwilling to greenlight them.

To facilitate our analysis of regulatory sandboxes in low- and middle-income countries, we propose defining them as platforms for regulatory experimentation. These platforms temporarily relax certain regulatory standards to explore and assess the potential benefits of new innovations. This definition emphasizes that the aim of a regulatory sandbox extends beyond merely permitting the operation of an innovative product or service. It also includes gathering evidence to inform potential regulatory modifications. In this light, a sandbox that focuses solely on testing technologies without evaluating regulatory implications would more aptly be described as a technology sector sandbox rather than a truly regulatory one.

According to this conceptualization, we have found that in several low- and middle-income countries, sandboxes have not been used to their full extent, but have been seen as spaces to bring the authorities closer to innovators, without there necessarily being an area of regulation that is subject to experimentation. This limits the potential of these tools and may even lead to some kind of disappointment with the results that these spaces have achieved.

Rather than reproaching an inappropriate use of the term regulatory sandbox this shows an enormous potential to develop this tool and to allow it to achieve desirable results in these countries. It is essential to begin the task of generating this knowledge and achieving successful cases in this sense, which may represent greater efforts but may be of greater benefit. They can even be great elements for the generation of innovation policies and institutional capacities for the adoption of technology.

This is why some experts recommend that sandboxes promote policies that impact entire ecosystems, instead of having narrow focuses on, for example, running pilot projects. Experience in other countries has shown that efforts like adopting machine learning in credit underwriting or facilitating data access with customer permission had significantly higher impacts than issuing waivers could ever have. It is also important to test novel products and provide regulatory relief when bringing innovative solutions to markets, but waiver-like policies often have blindspots of issues that can only be identified when an innovation is tested. Hence, it's important to remove obstacles to launching new products, with the corresponding risk management, even if they aren't fully compliant, because this allows for collaboration and supervision (Quan, 2019).

As we will see from this report, this is an issue that is undoubtedly at an early stage but continues to attract the attention of low- and middle-income countries and can become a relevant area of work and improvement.

B. Latest research

The latest research on regulatory sandboxes can be classified into three themes, described below.

1. Regulatory sandboxes in the Fintech sector and its impact

A variety of literature has focused on analyzing the sandboxes that have already been developed in financial matters. The literature is extensive, from those who demonstrate the benefits of sandboxes to those who criticize them for the harmful effects they may have on financial systems.

A working paper by the Bank for International Settlements assesses the impact of regulatory sandboxes on fintech firms' access to capital. The study highlights that fintechs participating in the UK sandbox experienced a 15% increase in capital raising post-entry and saw a 50% higher likelihood of securing funding. Furthermore, the research indicates that sandbox participation is associated with higher survival rates and an increase in patent filings among firms, suggesting enhanced innovation. The paper attributes these positive outcomes to sandboxes' role in reducing information asymmetries and lowering regulatory costs, making it easier for fintechs to navigate the financial landscape (Cornelli et al., 2023).

Some literature explores the way in which the United States has approached regulatory sandboxes. United States federal government agencies have shown reluctance to implement fintech regulatory sandboxes, but experts believe this has been to its detriment, since internationally firms have been able to move much quicker, particularly in Europe. A multi-agency cooperation is recommended at state and federal level because this would be the best way to foster innovation in the fintech space, producing better norms and regulations, and improving supervision and enforcement, which would reduce uncertainty and in turn benefit the entire market (Bawany, 2021).

However, regulatory sandboxes in the fintech sector carry certain risks. Beyond their role as regulators, sandboxes also act as facilitators, paving the way for fintech innovations to permeate society more broadly. This often leads to these technologies infiltrating non-financial social domains, a process referred to by some experts as 'risk-washing'. This term describes how the perceived safety of sandbox-tested innovations can lead to their uncritical acceptance and integration into various social spheres, potentially causing unintended disruptions. Such expansions of fintech applications into areas not originally intended for their use raise important concerns about their broader societal impact (Brown & Piroska, 2021).

Experts have suggested several enhancements to the regulatory sandbox framework to attract top-tier fintech innovators while safeguarding consumers and maintaining financial stability. In the UK, for instance, regulatory proposals include allowing private investors to allocate their capital towards funding sandbox participants. Such initiatives aim to lure startups by offering legal certainty and easier access to finances. By hosting fintech startups, the UK not only leverages their technological advancements to deliver superior financial services to its citizens but also prevents these firms from relocating abroad. Evidence suggests that fostering the growth of fintech firms within the host country can significantly contribute to its economic development. Another strategy to stimulate growth within the sandbox is to create opportunities for foreign investors to engage with the local fintech sector, ensuring they are adequately protected. This approach aims to tap into the untapped potential of smaller investors who might support projects that larger investors have overlooked, thereby promoting the democratization of profits and attracting foreign direct investment (Truby, 2018).

2. Regulatory sandbox for emerging technologies (AI, cryptocurrencies, blockchain, etc.)

Regulatory sandboxes have centered on disruptive technologies like AI or blockchain, and some literature has analyzed this process. In blockchain governance, regulatory sandboxes present an opportunity to integrate law, social norms, market, and technical infrastructure —all four regulatory forces. Fintech governance has in the past insisted on focusing only on markets and technology, but proper regulation requires integration of law and social norms (Reshef Kera, 2020).

The first format of a regulatory sandbox is attributed to the UK Financial Conduct Authority, and this model has been adapted by regulators the world over ever since. In the United States, regulatory sandboxes have been considered in various states when discussing the matter of blockchain innovators and regulation, with Arizona, Florida, Hawaii, Nevada, North Carolina, Utah, West Virginia, and Wyoming being among the first states to implement them. These sandboxes vary in several characteristics, such as scope, which entity it is administered by, and who can participate. Federal authorities have yet to implement interstate regulatory sandboxes, and states have been cautious to launch initiatives that rely on intrastate collaboration because they can easily cross the line into federal jurisdiction. This caution is the consequence of recent settlements and investigations surrounding cryptocurrencies and other fintech innovations, which have resulted in criminal enforcement actions by the Department of Justice and civil enforcement actions by corresponding entities (Jones Day, 2023).

Experts in the field of AI have underscored the necessity for regulatory sandboxes dedicated to this technology to foster institutional interdisciplinary collaboration and empower regulatory bodies with enhanced AI expertise. Drawing from the fintech sector's experiences, it's evident that such sandbox models facilitate easier access to financing and market entry, thereby accelerating the provision of services to consumers. The pragmatic and evidence-based approach adopted by regulatory sandboxes, which often leads to legal modifications or fresh interpretative guidelines, underscores the adaptability and responsiveness of this regulatory mechanism. Despite these advantages, a notable challenge remains: the absence of standardized procedures for testing and criteria for participant eligibility. This lack of uniformity, especially in the absence of well-defined sandbox specifications,

poses significant risks, potentially jeopardizing consumer protection, competitive fairness, and the security of public and personal data. To mitigate these risks, it's imperative to devise and implement clear and comprehensive standards that govern the operation of AI regulatory sandboxes.

Another mistake often made is thinking of sandboxes as small-scale testing frameworks when the interest in participation can result in pressure to expand them. Instead, building a structure that can accommodate multiple participants, and using tools like govtech[1] and regtech[2] to automate these processes, can set sandboxes up for success. It would also be ideal if sandbox compatibility is evaluated at an international level, to avoid forum shopping and arbitrage caused by diverging standards and some sandboxes being more lenient (OECD, 2023).

For rapidly evolving technologies such as AI, regulatory sandboxes offer a more effective approach than traditional regulatory frameworks. Sandboxes facilitate a quicker path to market for innovative products, thereby providing legal certainty to emerging businesses. This legal clarity encourages further innovation. In contrast, conventional regulatory processes can be exceedingly slow. A case in point is the EU AI Act, proposed in April 2021. Despite being in the adoption process, it is not expected to be enforceable until 2025. The sluggish pace at which traditional regulations are adopted makes them challenging to update. For example, the AI Act does not address generative AI, a technology that has seen significant growth in recent years. Regulatory sandboxes, on the other hand, offer a solution to this problem. They are designed to be adaptable and flexible, capable of evolving alongside new technological advancements without compromising consumer protection. This adaptability ensures that regulatory measures remain relevant and effective in the fast-paced world of technology.

An AI sandbox can help ensure that systems tested in the established space are safe to use, which boosts consumer confidence as they begin using a new product. Regulatory sandboxes also foster collaboration among regulators, businesses, and other stakeholders, creating better regulations that balance the needs of all parties. Allowing regulators and those regulated to learn from each other promotes trust and increases technology adoption. However, regulatory sandboxes bring risks such as inadequate safeguards and unforeseen consequences. These issues need to be addressed from the outset of their design.

While the EU AI Act mentions a regulatory sandbox, it does so marginally, suggesting that EU Member States introduce a sandbox. It does, however, not require that they do so, which would prevent authorities from creating spaces for real experimentation. Experts recommend introducing an experimentation clause that will allow states the flexibility in enforcing the existing legal framework necessary for a space like a sandbox to be successful. This would allow for attracting AI companies and creating honest dialogue between them and the regulators. While a successful operating regulatory sandbox requires resources and is costly, these costs will be paid off by the benefits that proper uses of AI can bring (Ringe, 2023).

3. Sandboxes in new economic sectors

The concept of regulatory sandboxes, originally popularized within the financial sector, is now garnering attention across various other economic and social domains. This broadening interest is not limited to a singular technology but spans multiple sectors, reflecting a growing recognition of the potential benefits that regulatory sandboxes offer. The academic community is increasingly documenting this trend, highlighting the diverse applications and advantages of implementing such frameworks. Among

[1] The European Commission has defined govtech as follows: "The term GovTech refers to the use of emerging technologies and digital products and services by government from start-ups and SMEs - instead of relying on large system integrators." Definition available at: https://joinup.ec.europa.eu/sites/default/files/news/2022-03/JRC128247_01%5B1%5D.pdf.

[2] World Economic Forum defines regtech as follows: "application of various new technological solutions that assist highly regulated industry stakeholders, including regulators, in setting, effectuating and meeting regulatory governance, reporting, compliance, and risk management obligation.". Definition available at: https://www3.weforum.org/docs/WEF_Regulatory_Tech_for_the_21st_Century_2022.pdf.

the sectors exploring the potential of regulatory sandboxes are healthcare, technology, environmental sustainability, and consumer goods, each seeking to understand how this flexible regulatory approach can foster innovation while maintaining necessary safeguards.

Healthcare and health services

Regulatory sandboxes can be used to improve health and social care services, not only improving the healthcare outcomes and experience, but also improving the experiences of regulators, healthcare providers, and commissioners. It can become a new collaborative space where participants determine the standards of a good experience, designing and trying out innovative solutions in the healthcare sector. Evidence shows that regulatory sandboxes have led to adjustments in processes and policies. These sandboxes tend to focus on optimizing patient outcomes by innovating interventions or service models, with, for instance, testing of digital health-related tools, machine learning applications for diagnostics, tele-health models, and blockchain (Leckenby et al., 2021).

Energy and renewable resource

Energy regulatory sandboxes have been found to follow certain innovation trends, like integrating distributed energy resources in electricity markets, the injection and production of synthetic gas, and dynamic distribution tariffs combined with local energy sharing. Some countries and regions have experimented with network operation processes, but these are less standardized. Regulatory sandboxes in this sector may impact the implementation of energy communities and regulatory barriers to production of synthetic gas in some regions, and while they might result in learnings in certain categories, no regulatory exceptions have been observed by experts who have studied sandboxes in this sector (Beckstedde et al., 2023).

Telecommunications industry

There is now more access to experiences on how this sector and industry is embracing sandboxes. For example, in Bahrain the telecommunications authority launched an Innovation License focused on Internet of Things (IoT), Augmented Reality/Virtual Reality/Extended Reality (AR/VR/XR), Wi-Fi 6, and blockchain, among other technologies. Firms obtaining an innovation license can test new wireless services and technologies in the country; have faster access to radio spectrum to conduct their tests; build partnerships with the regulatory authority and other industry actors. This innovation license works like a regulatory sandbox and looks to develop Bahrain's telecommunications industry (Ramadan, 2022).

In India, a regulatory sandbox for OTT communications apps is being explored, which will enable apps to try out features in a live yet controlled environment before mass deployment. The sandbox will benefit both established and new companies working in the over-the-top communication app space, including both existing apps trying new features, and altogether new apps. Apps that could potentially benefit from participating in this sandbox include WhatsApp and Signal (Sarkar, 2023).

C. Research on regulatory sandboxes' impact on economy and policy evaluation

Finally, it is possible to see that some of the latest academic literature has centered now on assessing the impact of sandboxes, specifically in the financial sector. A fintech regulatory sandbox in the UK was evaluated and no concluding evidence was found towards how much the sandbox contributed to the growth of financial institutions. Introducing the sandbox served as a catalyst for digital banking, but evidence suggests that these spaces have detrimental impacts on the financial performance of digital banks, increasing costs of compliance and efficiency (Washington et al., 2022).

Other researchers have found that regulatory sandboxes in the fintech space have not been empirically proven to be effective, even though they have been beneficial to creating a fintech ecosystem. However, upon comparing regulatory sandboxes in nine selected countries, they concluded that the impact of sandboxes on fintech venture investment growth was positive. For some researchers, regulatory sandboxes may play a key role in increasing venture capital into fintech ecosystems as they remove regulatory uncertainty (Goo & Heo, 2020).

It is interesting to observe how some of this research is re-thinking the role of regulatory sandboxes in the financial sector. For some expert's regulatory sandboxes also present the opportunity to bring moral imagination into financial authorities, on top of the regulatory certainty that they often promise. Moral imagination is defined as creatively identifying different options for responding to a specific challenge, considering the potential positive and negative outcomes that may arise from each response. This creates a new landscape where innovation is not only compliant, but also imaginative and responsible. If regulatory sandboxes are designed to be spaces for moral imagination, regulators, and innovators, together, can consider all possible implications of what is being designed or tested, which would open the road to responsible innovations (Undheim et al., 2022).

It should be noted that a single regulatory sandbox project can be classified in multiple themes at the same time, due to the intersections between these topics. In that way one can have regulatory sandboxes in fintech that are testing the impact of AI-based financial products, or sandboxes for the energy sector testing new blockchain protocols. Given the rapid advancement of technology and innovation these academic categories are blurring.

1. Main elements to be observed from academic work on regulatory sandboxes

The academic literature and technical reports identified offer relevant insights about different levels. There is an increasing academic interest in regulatory sandboxes and their impact in different sectors. Some authors have been showing their disappointment on some sandbox experiences while in other studies sandboxes have shown to have a positive economic impact in some countries. This now means that there is plenty of information and some of it is going in completely different directions.

It is interesting to observe how regulators interested in designing a regulatory sandbox approach all this information and the available literature. In many middle- and low-income countries there are public servants analyzing if regulatory sandboxes should be implemented by their agencies and can encounter this kind of information.

When approaching this literature, the conclusions are the following for policymakers:

- Regulatory sandboxes are a trending measure: without a doubt, regulatory sandboxes are a novel measure that should be explored. The way they have been used and the way they have generated confidence in several companies make sandboxes attractive measures that have generated high expectations. Failure to explore them could mean being left behind in a measure that could change the way regulation is done.
- Beyond the financial sector, there are other sectors with high interest in the subject: the financial sector has been a pioneer in the subject, but regulatory sandboxes have transcended this sector. Their functionality and the way in which they have been promoted means that various sectors, especially those with high regulations, complex regulations or with a greater impact on innovation, are becoming increasingly interested in this type of project.
- They have become almost a requirement to enter regulating certain technologies: it seems that before delving into any regulatory proposal on new technologies, these types of experiments must be carried out. Even many regulatory proposals on AI and other emerging technologies include specific chapters for the development of these spaces. Therefore, they are becoming a standard and common language when approaching discussions on the governance of emerging technologies.

- They seem to work: the results are mixed, and all kinds of evidence is beginning to emerge about the impact of regulatory sandboxes. However, some studies have attributed very positive results in terms of economic and business generation, which means that the tool continues to be viewed favorably. Undoubtedly the impact work has shown that regulatory sandboxes are transforming the financial sector, and this increases the interest in this figure.
- They can be improved: there is also a wide range of literature that shows that regulatory sandboxes are still a space for innovation and that they are themselves still in a testing stage. There is still much to improve and understand about these tools. This presents the complexity of applying a tool that is still in a stage of testing and change, so its application requires caution.

The surge in relevant literature worldwide significantly influences regulators. This proliferation of information and insights sparks heightened interest in adopting these methodologies, especially among regulators in low- and middle-income countries. Often, this interest is coupled with external pressure from experts and entrepreneurs advocating for innovative solutions. Consequently, regulatory sandboxes have been established in these countries, yielding invaluable insights and laying the groundwork for future advancements.

III. Main lessons learned and evidence collected

Low- and middle-income countries are increasingly engaging with regulatory sandboxes, driven by evolving definitions and the wealth of encouraging literature on the subject. Interviews reveal a consensus on the potential benefits of regulatory sandboxes yet acknowledge that their implementation is an ongoing learning journey. The imperative lies in maintaining continuous improvement and ensuring that the insights gained are preserved and built upon.

The following are some of the main lessons learned from the cases of the countries interviewed and the regulatory sandbox projects they have generated.

A. Cultural change (mindset) and promoting innovative approach to regulation

The cases studied showed that the creation of regulatory sandboxes implies, above all, a cultural change. The creation of the rule of law concept has been based on the idea that the rules that are issued are duly complied with and that non-compliance is supervised and sanctioned. This has been the challenge and effort of decades of work in developing countries. Therefore, the idea of starting to experiment with the rules and making compliance with some of them enforceable is still challenging.

Regulatory sandboxes are not an invitation to bypass the rule of law, but rather an opportunity to extend beyond it to understand the impact of regulatory application on innovative ecosystems. In all studied cases, facilitating such regulatory flexibility has been challenging. In Kenya, for instance, there is meticulous attention to which rules can be relaxed, with specialized teams within the securities authority reviewing each regulation before approval. A similar approach is observed in Colombia, where the financial authority carefully selects the rules it wishes to ease. In Brazil, analyzing the potential for regulatory flexibility has taken over a year, and it remains a matter of debate what form of regulatory flexibility should be pursued.

Therefore, one of the first lessons learned is the need to deepen a culture of regulatory experimentation. This culture must be clear in demonstrating that the aim is not to relax or soften supervisory capacities, but to ensure that regulation adapts to the new changes that are taking place.

To this end, it was possible to observe three elements that can motivate this change:

(i) Bringing young and innovative professionals into the team: In the case of Malaysia, it was interesting to note that the authority's bet was to bring in a team of young professionals with the objective of innovating in financial and legal matters. This is coupled with profiles of people who know the technology and the benefits it can bring. However, they also worked together with experienced policymakers that provide knowledge on how these processes should be conducted within these agencies.

(ii) Highlight the benefits of technology: Emphasizing the positive impacts of technologies under consideration for experimentation is crucial, showcasing their potential benefits to the supervised sector. The Colombian financial authority recognized that fintech technologies could significantly enhance financial inclusion for the poorest segments of the population by increasing their access to financial services. These benefits underscore the sandbox's value and relevance, compelling the authority to contemplate necessary regulatory adaptations to serve societal interests better. Convincing regulators to adopt a new mindset isn't about enforcement but involves a persuasive and strategic process that might include dialogue with stakeholders, evidence from pilot programs, and a commitment to data-driven decision-making.

(iii) It can help to motivate necessary legal changes: In some cases, authorities have evidenced that they need to implement regulatory changes, either because of the rapid advancement of technology or because they need greater authorities. In the case of Brazil, the regulatory sandbox of ANPD has been seen not only as an opportunity to work on data protection law issues, but also to think of the data protection authority as an AI authority. In this way, before introducing reforms that may be controversial, sandboxes help to explore such changes, in a less radical way.

Certainly, the legal and public innovation culture impacts the development of sandboxes. Regulatory sandboxes are disruptive in the sense that they experiment with some rules, even if only for a limited time. This generates resistance and in all the cases analyzed it became clear that in low- and middle-income countries the authorities are not necessarily initially favorable to this type of change, which may require various strategies to be implemented. Encouraging public innovation should mean that regulation should also be considered as a space for innovation and new methodologies. Perhaps efforts in public innovation have focused on the provision of services and not on regulatory oversight.

This may explain why some sandboxes initially lacked genuine regulatory experimentation. In Colombia's privacy-by-design sandbox, regulatory experimentation was somewhat restricted, aiming to provide a foundational sandbox experience. Consequently, the focus was more on guiding participants to comply with existing regulations rather than exploring regulatory adaptability. This trend is not uncommon in regulatory sandboxes, which often begin as platforms for dialogue between technology firms and regulators, similar to Kenya's experience. There, the project was seen as innovative and pioneering, offering public official's insights into technological advancements and disruptive financial products in the industry. However, to unlock the full potential of sandboxes, further steps are essential. Without incorporating regulation into the experimentation process, sandboxes risk becoming merely public innovation labs or testing grounds, rather than arenas for regulatory evolution and transformation.

B. Innovation policies as a general framework for sandbox implementation

As described in the previous point, sandboxes must overcome internal resistance and must therefore be developed in conjunction with a public policy that promotes them. In this sense, this study has shown that regulatory sandboxes in low- and middle-income countries benefit if they are part of a broader innovation, technology, or science policy. Regulatory sandboxes are a tool, not an end in themselves. The case of Malaysia, Colombia or Kenya demonstrate that these are efforts that have been developed within the framework of innovation, digital transformation, or artificial intelligence policies. This has allowed sandboxes to be oriented towards the modernization and innovation objectives of public sectors in these countries, which facilitates their adoption at various levels.

Incorporating regulatory sandboxes into wider strategic initiatives garners backing from various stakeholders involved in the innovation ecosystem. In Colombia and Bermuda, for instance, sandbox initiatives have received support from the highest governmental levels, including the Presidency and Ministries, which champion such projects. Beyond their immediate applications, such as in energy or data standards, sandbox outcomes are increasingly informing broader state policy and capability development. Innovation-centric policies are recognized for amplifying the impact of sandboxes. Moving away from limited focuses, like pilot programs or regulatory exemptions, to a more holistic approach that encompasses the entire innovation ecosystem can enhance effectiveness. Initiatives like applying machine learning in credit underwriting or improving data accessibility have demonstrated their potential to drive significant policy advancements, outstripping the impact of more confined efforts like isolated experiments (Quan, 2019).

In this way, sandboxes seem to have a virtuous relationship with technology and innovation policies. In those countries where there is a clear innovation or technology policy behind sandboxes, they become more robust and have clearer objectives. The case of Malaysia is a demonstration of the different uses that the sandbox space can have for economic modernization and financial transformation policies. The case of Brazil's project design has been delayed and more difficult to achieve given that Brazil's AI policy remains under discussion and the AI sandbox was developed even though the policy was still under continuous redesign.

C. Building interdisciplinary teams (resources)

In all the cases studied, the importance of interdisciplinary teams was demonstrated. These sandboxes exist thanks to the creation of these teams, which in the examined countries have been complex and perhaps one of the biggest challenges. Sandboxes are first developed in entities and regulatory agencies where people with expertise in law, economics and regulation predominate. However, several of these teams have been able to integrate technical expertise and technology professionals who have become essential for this purpose. The problem is that attracting and retaining these experts has been complicated, causing delays in the sandbox implementation process.

In Brazil, the technology and innovation team of ANPD has led this project and has been fundamental to its success, together with lawyers who have followed this line. The opposite is the case in Colombia, where the project's leading team was composed of lawyers, so the exchange focused on elements of the applicable rules, rather than on technology. This is undoubtedly because multidisciplinary teams are difficult to generate and that at times this type of talent is scarce, costly and there is no clarity as to the functions they would perform. In the case of Bermuda, the technical knowledge has come primarily from the participants, which may limit the government team's ability to understand the technical component and transfer knowledge about it.

The most enduring sandboxes, like those in Kenya, Colombia's financial sector, and Malaysia, owe their success to the formation of multidisciplinary teams focused on technology and innovation. These teams have effectively retained technical experts by encouraging them to tackle more complex projects and foster knowledge creation within their organizations.

Forming such teams is crucial for sandboxes to delve into both normative and technical discussions. This approach enables authorities and governments to use sandboxes for exploring opportunities that surpass initial expectations and enhances flexibility. Without this, there's a tendency for teams to concentrate solely on familiar regulatory matters, curtailing the technological potential. Notably, sandboxes like Brazil's have distinguished themselves through a significant technical emphasis, fostering increased confidence among potential participants.

D. Keeping flexibility to promote innovation

It has been interesting to learn that government entities in countries such as Malaysia or Colombia's financial authority recommend that these teams remain small and flexible. In the case of Colombia, there is a small sandbox unit composed of no more than four or five people who also work in other areas. This allows the team to interact with the entire entity and provide a service to different areas. In the case of Kenya, only a few staff members are constantly involved in the project, and they divide their functions efficiently. In Malaysia, the unit has remained relatively small so as not to lose flexibility and adapt to new needs.

In these countries this flexibility allows sandbox units to be seen not as a burden or as highly bureaucratic teams, but as teams capable of adapting to various circumstances and needs. Therefore, it becomes clear that these teams must be specifically designed for the objectives that the sandbox wants to elaborate. One of the most specific elements is to create trust in the participants and to be able to obtain results from the sandbox as evidence for regulatory improvement.

In addition, these small, flexible teams tend to interact quite well with local entrepreneurs, as in the case of Kenya. In this country, staff members interact with the entrepreneurs and seek to understand how the innovations they make work, until they are approved by the sandbox committee. This not only increases trust but collaborative work.

E. Sandboxes on relevant economic sectors

Sandboxes designed with a focus on country-specific issues tend to be more sustainable. The studied sandboxes have made significant impacts by addressing pertinent challenges. Financial sandboxes, for example, have played a crucial role in evaluating new digital identification methods, lending platforms, and groundbreaking innovations like cryptocurrencies. Others have concentrated on essential areas such as energy generation or generative AI. A sandbox's focus on relevant topics enhances its effectiveness, particularly if it's among the first in a country. However, sandboxes overly specialized in niche or technically complex areas may lose public relevance. This aspect is crucial, as sandboxes often need to engage with public interest and attention to drive policy adoption or changes effectively (Bromley-Trujillo & Poe, 2018).

However, it is essential that the sandboxes not only focus on relevant issues, but also on fundamental questions for the future of the regulations being analyzed. In this regard, the cases studied show mixed evidence. Colombia's data protection sandbox had limited impact as the issue of privacy by design or by default did not prove to be as imperative to the regulatory agenda, or at least was not properly connected with regulatory reforms to be introduced. In Bermuda the sandbox has been interesting for being innovative but its effects, so far, seem to be limited to the operation of a single business model that

does not seem to mean a major change in the country's energy sector. Brazil's sandbox is interesting because of the generative AI theme, but it remains to be seen whether it will have an impact on the discussions on the governance of this technology, as it only focuses on transparency issues.

Financial authorities have been more effective in identifying these types of relevant and impactful regulatory issues. All these authorities have been engaged in studying multiple innovation and technology projects. By understanding them, they have been able to identify those that can become market shapers but that raise challenging questions regarding their operation. An example of this is the Malaysian sandbox in which digital identity applications have been analyzed, but only some of them have raised questions regarding the identification of individuals and the risk to the financial system. It is in these cases that the authority has been able to draw on sandboxes and important lessons that they generated for the financial system.

One of the main reasons that probably explains this complexity is that the authorities of many of these countries have many limitations to determine the specific regulatory and policy opportunities from these experiences, especially since they do not have constant access to these innovations. Public servants in these countries face the challenge of easily connecting these technologies with relevant issues in the public agenda. Policy makers in low- and middle-income countries seem to look at sandboxes as their first experiences to learn more about technological innovations, which seems like a reasonable purpose. However, relying exclusively on regulatory sandboxes for this learning to take place can make these projects not achieve its entire potential and probably to lose public salience, which seems to be critical for their success.

Therefore, it appears that prior to initiating a sandbox, there should be an effort to engage with the innovation sector both domestically and internationally. This might involve establishing an innovation testbed or hub where authorities and innovators collaborate to accurately identify the regulatory challenges to be examined within a regulatory sandbox. This approach can also improve access to potential participants, an aspect identified as challenging by all participating countries, particularly for those with genuinely innovative developments.

F. Sustained efforts provide better results

Regulatory sandboxes cannot be established rapidly or on a temporary basis. The rollout of such initiatives is time-consuming, particularly when they represent new endeavors in a specific setting. Studies indicate that it is imprudent to treat these as quick-fix solutions that can be implemented swiftly by mirroring strategies from developed nations. Such direct transplants often fail to produce significant outcomes. The financial sandboxes in Kenya, Malaysia, and Colombia underwent extensive development phases before coming to fruition, with some taking over two years to yield preliminary results. Brazil's sandbox was developed over a year, while Colombia's privacy sandbox spanned two years without initial outcomes from the first participants. Bermuda spent one and a half years planning its sandbox, which is still in the implementation phase.

This does not mean that sandboxes should be considered expensive and difficult to implement, but neither should they be considered as tools that do not require specific analysis and endurance. All the sandboxes that have been analyzed have been able to be designed and published because they have had a previous analysis and work for their development.

Sandboxes undeniably demand a significant investment of time and resources. The pivotal question of whether such an endeavor is justified and cost-effective remains unanswered by this report. However, it is evident that all the involved authorities have acknowledged benefits in developing these environments, with many asserting the importance of continuing such efforts. Numerous studies have explored the impact of sandboxes on economic growth and entrepreneurship. Yet, case studies

consistently show that there is no shortcut to creating sandboxes or achieving immediate results from these initiatives. Several interviewed countries, particularly Kenya and the Colombian financial authority, highlighted the crucial role of sandboxes in fostering innovation within their financial sectors. They noted that sandboxes facilitated not only national innovation but also internal advancements within their respective organizations. Sandboxes have enabled these authorities to embrace a broader range of innovation and technology proposals, thereby enhancing their capability to modernize various aspects of their operations, including the adoption of regulatory technology (regtech) tools.

G. Reaching an implementation "momentum"

Many of the authorities interviewed have reached the point of implementation after various challenges and difficulties were overcome. Implementing a regulatory sandbox is not an easy task, either due to lack of participants or lack of knowledge or confidence in their projects. Therefore, it is critical not to lose momentum at the beginning of implementation until a point is reached where the regulatory sandbox project achieves results. It is difficult to get initial participants on board, as there may be a lack of confidence in how the project will work. But once this is achieved, all the authorities point out that there is a "momentum" of implementation that should not be lost. Perhaps only in the case of Bermuda implementation was secure as the participant company promoting this project provided this certainty for the government to go ahead with this project, but the other regulatory sandboxes analyzed have been open to interested parties.

Achieving the necessary momentum in implementation requires persistence and a clear demonstration of the incentives to participate in this project. Even in cases such as that of the financial authorities of Colombia and Malaysia, this momentum has allowed them to lead legislative and regulatory projects to broaden the scope of sandboxes and experimentation in each of these countries. The Colombia Data Protection authority opened the regulatory sandbox in two different moments to attract more participants, although it was planned to just have one open call. A second round of participants seems to yield more interesting projects and foster the implementation process. These efforts are coupled with measures that increase confidence for participants, such as confidentiality agreements and information exchanges by secure means.

H. Strategic alliances and collaborative implementation

Many of these sandboxes have benefited from the fact that the entities have not worked alone, but with national and international organizations and agencies. This has allowed them to have greater coordination and impact, more participants and been able to continue with these efforts for a longer period. In the case of Colombia, the privacy sandbox was possible thanks to the development of an initial design developed by CAF-Development Bank of Latin America. Brazil's generative AI sandbox was supported by the same entity and Bermuda's sandbox was developed with the support of the United Nations and a Swedish company. Financial sandboxes have also had the support of international entities such as the World Bank. Undoubtedly, these efforts have been given support in terms of access to resources, information and sustaining this type of project for all time required.

Additionally, the support of universities in these countries and abroad has contributed knowledge and experts in the field. Experts have been fundamental, especially in the implementation of some of these projects. In other cases, experts from the sector, such as in Bermuda, have been fundamental in generating these types of projects. However, the challenge is to know how much knowledge transfer has taken place and has remained with the government officials and regulatory agencies that have worked on these projects. This has not yet been possible to determine.

In these countries, authorities working on their own to develop these projects face numerous challenges, since these projects still have internal resistance, and many governments feel that they need expert knowledge to do something valuable. For this reason, they have not usually worked independently. At this point it is worth highlighting the case of the Brazilian Sandbox, in which the data protection authority has met with more than eight data protection authorities around the world that have experience in developing this type of sandboxes, to learn their lessons and challenges. This has undoubtedly allowed Brazil to have a modern and advanced regulatory sandbox on generative AI, taking advantage of all these previous experiences. In the case of Colombia, a national committee of sandboxes was created to meet to discuss these projects and find ways of collaboration and knowledge exchange.

IV. Assessing readiness to develop sandboxes: the RESMA tool

As can be observed, the lessons learned allow us to draw fundamental conclusions for development cooperation partners interested working on and supporting regulatory sandboxes in low- and middle-income countries:

- Regulatory sandboxes will continue to be a topic of high interest. Even more so if relevant actors around the world continue to promote and encourage their use. For the European Union, regulatory sandboxes will play a fundamental role in the regulation of emerging technologies. Therefore, it is not surprising that low- and middle-income countries are interested in carrying out these projects in the coming years.
- Development cooperation partners are expected to face an increased number of requests to support projects in low- and middle-income countries, due to the specific needs of these nations and the significant effort required to design such projects. Furthermore, the focus on economic development is shifting towards regulatory innovation, with regulatory sandboxes expected to play a crucial role in these discussions.
- Currently, there is insufficient evidence to fully understand the impact of regulatory sandboxes in low- and middle-income countries. However, there are criteria that can help these countries determine whether the establishment of a regulatory sandbox is justified, beyond the influence of prevailing enthusiasm. Development cooperation organizations could then focus their efforts on assisting these countries with this preliminary analysis and collaborate with other partners in these endeavors.

This proposal outlines a methodology for evaluating a country's readiness to implement regulatory sandboxes, referred to as the Regulatory Sandbox Maturity Assessment (RESMA) tool. The RESMA tool draws on data gathered from the countries under study, as well as experiences from other low- and middle-income nations that have initiated the development of regulatory sandboxes.

The RESMA tool consists of the following items:

A. Policy framework for regulatory experimentation

The first element to consider is the existence of public policies that favor and even promote testing environments such as regulatory sandboxes. In this sense, an initial review of these policies, standards, initiatives, or mission objectives related to innovation, technology and science is essential. The objective is not only that there is a policy framework around these projects, but also that this will clearly establish the objectives of the regulatory sandbox and the relevance of the evidence obtained in this project.

Without the existence of policies that favor experimentation spaces like sandboxes, there are several risks. The first is that sandboxes are developed without a clear purpose and restricted to testing technologies in a very limited way. In addition, sandboxes may become an imposition, almost a project that is developed by people interested in the subject but who do not have sufficient institutional support, which may generate resistance. This leads then to sandboxes being seen more as an obligation or a passing issue and not as a space worth developing to meet other objectives.

The following is an example of how this tool can be developed and some answers in the form of an example that may help to understand the analysis process:

Diagram 1
Identify policies or initiatives that are associated with the implementation of the sandbox

Question	Answer
1a Is there a policy or initiative that promotes regulatory experimentation or new forms of regulation in country Z?	Country Z's artificial intelligence strategy promotes the development of regulatory experimentation spaces.
1b Are there public innovation policies that can be related to regulatory sandboxes?	See previous answer.

Question	Answer
2a What are the objectives of this policy?	Make the country a leader in the adoption of AI. Facilitate the use of AI in strategic sectors of the country's economy.
2b Which entities lead this policy and its implementation?	The National Innovation Directorate.

Source: Own elaboration.

As illustrated, the aim of the initial phase is to assess the policy environment surrounding the regulatory sandbox, thereby facilitating its design and subsequent implementation. The example provided demonstrates a country's commitment to integrating these mechanisms within its AI strategy, which can streamline the process. This indicates a clear interest in the tool and its deployment, enabling the determination of an appropriate level of maturity in this initial phase and paving the way for the next stage of analysis.

Alternatively, it is advisable to first acquire knowledge about various regulatory experimentation mechanisms and their capabilities. This foundational understanding will enable a country to develop regulatory sandboxes efficiently and in accordance with its predefined goals.

B. Identifying relevant regulatory questions

The second point in this assessment is to specifically identify the issues to be addressed within the regulatory sandbox. As described throughout the report, the identification of the issues to be developed within the sandbox is fundamental. Usually, defining this type of regulatory question is not the task of a single entity. A clear example of this is the case of Bermuda, where it was a company that raised the possibility of having a regulatory sandbox in energy given the innovative model they had developed.

Often, establishing regulatory sandboxes necessitates legislative amendments to facilitate these experimental environments. It is crucial, therefore, to evaluate this aspect to ascertain a country's readiness for a regulatory sandbox. We emphasize that regulatory sandboxes serve as platforms for testing regulations, where innovations are introduced, and existing rules are adapted to be more flexible. This implies that regulation itself becomes a subject of experimentation. If the objective is to gain a deeper understanding of emerging technologies or innovations, alternative platforms might be more suitable for such explorations.

A clear example of this is what has been developed by financial authorities such as Kenya or Colombia. Before entering into the development of regulatory sandboxes, they had innovation hubs or testbeds where they learned more about some of the developments. Within these spaces they met projects that proved to be challenging and in which they saw the potential to develop a regulatory sandbox. This measure may not only prove to be cost-efficient but may also avoid excessive use of sandboxes. Therefore, in this stage of the analysis countries will define if they have clear regulations to be tested in a sandbox or if they should start with other tools before considering a regulatory sandbox.

Diagram 2
Setting regulatory questions to be addressed

Question	Answer
3a Has the innovation you want to test in the regulatory sandbox been clearly identified?	We have been aware of new generative AI systems that are going to be implemented in the public sector, especially in the health sector. It is considered that it can help diagnose some diseases more effectively and avoid costs to the system.
3b Are there any regulations that are impacted by the innovation identified? What is the regulatory question to be addressed?	Yes, the health regulation states that it is necessary for patients to authorize the use of all their data, including results that have been anonymized.
3c How was this regulatory question identified?	We identified this tension in a public consultation on data protection and public health services. Several participants told us that they have not been able to obtain all the data required for their AI projects because of this regulation.

Question	Answer
4a Which authority oversees the regulation that would potentially be analyzed in the sandbox?	The national health authority is responsible for overseeing the use of patient data and sanctioning its use.
4b Could the authority try a new regulatory approach?	Yes, the national health authority is responsible for setting specific requirements for the use of patient data and can change these requirements if necessary.

Source: Own elaboration.

Based on the identified regulatory tensions, it is feasible to conclude that a sandbox could provide significant value by offering a constructive pathway for the country's innovation and technology ecosystem.

C. Resources available and cost-effectiveness analysis

At this stage, it's crucial to evaluate the country's capacity to establish a regulatory sandbox, focusing on the availability of resources and their efficient utilization. Given that sandboxes typically demand substantial human and financial resources, the implementation strategies must be efficient.

Diagram 3
Measuring efficiency (cost-benefit assessment)

Question	Answer
5a Are there resources for the development of a regulatory sandbox?	The national health authority has an innovation team that could lead this space.
5b Are there potential partners for the development of this project?	Yes, the regional investment bank wants to support us through its Regulatory Modernization program. The Ministry of Health is willing to support us with people from their team. We also have experts from the National University who are interested in supporting the development of the sandbox.

Question	Answer
6a Have similar sandbox projects been identified around the world?	There is a regulatory and health sandbox project in country Y. It is aimed at evaluating new forms of payment for health services. The experience is valuable but not the same.
6b Is it possible to collaborate or work with other countries in sandboxes?	No, other identified projects are either in the closing stages or have not yet been implemented.

Source: Own elaboration.

In this case, it is valuable to note that this tool is based on the sandboxes developed by countries, especially the lessons learned in Brazil. The ANPD made an important effort to identify multiple cases of regulatory sandboxes around the world and define their main features. This allowed them to define precisely whether a sandbox was necessary and in which areas it would be innovative, in order not to duplicate efforts. This has undoubtedly led Brazil to generate an innovative sandbox that generates attention and does not duplicate efforts already being made by other entities. This was also an element that attracted the attention of entities such as CAF-Development Bank of Latin-America. They saw this analysis as evidence of the serious work developed by ANPD and were convinced of supporting the team with resources, due to the efficiency of the team involved in this project.

This also consists of a new way of approaching the task of regulation, in which regulatory evidence plays a preponderant role. This follows the cost-benefit analysis proposed by experts like Harvard Law School professor Cass Sunstein. Sunstein's theory is that public policy should be based strictly on careful consideration of costs and benefits. Considering items like how many lives will be impacted by this policy and whether it will be a positive or negative impact, how much it will cost

consumers, and whether it will cause harm to small businesses or workers is essential to understanding the costs and benefits of the actions of policy officials. This method of analysis is a useful for ensuring that policies make people's lives better (Sunstein, 2019). Regulatory sandboxes should also be subject to this kind of analysis.

D. Organized working methodology

Regarding the working plan and methodology of the sandbox, it is essential to determine whether the entities have sufficient capacity to develop the sandbox and have methodologies to develop it. This will allow authorities to know if the implementation will be easy or if it is necessary to generate capacities for the sandbox to be developed in a satisfactory way:

Diagram 4
Working plan and methodology

Question	Answer
7a Has any methodology been developed to implement the regulatory sandbox?	Yes, the methodology that Singapore has proposed in AI sandboxes is being used as a reference model. Therefore, the sandbox is expected to last for 12 months with constant authority oversight and possibility to defer the test.
7b Are there clear participant selection criteria and participation methodologies?	Initially, we are positing two criteria: -Entrepreneurs: companies with no more than 20 employees. -Local: entities established in the country.
7c Will the team be able to follow up with participants?	If the innovation unit will have two people dedicated to working with the participants. For this reason, only two participants will be selected.
7d Are there internal capacities to monitor this type of innovation?	Yes, the innovation unit has generated a shared repository of information to be accessed by all participants.
7e Has the team developed any initial format or mechanism for presenting the results of the regulatory sandbox and the information collected?	We have a tool that will allow us to synthesize the main learnings from this space and begin to generate a report that will be presented to the public once the process is completed.

Source: Own elaboration.

From the country-cases analyzed in this report it was possible to see that some sandboxes have more impact if teams are prepared to collect relevant evidence that will have an impact in future policy discussions. It is advisable that the teams are prepared to work with the participants and to elaborate results and collect evidence from these spaces under a clear methodology. A sandbox should not start until these capabilities have been initially developed, since if the team does not have the tools to do this analysis and follow-up, the effects of the sandbox may be very limited.

In the Colombian data protection authority's case, the entity entered the sandbox without established mechanisms for information collection. This lack of infrastructure posed a significant challenge in showcasing the sandbox's results, particularly in terms of influencing public policy analysis on AI or shaping new regulatory proposals in this field. The knowledge gained from these exercises remained confined to the individuals directly involved in the project. Despite these challenges, the project's ambitious nature has earned it global recognition, with several factors contributing to this acclaim. The Colombian data protection authority's pioneering efforts in launching this initiative have been notable, and the sandbox has arguably made a positive impact in terms of regional influence and capacity-building efforts. Implementing systematic information collection methods could enhance the sandbox's effectiveness even further. It's also crucial to clearly define the types of information to be gathered, ensuring that expectations among potential participants are aligned. This approach underscores the sandbox's role as a platform for information exchange, fostering transparency and trust in the process.

E. Capacity to introduce policy reforms and increase capacity

Finally, the regulatory sandbox and the authority leading it have the capacity to influence policy development and regulation. The sandbox not only seeks to increase knowledge about the technology being developed that impacts a sector, but also to determine the need for regulatory changes or otherwise inform policy. In the case of financial authorities, sandboxes have been seen as transparent spaces in which innovators can impact regulation and suggest changes in the way it is being applied.

In Kenya, Malaysia and Colombia, financial sandboxes have made it possible to think about new policy and regulatory reforms in the sector, generating new parameters that facilitate new business models which benefit the market and consumers. If there is no or limited capacity to influence these processes, the sandbox may not generate greater value.

Diagram 5
Capacity to influence policy and regulation

Question	Answer
8a Are their mechanisms to work with other sector entities and decision makers?	Both the Ministry of Health and the Presidency of the Republic will participate in and support the process.
8b Is it possible to introduce reforms to broaden the scope and capabilities of the sandbox in the future?	Yes, the national health authority is collaborating with Congress on these matters. Based on this partnership, we have the potential to introduce reforms that could broaden the sandbox's capacity in the future, should the sandbox prove to be successful.

Source: Own elaboration.

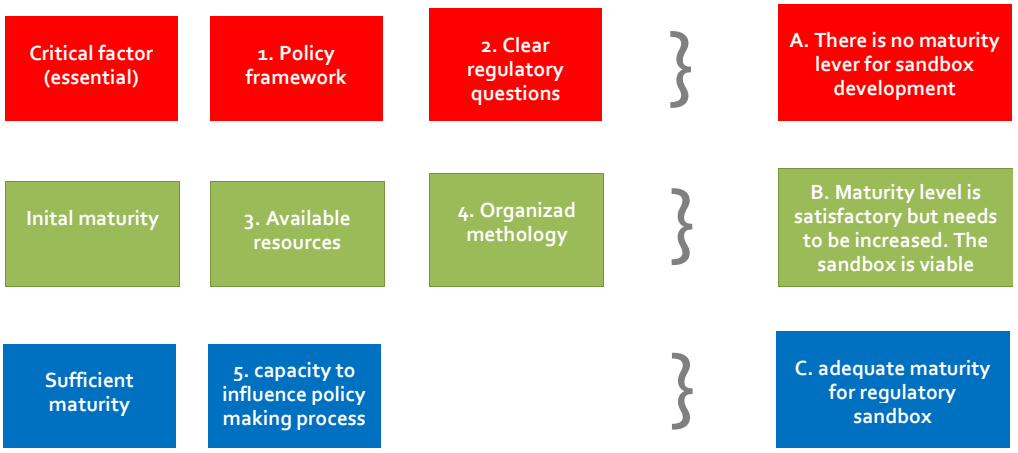
In Malaysia, it has become clear that strategic alliances have empowered the authority to amend legislation and extend its jurisdiction. Similarly, in Colombia, the Financial Superintendence has spearheaded groundbreaking legislation in the fintech sector, covering areas like open banking and financial inclusion. These examples illustrate the capability of well-established sandbox teams to engage with and shape policy and regulatory landscapes, thereby exerting a significant impact. Furthermore, regulatory sandboxes emerge as pivotal tools in augmenting state capabilities for oversight and the enactment of new regulations, especially pertinent in low- and middle-income countries.

F. The assessment

After collecting all the relevant information, we can assess the maturity level of a sandbox project to determine its viability for implementation and identify the necessary considerations.

A proposed building block of the maturity level assessment for regulatory sandboxes is presented below.

Diagram 6
Maturity level assessment



Source: Own elaboration.

As shown in the graph above, the maturity analysis is established at three levels:

(i) Level A-No maturity for sandbox development:
In this case, the lack of a clear policy and capabilities lead to the conclusion that there are no capacities to implement a regulatory sandbox that has an impact and is justifiable. In this case it is important to point out that both elements are fundamental. The definition of those regulatory questions or issues to be analyzed is highly relevant. If the entity does not have these regulatory issues clear, it can opt first for other methodologies such as innovation hubs or testbeds to learn more about the technologies, answer regulatory questions, and identify those questions that justify the sandbox in the future. In addition, policies are needed to justify and motivate the development of these spaces, otherwise the project will encounter a lot of resistance that will make it difficult to implement.
In those cases, the task of regulatory experimentation and innovation can be initiated, but not yet through a regulatory sandbox.

(ii) Level B-There are elements to develop a sandbox:
If level A has been passed but there are still doubts about the methodology or resources required, a level of maturity is reached that makes a sandbox viable but not immediately. It is necessary to generate initial capabilities in terms of available resources and a clear working methodology. All this is part of a previous work to achieve sufficient maturity. It is clear in the case of Colombia or Brazil that the sandbox started with a previous task that allowed it to have a methodology, a way of working and coordination and a knowledge of how this type of regulatory space can be developed. All this led to a degree of maturity that allows these spaces to function. In the case of Kenya it was the same, given that this idea began to be explored once the financial authorities of other countries had developed this type of methodology. The Colombian financial authority was working on this in parallel with the innovation hub.
It is at this level that the work of entities interested in supporting this type of sandbox project can be focused.

(iii) Level C: the sandbox is viable
At this maturity level, a regulatory sandbox becomes a feasible and influential project for low- or middle-income countries. Immediate impact on public policies isn't a prerequisite, as a

functional sandbox can gradually shape policy and regulatory development over time. Given the novelty of such projects, it's crucial to provide them with the opportunity to affect policy and regulatory frameworks, as has begun in countries like Bermuda, Kenya, and Malaysia.
What is fundamental is that from the beginning, the sandboxes have the tools to collect and process information in such a way that they can influence the development of public policies or discussions on the governance of different technologies. This will be the only thing that will allow sandboxes to have enough public salience and serve as sustainable and valuable projects. This can transform them into elements that generate increased state capacities to respond to new technologies quickly and effectively, not only reacting to these changes but also being proactive in this regard.

V. Conclusion and opportunities for impact

Regulatory sandboxes have undoubtedly captured global interest, with an increasing number of countries keen to explore their potential. The challenge of navigating a complex and ever-evolving technological landscape renders them a compelling tool for deepening technological understanding and crafting appropriate state responses. However, there's a risk that an overwhelming demand for such projects might compromise the achievement of their initial objectives. While regulatory sandboxes offer significant value, particularly to low- and middle-income countries, their effectiveness hinges on careful and efficient utilization. Hastily and recklessly deploying sandboxes may lead to more disappointments than successes.

Therefore, it is prudent for countries to utilize tools like RESMA (as previously mentioned) to thoroughly evaluate their preparedness for implementing a sandbox, including the requisite resource and personnel investments. Rather than indiscriminately increasing the number of sandboxes, it's crucial to recognize them as a specialized regulatory approach, apt only in particular contexts. Tools such as RESMA represent an initial step towards such analytical efforts. While these tools can be refined and tested further, more comprehensive efforts are essential to prevent the risk of 'sandbox fatigue,' which could prove especially burdensome for low- and middle-income countries engaged in these initiatives.

The case studies illustrate that the regulatory sandbox concept is dynamic, encompassing a wide array of technology projects facilitated by regulators and innovators. It is crucial, therefore, to clearly define the core components of a sandbox to ensure all participants have aligned expectations. The undesirable outcome is the launch of an initiative labeled as a regulatory sandbox that, in practice, functions merely as an innovation testbed or a collaborative innovation platform. Such a scenario can lead to confusion and disillusionment among participants, potentially casting regulatory sandboxes in an undeservedly negative light due to their misuse in some instances.

As a result, some points of conclusion to be considered by development cooperation partners are also pointed out:

(a) Low- and middle-income countries will increase their interest in regulatory experimentation and regulatory sandboxes

The enthusiasm for regulatory sandboxes, particularly in developed countries and those leading in regulatory matters, suggests that new regulations may encourage the creation of more sandboxes, as exemplified by initiatives like the AI Act in Europe. Consequently, there is a strong incentive for countries to establish regulatory sandboxes in the near future, a trend that is expected to gain momentum. Therefore, it is crucial for international and development cooperation organizations to devise a work plan centered on these regulatory experimentation models and to identify strategies for their effective implementation, especially for those committed to fostering innovation and technology adoption.

(b) Low- and middle-income countries can develop efficient regulatory sandboxes:

Regulatory sandboxes are viable not only in developed countries but also in low- and middle-income nations. The key is to build the requisite maturity and conditions before diving into the creation of a sandbox. In this context, a thorough and meticulous analysis can prove more beneficial than hastily setting up a sandbox. Tools such as RESMA, as mentioned earlier, can assist in evaluating the necessary steps to enhance this maturity level and in pinpointing where efforts should be concentrated, thereby identifying the specific readiness stage of each country.

(c) Regulation and innovation, a key relationship:

Regulatory sandboxes exemplify the vital connection between innovation and regulation. It's crucial to acknowledge this relationship, particularly as low- and middle-income countries face growing pressures to regulate a variety of technologies and innovative offerings. Regulatory sandboxes offer these countries a platform for fostering dialogue between regulators and innovators, an interaction that is increasingly important. However, it's essential to remember that sandboxes are not the sole avenue for such engagement; numerous other options exist. Nevertheless, the burgeoning interest in these dialogues within such countries is a positive development that should be nurtured.

(d) Collaboration and cooperation:

Regulatory sandboxes necessitate the collaboration and cooperation of various stakeholders; they cannot be effectively deployed by a single governmental unit or agency alone. It's crucial for development cooperation partners to adopt specific methodologies for participating in such projects in low- and middle-income countries. RESMA stands out as an appropriate tool for this endeavor, and it's essential for agencies worldwide to become acquainted with these efforts and their potential impacts. Development cooperation partners should enable government agencies to adopt a proactive approach in this area. Moreover, by employing tools like RESMA, development organizations can introduce fresh perspectives to an evolving discourse, thereby becoming significant global actors in shaping innovative regulatory approaches.

Furthermore, it is noteworthy how low- and middle-income countries with established regulatory sandboxes are keen on sharing their insights with others. This collaborative spirit is invaluable for avoiding redundant efforts and ensuring the efficient utilization of limited resources in these regions. Facilitating such exchanges and identifying effective methodologies and best practices are also critical tasks that merit attention.

(e) Sandboxes can increase capabilities, but not immediately:

Regulatory sandboxes are burgeoning with untapped potential, and we are just beginning to grasp their full capabilities. Their characteristics and impacts are continuously evolving, underscoring the importance of ongoing analysis and impact assessments. These evaluations are crucial for shaping the future of sandboxes and advocating for their use across both developed and low- and middle-income countries. One key area of interest is their role in enhancing state capacity. Some studies suggest that

sandboxes have contributed to capacity building by enhancing regulators' understanding of technologies and fostering dialogue between regulators and industry (Appaya & Haji, 2020).

However, it is premature to draw definitive conclusions from the cases analyzed so far. While some sandboxes show promise in yielding such beneficial outcomes, their overall impact might still be limited. Development cooperation partners play a critical role in delving deeper into these findings and elucidating how sandboxes can foster these capabilities.

The journey into regulatory experimentation and innovation is just beginning. Nevertheless, there are ample opportunities for development cooperation partners to craft a compelling agenda for the coming years. Their endeavors can support low- and middle-income countries in navigating the delicate balance between regulation and innovation, ultimately aiming to leverage technology for the betterment of their communities.

Bibliography

Appaya, S., & Haji, M. (2020, November), *Four years and counting: What we've learned from regulatory sandboxes*. World Bank Blogs. https://blogs.worldbank.org/psd/four-years-and-counting-what-weve-learned-regulatory-sandboxes.

Bank Negara Malaysia (2023), *Regulatory Sandbox*. Bank Negara Malaysia. https://www.bnm.gov.my/sandbox.

Bawany, I. (2021, November 16), Regulatory Sandboxes: A new future for FinTech? *Nyujlb*.https://www.nyujlb.org /single-post/regulatory-sandboxes-a-new-future-for-fintech.

Beckstedde, E., Correa Ramírez, M., Cossent, R., Vanschoenwinkel, J., & Meeus, L. (2023), Regulatory sandboxes: Do they speed up innovation in energy? *Energy Policy*, *180*, 113656. https://doi.org/10.1016/j.enpol.2023.113656.

Bromley-Trujillo, R., & Poe, J. (2018), The importance of salience: Public opinion and state policy action on climate change. *Journal of Public Policy*, *40*(2), 280–304. https://doi.org/10.1017/s0143814x18000375.

Brown, E., & Piroska, D. (2021), Governing fintech and fintech as governance: The regulatory sandbox, riskwashing, and disruptive social classification. *New Political Economy*, *27*(1), 19–32. https://doi.org/10.1080/13563467.2021.1910645.

Cornelli, G., Doerr, S., Gambacorta, L., & Merrouche, O. (2023), Regulatory sandboxes and fintech funding: Evidence from the UK. *Review of Finance*. https://doi.org/10.1093/rof/rfad017.

European Parliament (2022, June), *Artificial intelligence act and regulatory sandboxes*. https://www.europarl.europa.eu /RegData/etudes/BRIE/2022/733544/EPRS_BRI(2022)733544_EN.pdf.

Goo, J. J., & Heo, J.-Y. (2020), The impact of the regulatory sandbox on the fintech industry, with a discussion on the relation between regulatory sandboxes and open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(2), 43. https://doi.org/10.3390/joitmc6020043.

innovaSFC (2020, May), *Manual de Funcionamiento de laArenera*. Superintendencia Financiera de Colombia. https://caracoltv.brightspotcdn.com/ed/1c/8398710945b2bffodd3f6073629d/manualarenera.pdf.

Jones, J. S. (2023, May 31), *Bermuda introduces 'sandbox' for new energy technologies*. Power Engineering International. https://www.powerengineeringint.com/renewables/bermuda-introduces-regulatory-sandbox-for-new-energy-technologies/.

Jones Day (2023, April 28), EU and U.S. regulatory sandboxes: Groundbreaking tools for fostering innovation and shaping applicab... *Jones Day*. https://www.jonesday.com/en/insights/2023/04/eu-and-us--sand boxes-are-groundbreaking-tools.

Kenya Capital Market Authority (2023, May 4), *Regulatory sandbox*. https://www.cma.or.ke/regulatory-sandbox/.

Leckenby, E., Dawoud, D., Bouvy, J., & Jónsson, P. (2021), The Sandbox Approach and its Potential for Use in Health Technology Assessment: A Literature Review. *Applied Health Economics and Health Policy*, *19*(6), 857–869. https://doi.org/10.1007/s40258-021-00665-1.

OECD (2023), Regulatory sandboxes in artificial intelligence. In *OECD Digital Economy Papers*. Organization for Economic Co-Operation and Development (OECD). http://dx.doi.org/10.1787/8f80a0e6-en.

Participa + brasil - Regulatory sandbox on artificial intelligence and data protection in Brazil. Participa + Brasil. Retrieved November 28, 2023, from https://www.gov.br/participamaisbrasil/regulatory-sandbox-on-artificial-intelligence-and-data-protection-in-brazil.

PYMNTS (2022, July 20), *Inside the UK's regulatory sandbox: How it fosters fintech innovation, drives multisector growth*. PYMNTS.Com - What's next in Payments and Commerce. https://www.pymnts.com/news/regution/2022/inside-the-uks-regulatory-sandbox-how-it-fosters-fintech-innovation-drives-multisector-growth/.

Quan, D. (2019, September 25), *A few thoughts on regulatory sandboxes*. Stanford PACS. https://pacscenter.stanford.edu/a-few-thoughts-on-regulatory-sandboxes/.

Ramadan, D. (2022, October 20), *Access alert: Bahrain Introduces Telecommunications Regulatory Sandbox*. Access Partnership. https://accesspartnership.com/access-alert-bahrain-introduces-telecommunications-regulatory-sandbox/.

Regulatory Technology for the 21st Century (2022, April 13), World Economic Forum In collaboration with the Global Future Council on Agile Governance https://www.weforum.org/publications/regulatory-technology-for-the-21st-century/.

Reshef Kera, D. (2020), Sandboxes and testnets as "trading zones" for blockchain governance. In *Advances in Intelligent Systems and Computing* (pp. 3–12). Springer International Publishing. http://dx.doi.org/10.1007/978-3-030-52535-4_1.

Ringe, W.-G. (2023, May 12), *Why we need a regulatory sandbox for AI*. Oxford Law Blogs. https://blogs.law.ox.ac.uk/oblb/blog-post/2023/05/why-we-need-regulatory-sandbox-ai.

Sandbox regulations and seabased. Government of Bermuda. Retrieved November 28, 2023, from https://www.gov.bm/articles/sandbox-regulations-and-seabased.

Sarkar, G. (2023, October 25), Government explores regulatory sandbox for OTT communication apps. *Inc42 Media*. https://inc42.com/buzz/government-explores-regulatory-sandbox-for-ott-communication-apps/.

Sunstein, C. R. (2019), *The cost-benefit revolution*. MIT Press.

Superintendencia de Industria y Comercio (2021), *¿Qué es el Sandbox sobre privacidad desde el diseño y por defecto en proyectos de inteligencia artificial?* Superintendencia de Industria y Comercio. Retrieved November 28, 2023, from https://www.sic.gov.co/sandbox-microsite.

_____(2021), *Sandbox sobre privacidad desde el diseño y por defecto en proyectos de inteligencia artificial Formato de aplicación*. Surveymonkey. https://es.surveymonkey.com /r/FormularioSandbox2021.

Truby, J. (2018), Fintech and the city: Sandbox 2.0 policy and regulatory reform proposals. *International Review of Law, Computers & Technology*, *34*(3), 277–309. https://doi.org/10.1080/13600869.2018.1546542.

Undheim, K., Erikson, T., & Timmermans, B. (2022), True uncertainty and ethical AI: Regulatory sandboxes as a policy tool for moral imagination. *AI and Ethics*, *3*(3), 997–1002. https://doi.org/10.1007/s43681-022-00240-x.

Washington, P. B., Rehman, S. U., & Lee, E. (2022), Nexus between regulatory sandbox and performance of digital banks—a study on UK digital banks. *Journal of Risk and Financial Management*, *15*(12), 610. https://doi.org/10.3390/jrfm15120610.

Wave power parks. SEABASED. Retrieved November 28, 2023, from https://seabased.com/seabased-wave-power-parks.

What is a sandbox? (2021, February 26), proofpoint. https://www.proofpoint.com/us/threat-reference /sandbox.

Annex

Annex 1

Table A1
Overview of selected regulatory sandboxes

	Bermuda	Brazil	Colombia (data protection authority)	Colombia (financial authority)	Kenya	Malaysia
Description	Energy regulatory sandbox to test a wave energy park that the Swedish ocean developer Seabased plans to develop.	The Brazilian DPA wants to analyze the impact of generative AI in the implementation of Article 20 of their General Data Protection Law (algorithmic transparency).	The Colombian DPA is interested in testing the implementation of privacy by design and by default principles in AI system design and deployment.	A space specifically created for testing financial regulations, with a focus on innovations in the fintech sector.	Capital Markets Regulatory Sandbox to facilitate testing of capital market products and solutions, particularly for projects in the development stage.	The sandbox provides regulatory flexibilities with safeguards to maintain financial stability, transaction integrity, fair business practices, and consumer protection. Designed with a risk-proportionate approach.
Starting year	2021	2023	2021	2017	2017	2016
State of development	Implementation stage	Design stage	Implementation stage	Advanced implementation stage	Advanced implementation stage	Advanced implementation stage
Initiator/ organization	Ministry of Home Affairs	ANPD-Brazilian Data Protection Authority	SIC-Colombian Data Protection Authority	SFC-Colombian Financial Authority	Capital Markets Authority	Bank Negara Malaysia
Purpose	This initiative encourages testing of renewable energy technologies in Bermuda.	ANDP strategically incorporated machine learning technologies and generative AI into their sandbox to actively engage with and comprehend these emerging technologies. They want the testing to inform Congress Bill 2338/2023.	Determine if PbD and PbD principles can be applied in Colombia. Draft guidelines following the results identified.	Introduce financial products and services that increase financial inclusion.	Increase investment in Kenya's capital market. Promoting one of the most innovative capital markets in Africa.	Fostering financial sector innovation
Monitoring areas	Energy sector	Data protection	Data protection	Financial market	Capital markets	Financial market
Time frame	2 years	1 year to 18 months	1 year to 18 months	1 year	18 months	18 months

Source: Own elaboration.

The report examines the development and impact of regulatory sandboxes in low- and middle-income countries. With a focus on understanding the viability and effectiveness of these innovative spaces, it provides a comprehensive analysis aimed at policymakers, international organizations and national authorities considering regulatory sandboxes for new sectors and technologies.

Key insights include the emergence of regulatory sandboxes as vital tools for grappling with disruptive technologies, such as artificial intelligence, 5G and cryptocurrencies. Originally popularized by financial authorities in high-income countries, the adoption of sandboxes has expanded, prompting an investigation into their tangible benefits across various economies. The report highlights the need for a meticulous assessment of the readiness and potential impact of sandboxes and introduces the Regulatory Sandbox Maturity Assessment (RESMA) tool, which is designed to evaluate a country's preparedness for such initiatives.

Through case studies and interviews with public officials, the report emphasizes the importance of a clear policy framework, interdisciplinary teams and sustained efforts to ensure the success and impact of regulatory sandboxes. Furthermore, it stresses the significance of strategic partnerships and collaborative implementation to enhance the efficacy of these spaces for regulatory experimentation.

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