‘Antifragile’ regulators for developing countries? Lessons from Latin America

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Resumen

En este ensayo, analizamos el diseño pasado y el futuro potencial de las agencias reguladoras de los sectores de infraestructura en los países en desarrollo, con un enfoque en América Latina, su papel después de que algunas privatizaciones fueron revertidas y los nuevos desafíos que surgirán pronto para la regulación de la infraestructura debido al cambio tecnológico. Las agencias reguladoras se introdujeron en América Latina, África, Asia y los países postsocialistas cuando una ola de privatizaciones se generalizó a partir de 1990. El paradigma de la época era la provisión privada más la regulación y la supervisión pública en manos de nuevas agencias reguladoras independientes. Presentamos el paradigma de la década de 1990, discutimos sus detalles en el mundo en desarrollo, estudiamos su éxito y fracaso y buscamos comprender los nuevos objetivos y funciones de la regulación de la infraestructura (electricidad, gas natural, agua y saneamiento). Sugerimos que la independencia del regulador debe estar garantizada por diseño y tener cierta "antifragilidad" para superar los fuertes shocks de inestabilidad política y económica típicos de los países de la región latinoamericana y otros del mundo en desarrollo.

Palabras clave: regulación, agencias reguladoras, Latinoamérica, gobernanza regulatoria.

Abstract

In this essay, we discuss the past design and potential future(s) of regulatory agencies of infrastructure sectors in developing countries, with a focus on Latin America, their role after some privatizations were reversed, and the new challenges that will emerge soon for infrastructure regulation due to technical change. Regulatory agencies were introduced in Latin America, Africa, Asia, and post-socialist countries when a wave of privatizations became widespread from 1990 onwards. The paradigm of the time was private provision plus public regulation and supervision in the hands of new independent agencies. We present the 1990s paradigm, discuss its specifics in the developing world, study success and failure, and seek to understand new goals and functions of infrastructure regulation (electricity, natural gas, water, and sanitation). We suggest that the regulator's independence must be guaranteed by design and have a certain "antifragility" to overcome the strong shocks of political and economic instability typical of countries in the Latin American region and others in the developing world.

JEL Codes: L43, L51

Keywords: regulation, regulatory agencies, Latin America, regulatory governance.

1. INTRODUCTION

Looking back, 1990 stands out as a pivotal year. The conclusion of the Cold War marked the beginning of a race for countries from the former Second World (Eastern Europe, the former Soviet Union) and Third World (Latin America, Africa, and much of Asia) to align themselves with the former First World (North America, Western Europe, Japan, and Oceania), eagerly embracing globalized capitalism. This initial group of countries was often labeled as "Emerging".

The fresh start ushered in a revitalized belief in the power of market forces, enhanced openness to trade and financial flows, and privatization to add capital, technology, and know-how in sectors with solid spillovers and chronic deficiencies in the hands of states sometimes pressed by fiscal imbalances (Ferro et al., 2021). Those privatizations had scarce historical precedents, being the most famous of the British ones in the Thatcherian United Kingdom one decade before. In the British experience, privatization was initiated to inject efficiency and stimulate growth into a lagged economy, compared with Germany, France, and Italy in post-WWII (Viscusi et al., 2005). Alongside the privatization of infrastructure provision, the figure of regulatory agencies appeared: independent entities, free from political and business influences, thought to cope with technical matters and noteworthy tariff settings, as well as overseeing and monitoring the services (Church & Ware, 2000).

When developing (or emerging) worlds embarked on their accelerated privatization processes, they had three models to draw inspiration on how to regulate operators: the US, where since the early 20th century regulatory agencies coexisted with a consolidated system of regulation based on usage and practice, the UK, where brand-new regulatory bodies and a novel regulatory framework were established when privatization occurred, and the French system, where agencies did not carry out regulation but rather through contracts (Foster, 2005).

In Latin America, most countries mimicked the British experience. Chilean privatizations were contemporary to British ones, and regulatory agencies in Chile were the first to be created under the British model (Brown et al., 2006)[3]. Unlike Britain (and Chile), most Latin American countries faced severe macroeconomic trouble. The "original sin" of some developing countries' privatizations stemmed from fiscal imperatives and macroeconomic instability, coupled with more genuine microeconomic objectives aimed at technical and allocative efficiency (Andrés et al., 2008).

In the years following 1990, highly unstable countries, such as Brazil, Argentina, Peru, and Bolivia, began to stabilize their macroeconomic landscapes. In some cases, this stabilization was only transient (as in the case of Argentina). Meanwhile, in other countries, stability endured (such as in Brazil, Peru, Bolivia, and Uruguay), while in a third group of nations, macroeconomic instability was not a significant concern (including Colombia, Mexico, and Paraguay). Concurrently, democratization progressed throughout the developing world -partly as a dividend of the peace following the end of the Cold War. In Latin America, a new era of political stability emerged in most countries.

Over three decades, the success stories in privatization and independent regulation have been concomitant (even when, to our best knowledge, there is no formal analysis showing at least a strong correlation) with the countries

3.- While some writers argue that Chile was the first country to liberalize its electric sector, and while several reforms for privatization, restructuring, and competition were introduced, starting in the 1980s; this did not mean the creation of a wholesale electricity market, and for many years, the main generating company, and transmission and distribution companies, were under common ownership (Joskow, 2008) (Fischer et al., 2000). We thanked an anonymous referee for this necessary caveat.

where macroeconomic stability was achieved and sustained and where democracy was upheld (e.g., Chile, Brazil, Colombia). Conversely, failures are concentrated in countries where macroeconomic stability was not maintained, even in the presence of democracy (e.g., Argentina), where both the macroeconomic and the political climates deteriorated (e.g., Venezuela), or where the macroeconomy functioned well, but political authorities' bias changed towards some socialist view (Bolivia). In these latter countries, some utilities were renationalized, and regulatory agencies lost autonomy, influence, and/or power (e.g., Argentina) or were eventually replaced by new bodies, as was the case in Bolivia[4].

We aim to discuss the design of regulatory agencies in the 1990s, their role after privatizations, and the imminent challenges arising in infrastructure regulation due to technological advancements, with a specific focus on Latin America.

In pursuit of this goal, we pose five questions, each of which we address in a dedicated section. The first section is this introduction. In the second section, we try to understand the premises that guided the design of regulatory agencies in the developing world during the 1990s. In the third section, we endeavor to identify specific aspects of regulation in developing countries as compared to developed ones. In the fourth section, we explore what happened to regulatory agencies thought to regulate private providers when these were renationalized. In the fifth section, we ask which issues seem most lagged in the regional practice. In the sixth section, we analyze some emerging challenges for infrastructure regulators. Finally, in the seventh section, we present our conclusions.

2. WHAT WERE THE FOUNDATIONAL PRINCIPLES GUIDING THE DESIGN OF REGULATORY AGENCIES IN THE DEVELOPMENT WORLD DURING THE 1990S?

The fundamental premise underlying all the regulatory agencies established in the developing world after the 1990s is based on the "public interest" conception of regulation, in opposition to alternative normative or positive hypotheses aimed at explaining regulation (Viscusi et al., 2005). The rationale behind regulation within this paradigm is that it serves as a response to market failures (such as natural monopolies, technological externalities, public goods, and asymmetric information). The regulation mimics the behavior of pure competition, providing a "second best" solution to the lack of effective competition (Church & Ware, 2000). Implicitly, the paradigm assumes some benevolence on the part of the regulator (i.e., the regulator seeks to maximize social welfare), that market failures are identifiable, and that the problems they generate can be tackled at relatively affordable costs.

The regulation includes tariffs primarily because private unregulated monopolies would otherwise set prices far above marginal costs. The second-best facet of regulated tariffs stems from the impossibility of aligning prices with marginal costs in natural monopolies without driving them to bankruptcy. Additionally, the regulation addresses quality and service standards, as well as social, health, or safety considerations, infrastructure maintenance, and expansion. A significant contrast between infrastructure in developing and

4.- The correlation between stable macroeconomics and better regulatory and energy infrastructure performance (and vice versa) is a stylized fact easily verified in Latin America. Paradoxically, the theoretical explanations of the mainstream regulatory-economic literature focus on structural particularities of developing countries, such as institutional weakness and contractual incompleteness (Laffont, 2005; Estache & Wren-Lewis, 2009), in the same way that several empirical works linked to concession renegotiations in Latin America summarized in Guasch & Straub (2006), but leaving out theoretical links that study the relationship between macroeconomic stability and regulatory performance. It could be a fertile field of research to better understand this macroeconomic-microeconomic interaction with a significant impact on economic development. However, extensive literature has studied reverse causality, that is, how bad regulatory and/or tariff policies affected macroeconomic stability (Heymann & Canavese, 1988; Canitrot, 1983; Navajas, 2006).

developed lies in coverage, often only partially in the former. In developing countries, regulators also bear the responsibility of overseeing the completion of infrastructure projects and accommodating the needs of a growing population. However, conceptually, distortions can arise from regulatory actions akin to those activities arising from taxation. Taxation can impose deadweight losses by reducing quantities concerning non-taxed activities; regulation can impose costs by limiting otherwise optimal decisions of unregulated firms.

There are indirect costs associated with regulation, and regulatory activity can also lead to failures, particularly in developing countries (Estache & Wren-Lewis, 2009). For instance, procedures may prove ineffective; decisions can be made with insufficient information, revealed of costly implementation, or be biased to benefit or the opposite of the regulated operator. Certain decisions may be unsustainable or inconsistent due to political interference, while regulatory capture is an open possibility from different stakeholders (e.g., firms, unions, organized clients, politicians, etc.). Finally, regulators may not always act benevolently or be capable of doing so. The empirical importance of each potential failure is a matter for further investigation.

In the 1990s, there were certain normative assumptions surrounding regulatory agencies. Nowadays, however, some of these assumptions may have been relaxed based on experience, and the focus is now on achieving ambition through a "fit to purpose" and "agile" (OECD, 2021) regulator. The expression "fit for purpose" is common in modern regulatory jargon, indicating suitability for the function for which it was created. The regulatory agencies were initially conceived as "independent" entities akin to central banks or judiciary. Trillas (2010) discusses the regulator's autonomy regarding Central Banks. Endowed with some financial autonomy, shielded from political interference, staffed by capable and professional experts, and possessing the ability to face and solve conflicts that routinely arise from the service operations, regulators are entitled as arbiters between various interests: consumers versus producers, producers versus labor unions, producers versus politicians, and current customers versus future customers (Durand & Pietikäinen, 2020).

Berg (2013) points out the crucial role of a proper institutional framework and technical consistency in influencing both the performance of the regulator and the overall sector. His arguments are related to institution building, which implies establishing an adequate governance structure (concept about the rules of the game) and implementing correct substantive actions (in terms of game development). Suitable performing regulators are characterized by having adequate institutional capacity (ability to decide in an objective, technical, impartial, and integer way), organizational capacity (to function effectively), and operational capacity to enact reasonable regulations (Berg, 2013; Parker & Kirkpatrick, 2002; Cubbin & Stern, 2004). The expected outcomes of such regulatory effectiveness include increased efficiency in service provision (in terms of both resource allocation and production), sector expansion, investment levels, promotion of competition, and quality of services, among other variables (Brown et al., 2006).

Effective governance of regulatory agencies demands clarity in roles and mandates, autonomy, accountability, transparency, stakeholders' participation, and community engagement, along with the predictability of the regulatory interventions (Cubbin & Stern, 2004). In the same vein, OECD (2014) and IADB (2020) identify several best practices as principles of good regulation, including clearly defined roles, safeguards against undue influence on regulators, appropriate decision-making mechanisms aligned with governance structures, robust accountability and transparency procedures, commitment to the task and knowledge of the industry and its consumers, adequate financing to warrant independence, and measuring of performance and impact of regulations. The OECD has developed policy and regulatory governance indicators for Latin American countries (Querbach & Arndt, 2016).

Roitman et al. (2021) compile the principles of regulatory governance following Brown et al. (2006), identified as the classical model of independent regulator plus the new roles added by the practice and compiled by OECD in the Table reproduced below.

Table 1: The classical and the new roles of independent regulators.

Classical (Brown et al. (2006)	Classical + New Roles	
1) Independence and coordination	1) Independence and coordination	11) Federalism (if appliable)
2) Accountability	2) Accountability	12)Reduction and simplification of regulations
3) Transparency and active public participation	3) Transparency and active public participation	13) Regulation based on data and digital transformation
4) Foreseeability	4) Foreseeability	14) Regulation for innovation
5) Clarity of roles	5) Clarity of roles	15) Regulation based on evidence
6) Integrity and clarity of rules	6) Integrity and clarity of rules	16) Consumer-centric regulation.
7) Proportionality	7) Proportionality	17) Reputational management of institutional communication
8) Sufficiency of attributes	8) Sufficiency of attributes	
9) Appropriate institutional design	9) Appropriate institutional design	
10) Integrality	10) Integrality	

Source: Roitman et al. (2021).

3. Which specific features appeared in developing countries?

In the classic model of a regulator, we envision an agency characterized by political independence (autonomy), technical solvency among its staff, and budgetary autonomy (autarky-financial independence). This hypothetical and ideal agency would be capable of resolving conflicts, setting tariffs, monitoring activities, and imposing sanctions, if necessary, all while maintaining neutrality. This body would engage in dialogue with various stakeholders, including the government, unions, customers, the media, and the community, while remaining impartial and unbiased towards the interests of all parties involved, including business.

The description of the preceding paragraph represents an "ideal type" in the Weberian sense. However, things can be somewhat different in the developing world and Latin America because of different reasons, such as institutional fragility, a lack of political and financial independence, limited human capital, and challenges in attracting high-quality regulators facing well-paid professional managers. Depending on the country, none of these reasons can be present[5]. Reforms in these regions were coupled with the need to build reputation and credibility. Often, the groups that acquired or were awarded concessions for infrastructure services operated across multiple jurisdictions, with different levels of expertise, regulatory traditions, development/maturity of regulatory frameworks, and experience, benefiting from significant information and knowledge asymmetries. For example, experienced and global groups such as Suez, Repsol, Endesa, British Gas, Fenosa, etc., participated in several privatizations in the regions during the 1990s in Latin American countries. On the other hand, regulators were sometimes appointed by former public servants, politicians, or inexperienced (because the regulatory activity was completely new) managers.

In the British experience, for instance, regulators were granted the authority to issue (or revoke) licenses, whereas in some Latin American countries, such functions were sometimes retained by the government (e.g., Argentina). Similarly, an independent body functioned as an appellate court of regulatory decisions in Britain, whereas in Latin America, conflicts between regulators and regulated entities often required resolution by a ministry or

5.- For example, Querbach & Arndt (2017) identify deficiencies, challenges, and opportunities for improvement in regulatory policy in seven Latin American countries (in 2016) according to OECD regulatory governance standards.

secretary (e.g., Argentina). This administrative channel (to appeal Regulatory agency's decisions) usually involves the executive branch, which, as one of the parties to the concession contract, may act as both judge and party in administrative appeal resolutions. In parallel, countries such as Argentina have a judiciary channel available to protect the contract and, in addition, a foreign arbitrage court (e.g., CIADI) when foreign investors participate to be part of the process.

Regulators in developing countries are more prone to political influence, citizen pressures, media scrutiny, and union activism. Concessions have been suspended after unrest and protests in Bolivia and Argentina (Ducci, 2007), while regulatory agencies have been subject to "political intervention", including complete replacement with new agencies in some cases (e.g., Bolivia).

Therefore, in Latin American countries, regulators are not expected to enjoy the same level of independence (both political and financial) as depicted in the textbook model. Instead, the regulator's independence must be intentionally guaranteed by design and have a certain degree of "antifragility" to withstand the significant shocks of political and economic instability typical in the Latin American region and other developing countries.

Taleb (2014) defines antifragility as follows:

"Some things benefit from shocks; … there is no word for the exact opposite of fragile. Let us call it antifragile. Antifragility is beyond resilience or robustness. …. The antifragile loves randomness and uncertainty, which also means— crucially— a love of errors, a certain class of errors. Antifragility has a singular property of allowing us to deal with the unknown, to do things without understanding them— and do them well…". Taleb and Douly (2012), in turn, have defined fragility and antifragility technically as follows: "In short, fragility is related to how a system suffers from the variability of its environment beyond a certain preset threshold … while antifragility refers to when it benefits from this variability … that is, its sensitivity to volatility or some similar measure of [the] scale of a distribution... what has exposure to tail events suffers from uncertainty; typically, when systems … are made robust to a certain level of variability and stress but may fail or collapse if this level is exceeded, then they are particularly fragile to uncertainty about the distribution of the stressor, hence, to model error, as this uncertainty increases the probability of dipping below the robustness level, bringing a higher probability of collapse. In the opposite case, the natural selection of an evolutionary process is particularly antifragile, indeed, a more volatile environment increases the survival rate of robust species and eliminates those whose superiority over other species is highly dependent on environmental parameters."

In particular, in response to the practical challenges faced by regulators in several Latin American countries, Roitman & Valdez (2022) suggest the following measures: **a)** implementing a second-generation reform to allow greater competition in the last mile of public services; **b)** clarifying of the federal nature of regulators and a reducing the proliferation of sectoral agencies (where applicable) a better delimitation of jurisdiction; **c)** ensuring an optimal staff adaptation with strict suitability requirements (competitive exams) and stability of the positions resulting from these competitions; **d)** amending regulatory laws to require formal approval by Congress for the appointment and removal of board members, providing autonomy but with certain flexibility for coordination in the face of political changes; **e)** empowering regulators to act as competition prosecutors; **f)** modifying the financing mechanism of regulatory organizations to ensure independence from the Executive Branch; **g)** streamlining administrative processes and accelerating digitization efforts; and **h)** establishing the administrative career of national regulators.

The regulator's independence is also more complex when regulation involves state-owned enterprises, an issue discussed in the next section.

4. WHAT HAPPENED WITH REGULATORY AGENCIES WHEN PRIVATIZED FIRMS WERE RENATIONALIZED OR STATE-OWNED?

In Latin America, there are subsets of countries that re-nationalized (originally state-owned companies, privatized, and nationalized again) privatized enterprises and regulatory agencies (aimed to regulate private firms) that continue operating (such as in Argentina). Conversely, there are other cases where regulatory agencies were established before privatization; however, privatization never happened (e.g., Uruguay and Paraguay).

Does it make sense? What arguments can be raised, in pro or opposition, for the coexistence of regulatory agencies regulating public enterprises? We argue that there are compelling reasons to justify the separation of the regulatory and the operational activities. An autonomous regulator has the potential to accumulate highly specialized technical knowledge and expertise on the sector, distancing itself from current political debates and focusing on long-term considerations. This is essential for preserving infrastructure, which has a lifespan spanning decades and requires significant resources, particularly in countries where capital is relatively scarce.

Consider tariff setting, one essential objective of an independent regulator is to set tariffs that reasonably recover opportunity costs while balancing current customers' interests (who demand affordable and high-quality services) with future customers (who demand infrastructure longevity until they utilize the service). The infrastructure can only endure through regulated maintenance, which demands reasonable tariffs. Opting for cheap services in the short run may result in inadequate infrastructure (or none) in the future. Politicians typically operate with short-term perspectives in developing and unstable countries. Regulators are intended to advise on the risks of myopia on infrastructure.

On the other hand, the regulators must resist pressures of all types. While technical expertise and independence criteria are crucial, some political expertise is helpful. As Berg (2008) highlighted, independent regulators are established to reduce the power/influence of the infrastructure ministries on providers and partially depoliticize planning and control processes.

However, are there any guarantees of achieving some independence once a firm is renationalized (or never privatized)?

The regulated (state-owned) firm may wield significantly more power than the regulator. Examples may include water companies ESSAP (Paraguay), OSE (Uruguay), and AYSA (Argentina) in comparison to their respective regulators.

The recommendations remain consistent whether private enterprises or state-owned firms provide the service: independence can be formally granted if the agency is created by law, regulators are appointed by due process, ideally with terms not synchronized with political cycles, granting some degree of financial autonomy or independence, and ensuring the decision process is professional and transparent. While all these conditions are necessary, they are not sufficient on their own.

As for sufficient conditions, the regulator design should incorporate "antifragile" features that permit flexibility to adapt its direction in response to political changes in the executive branch. These flexible design characteristics may prevent a compromise of independence and, simultaneously, recognize the importance of maintaining continuity in the regulator's authority to develop and sustain infrastructure.

To further enhance the regulator's "antifragility" in the face of political changes, one approach could involve ensuring that when appointing members to the board of directors, there is political consensus

from Congress (while still appointing them based on meritocratic principles), akin to the directors of central banks. Additionally, the board president could be subject to replacement by two-thirds of the chamber's votes in an extraordinary but regulated manner each time there is a change in the head of the executive power.

What were the practices in the region during the pre-privatization age?

They were highly diverse. For instance, in Uruguay, tariffs typically covered opportunity costs, with natural gas distribution being an exception. Moreover, public enterprises often generated surpluses that were sent to the Treasury. In contrast, Argentina followed a different approach, with politically determined tariffs being the norm (with some exceptions in specific periods). The country has a long history of inflation, and the Treasury often had to provide subsidies to state-owned enterprises (and private ones in recent years). The experience in the rest of the region varies. For instance, Chile, which enjoyed well-financed privatized infrastructure before 1990, exhibited practices like Argentina's in the early 1970s, which were considered risky.

Public-owned enterprises are complex entities, with multiple "principal" stakeholders setting goals and objectives, making it challenging to define a clear objective function such as profit maximization, as seen in private corporations. Politicizing and patronizing can pose significant threats to the function of public enterprises. Much of the economic analysis on regulatory processes within contexts of multi-principal-agent models was predominantly regulatory. Studies by Bernheim & Whinston (1986) and Martimort (1996) are notable examples.

A different perspective of the problem arises from approaching the regulatory process through positive analysis, viewing it as the outcome of constrained optimization and motivated by the bid of various interest groups for government intervention. Peltzman (1976), Stigler (1971), Becker (1983), Rees (1984), Piffano (1989), Baron (1988), Spiller (1990), Navajas (1992) and Estache & Martimort (1999) have contributed to this field by emphasizing the importance of modeling the political influence of economic agents participating in the regulatory process. Fiscal and, in general, macroeconomic constraints often loom over public enterprises, as suggested by Canitrot (1983), Heymann & Canavese (1988), and González (1990). State-owned enterprises may rely on the Treasury to cover OPEX and often require government funding for CAPEX (as noted by Rozas Balbontín & Bonifaz, 2014).

Adhering to sound practices is crucial for public enterprises, including accountancy practices that separate their financial activities from those of the Administration, ensuring competition where possible, providing open access to essential facilities in competitive stages, practicing transparent cross-subsidies among activities, and accurately costing all activities attributed by the government that no private enterprise would develop otherwise as advocated by Baztarrica & Irrazábal (2020).

5. WHICH ISSUES ARE THE MOST LAGGED?

When the regulatory reforms began, the initial regulators were designed to replicate the formal structure of British regulators, committed to efficiency gains (Durand & Pietikäinen, 2020). However, economic and political challenges unique to the region conditioned the results, leading to the evolution of regulatory bodies from a normative approach of regulators to a "positive" model regulator (Roitman et al., 2021). The effectiveness of these regulators is often contingent upon their institutional autonomy, the federalism dimension, the degree of transparency, and public participation. The literature on the governance of regulatory agencies acknowledges several approaches. Drawing from new economic institutionalism, the Principal-Agent framework addresses why independent regulators should be established.

The consensus is that such regulators protect investments before political risk or government opportunism (Cubbin & Stern, 2006; Brown et al., 2006). The delegation occurs to improve the credibility of policy (Gilardi, 2002; Stern & Trillas, 2003; Thatcher, 2005; Montoya & Trillas, 2007).

The central questions from the political science and public administration literature are: Why did the independent regulator's model spread? And why are there variants of the model?

In the first case, the response is the need to protect overseas investments in a time of globalization (Jordana & Levy-Faur, 2005 and 2006; Gilardi et al., 2006); while in the second one, variations of regulatory agencies are explained by domestic configurations (Murillo & Martínez, 2007 and 2011). The infrastructure literature concerning good international practices answers the question: How should independent regulators function? Bringing primary conditions for good regulatory governance (Brown et al., 2006; OECD, 2005, 2011, 2012, 2014, 2016).

Empirical economic studies and qualitative political science literature also ask: How is the practice of independent regulators? The answer shows evidence of the positive role of independent regulators in the regulated sectors (Cubbin & Stern, 2004; Pratt & Berg, 2014; Pérez & Pérez, 2016). Conversely, it shows the unfavorable effects of the absence of good governance (Pratt & Berg, 2014; Singh et al., 2016). Additionally, some authors discuss the credibility and legitimacy of the regulators (Jordana & Ramió, 2009; Parrado & Salvador, 2011), while others observe the discrepancy between formal and "de facto" autonomy (Jordana & Ramió, 2010; Groenleer, 2014). In recent years, the regulatory reality of some Latin American countries shows that "de jure" does not necessarily imply "de facto" autonomy, and vice versa.

Political interference and lack of financial resources are universally discussed. In some cases, the regulatory agencies are financed with resources that are part of the national budgets, while in other cases, with resources directly collected or contributed by regulated entities. However, in both cases, regulators often lack control over their revenues, expenditures, and execution, as they ultimately depend on central government authorization by public sector financial management regulations. Despite having their sources of financing, they are still integrated into the National Budget, subjecting them to the budgetary management affected by the deficit levels and the goals to be achieved by the central economic management due to public accounting criteria (Roitman & Valdez, 2022). Human resources present another concern: the impossibility of remunerating them at the levels of private industry, threatening talent acquisition and retention, and the potential for former regulators to transition into industry roles (López Azumendi, 2016). Additionally, temporary appointments lacking the legal shielding to destitution bypass formal conditions for appointing directors.

Independence and autonomy in regulatory agencies usually require to be completed with accountability to prevent the perils of excessive autonomy and independence, which can hinder the due equilibria of interests the regulator should

respect. Accountability entails transparency in regulatory actions, including the public disclosure of information to the public and the stakeholders, and, in general, making explicit the arguments behind each decision (Baldwin et al., 2012).

Many Latin American countries have enacted legislation promoting transparency and access to public information. However, the quality and quantity of information disclosed on regulators' websites in this region often lag behind those of developed countries. Chile, Brazil, Colombia, and Mexico show similar results to OECD members (Mexico and Chile belong to the organization), and the rest of the countries are behind developed countries (Durand & Pietikäinen, 2020). Some regulators' websites may lack updated information or provide insufficient details. Critical information such as budgetary issues, procurement details, and audit results may also be missing. Moreover, the presentation of information on these websites may not be user-friendly, making analysis challenging (Roitman et al., 2021).

6. WHAT'S NEW IN INFRASTRUCTURE REGULATION?

Alongside the 1990s discussion on independent regulators, new challenges arise from technological advances and evolving regulatory practices that add to regulators' functions. These developments underscore the need to modernize, merge, transform, or change regulatory practices and responsibilities. One sound addition to regulatory functions is the analysis of the regulatory impact (RIA), along with new channels to promote the participation of the stakeholders and transparency (Roitman et al., 2021).

RIA analysis originated in the OECD in 1997, which defines it as a method for systematically evaluating regulatory impacts. Harrington & Morgenstern (2004) propose three tests to be applied to regulatory measures on an ex-post basis, while OECD (2004) provides a manual for several practical situations. RIA studies have been conducted in Colombia, Brazil, Chile, and Peru, among other Latin American countries. In Colombia, decree 2696/2004 established a framework for evaluating the impact of regulation, verifying whether the results adjusted to regulatory objectives. For Brazil, de Carvalho et al. (2019) propose RIA to evaluate the potential specific effects of a regulatory measure on water and sanitation services. Additionally, in Brazil, the power regulator (Agência Nacional de Energia Eléctrica, ANEEL) employs RIA to determine if the potential benefits of a regulatory measure outweigh the estimated costs. In 2021, ANEEL issued a guide for RIA assessment (Ministério de Economia do Brasil, 2022). Chile has also developed RIA by Law 20199/2017 for natural gas, while Peru has enacted Law 25844/1992 for the electric industry.

Estache & Serebrisky (2020) highlight the potential of new information technologies and big data as valuable tools for regulatory task improvement while cautioning about the necessary regulatory changes needed to reap their fruits. They also discuss the possibilities yielded by new developments in experimental economics for behavioral studies and the use of "nudges" to achieve regulatory objectives. These issues are essential before the new challenges in terms of scarcity of resources, environmental damages that hinder the infrastructure and the services, and the governance of regulated sectors.

Even when new functions and possibilities emerge for regulators, no new body of knowledge consolidates all the theory, the experience learned, and the new challenges. Roitman et al., 2021) outline several new challenges in a non-exhaustive list, including:**1)** reduction and simplification of regulations to improve productivity, **2)** regulation based on data and digital transformation of the regulator, **3)** regulation of innovation, **4)** regulation based on evidence, **5)** customer-centric regulation,

and **6)** new institutional communication and reputational management of the regulator. The common thread among these challenges is the centrality of information in the digital era.

Georgieva et al. (2021) also discuss the roles and attributions of reform committees in improving productivity, finding that, in most cases, the executive power is involved in appointing committees' members, raising concerns about their independence from politics and that in most of the committees, the private sector is represented. They also report some variability of practices among countries.

The common thread among these challenges is the centrality of information. Querbach & Arnt (2017) emphasize substantive issues, such as the requisites of mandatory revision of regulations, threshold tests to allocate resources effectively, and analyzing the cumulative effects of regulations in specific sectors.

Concerning digitalization, the discussion is embedded in a broader debate related to the fourth industrial revolution, on the one hand, and digital government, on the other. The characterization of the technologies in each industrial revolution (IR) is as follows: **1)** The First IR used water and steam power for mechanization. **2)** The Second IR applied electricity to create mass production. **3)** The Third IR employed electronics and information technology for automation. **4)** The Fourth IR combined physical, digital, and biological technologies in disruptive ways (Ferro, 2021).

OECD/IEA (2017) describes the current state of digitalization in energy sectors and tries to delve into its possible future evolution, analyzing its impact on public policy, firms, and consumers. The study recommends that governments focus on developing a digital experience among their staff, ensuring access to opportune, solid, and verifiable data, adding flexibility to their policies to adapt to new technologies and innovations, experimenting with new information technologies, fostering debates on digitalization, researching digitalization, promoting equitable access to digitalization, and learning from the experience.

Regulation based on experience is one goal the RIA allows and is enthusiastically endorsed by international agencies as good practice. This mechanism permits transparent regulator activity, encourages participation and discussion, and, in the end, fosters regulatory improvement. Peacock et al. (2018) outline the advantages and barriers regarding internal procedures, financial resources, and complexities of transforming raw data into valuable information, and the utility and importance of planning, evaluation, and prediction. They recommend entitling experts to the study of an ideal regulation process based on evidence, providing access to all data available for the regulator, setting norms of effective mandatory enforcement, incentivizing competition between regulators for innovative solutions, and giving flexibility for experimenting with new solutions, among others.

The interests and desires of the customers are cumbersome in the new reality. Government and regulators should pay special attention to consumers' needs, expectations, and opinions when designing policies and actively involve them in the regulatory process (Roitman et al., 2021). Customers would demand (and pressure for) more integrated services than in the past and would rest on more proactive management from governments and regulators (OECD, 2019). World Bank (2020) offers examples of regulatory governance with Integrated Service Delivery, which combines multiple services in a location to be centered on the usuaries. Beyond the single-window approach, one single agency can centralize the services before the clients by organizing, integrating, and simplifying registration, licensing, and inspection made by all the regulators involved, bridging front-office and back-office, and the technology to integrate them. The aimed results are an improvement in the service, government efficiency, supervision, regulatory enforcement, and the addition of tools against corruption.

In an era of more digital relations with consumers, a not negligible challenge is the regulator's institutional communication and reputational management. Part of this is the horizontalization of communication because social networks can directly affect the regulated firms' and regulators' reputations. Effective communication becomes

critical, and damage control should be considered. Carpenter (2010) suggests that "…when trying to account for a regulator's behavior, look at the audience… and the threats". Busuioc & Rimkutè (2020) add that reputation is multidimensional and implies good technical records, capacities, procedures, and ethical image.

Conceptually, bureaucratic reputation is made of **1)** a particular vision indicating the contribution of the agency to the public good, **2)** the multifaceted nature of reputation, **3)** the existence of multiple audiences (consumers) with disparate expectations, and **4)** the context of the knowledge society and the tendency to blame a responsible. Thus, the reputation is always in danger. Thus, the regulators' responses before the public condemn the selective use of communication. Reputation is an asset, a valuable resource to gain and preserve independence. An agency can be closed if its reputation deteriorates, and conflicts can escalate to levels that justify the former. Lewis (2002) finds that almost two-thirds of American agencies created between 1946 and 1997 had been canceled, primarily because of political reasons. On the other hand, the reputation management of the agency can move toward a very strategic use of communication (Bach et al., 2021).

7. CONCLUSIONS

After the globalization wave of capitalism in the 1990s, infrastructure sectors were reset in most of the developing world. From state-owned enterprises, energy and water sectors were privatized in numerous countries, and regulation of these activities was delegated to new, technically oriented, politically independent, and financially autonomous agencies. Those bodies used the accumulated experience of Britain, which had undergone recent privatizations, and the US, which had a long tradition of regulatory agencies at the federal and state levels.

This paper aimed to discuss the 1990s regulatory agencies' design and their specifics in developing countries, with a focus on Latin America. It sought to explore how these agencies adapted to challenges, such as the reversal of some privatizations, and to anticipate the new challenges that infrastructure regulation will face due to ongoing technical advancements. It tries to understand the premises under which regulatory agencies were designed in the developing world in the 1990s. One fundamental premise was to shield these agencies from undue political interference and to preserve a double role to the regulator: a mimic of competition (inducing some conducts by controlling structure and monitoring performance) and an impartial referee between interests. The tools were political insulation, technical endowment, and financial autarky. However, circumstances and practices in developing countries sometimes threaten or impede the new regulators' expected functioning (or performance). Political and economic pressures and long-established patronizing practices jeopardized the textbook agencies. They must adapt to local conditions. Some countries with more mature institutions survived and produced good results; in others, their functioning has sometimes interfered, and in a third group, they were even eliminated.

It was suggested that the regulator's independence must be guaranteed by design and have a certain "antifragility" (as defined by Taleb, 2014) to overcome the strong political and economic instability shocks typical of countries in the Latin American region and others in the developing world, giving a degree of flexibility to institutions that are "work in progress." These institutional

"antifragility" features may be explored and defined more precisely in further research.

A group of countries privatized and renationalized infrastructure sectors, maintaining their regulatory agencies in operation, while another group never privatized but erected regulatory agencies in the 1990s. There is a discussion on the relevance of having regulatory agencies when public enterprises provide the services. There are arguments in favor: Regulators care for the long run, constitute a reservoir for a precise body of sectoral knowledge, and are barriers against political pressures. Of course, in less developed countries, in terms of institutions, all the formers can be dismissed easily. In countries with long-standing democratic records, such as Uruguay, regulatory bodies can be overcome in power by publicly owned enterprises even while being respected and considered in their decisions.

New challenges appear because of new times of accelerated technical change, especially in the technology and communication industries. They set new expectations on regulators with more proactive conduct, offer new tools for transparency and auditing, and generate new threats to reputation, obliging regulators to design communication strategies.

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