

# Updating infrastructure regulation for the 21st century in Latin America and the Caribbean

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# Updating infrastructure regulation for the 21st century in Latin America and the Caribbean

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## Abstract

This paper argues that, while most countries in Latin America and the Caribbean have managed to significantly improve the short-term efficiency of their infrastructure services since the widespread liberalization of the 1990s, they have been slow to ensure a fair distribution of the gains. They have also been slow in making the investments needed to ensure the prospects of future generations, including by protecting the environment for the long term. The paper places at least part of the blame on regulatory failures. It also shows how past mistakes can be corrected by the significant sectoral transformations, driven by new technologies, now underway. Digitalization is altering the economic characteristics of infrastructure services. Resulting changes in governance and financing options demand adjustments to economic regulations, including by broadening the regulatory toolkit to integrate new insights offered by developments in behavioral economics.

## 1. Introduction

This paper considers why and how infrastructure regulations need to further evolve in Latin America and the Caribbean. Despite decades of reform, a large share of the production and delivery of infrastructure services is still assigned to regulated monopolies. The formal regulations applied to these monopolies, whether they are public or private, are typically handled by regulatory agencies that are separate from sector ministries. These regulations look good on paper but are rarely put into practice—and it is this gap between *formal* and *effective* regulations, observed across the region, that underlies the need for greater change.

Formal regulations in the region have historically been designed based on international best practices, specifically the regulatory approaches of the United States and United Kingdom. Meanwhile, the regulations that actually get implemented are adapted to the economic, institutional, and political context. Since this context evolves, effective regulations evolve as well, to adapt to new constraints and new opportunities while addressing the mistakes of older regulatory approaches. This process of adaptation can be guided in part by existing regulatory arrangements. But for deeper change to occur, more structural and institutional adjustments are needed.

Guiding the process of regulatory adaptation largely depends on the political will to adjust pricing, standards, or service obligations to address changes in political or societal preferences. The most obvious examples are the changes required to address growing concerns about environmental health and poverty in the region. The options are clear, and most fit reasonably well within available regulatory tool kits. The degree to which available tools adapt to changes in preferences largely depends on the skills of the design and implementation units in each country and on the political will to allocate or reallocate the necessary resources.

The capacity to make deeper adjustments depends on the extent to which regulatory agencies and related institutions can adapt to the complex, largely innovative, changes taking place in sector financing, production, and consumption. For instance, the growing role of institutional investors has changed the way regulated firms manage their corporate finances—and it has also changed the governance of infrastructure sectors and the way financing strategies impact regulatory outcomes (e.g., Georgoulas et al., 2018a). Similarly, digitalization changes the way firms produce, users consume, and governments use and share information, increasing the market power of firms in the process (e.g., Calligaris, Criscuolo, and Marcolin, 2018). This, in turn, leaves room for abuses many regulators are not yet ready to deal with.

Constrained in many contexts by tight budgets, countries in the region have been slow to address these changes. This has widened the gap between formal and effective regulations, and the ongoing widening of this gap represents a key but often overlooked reason why sectors are not able to deliver on their long-term efficiency or equity goals. It may also explain why they are unable to find the financing needed to meet the growing infrastructure needs of the region. Recent developments in many countries indeed suggest that changes in market structures, financing sources, technologies, and governance preferences in the region have seldom been met by appropriate adjustment to the regulatory framework. The result is that now both formal and effective regulations are lagging demand for regulatory oversight.

This paper suggests directions for regulatory reforms in the region. To this end, section 2 takes stock of current and emerging regulatory challenges. Section 3 summarizes key emerging changes that are likely to define the future of regulatory frameworks in the region. Section 4 concludes.

## 2. An unfulfilled policy agenda

From now to 2030, the average country in Latin America and the Caribbean requires investment of about 0.5 percent of gross domestic product (GDP) in water and sanitation services, 1.2 percent in energy, and 1.4 percent in transport (Rozenberg and Fay, 2019). Between 2008 and 2015, only about 0.3 percent was spent on water and sanitation, 1.0 percent on energy, and 1.6 percent on transport. This was not enough to ensure their quantity, in some cases, and not enough to secure their quality in all cases.

Various recent global reviews of the state of infrastructure services have highlighted the central role of regulatory weakness in their underperformance (e.g., Fay et al., 2017; Georgoulas et al., 2018; Watkins et al., 2017). Also, there is a mismatch between institutional capacity and the assignment of mandates across agencies, ministries, and government levels (Estache, 2020). Some failures can also be linked to an inability or unwillingness to adjust regulatory design to evolving political and societal preferences. How these failures affect each infrastructure sector will be summarized, followed by general recommendations for structural regulatory reforms in the region.

**Water and sanitation.** In most countries of the region, the performance of this sector falls below the average observed in other regions at similar levels of development. Physical assets, maintenance practices, and service quality all need to be improved to meet growing demand, and yet the sector remains underfunded (Bertoméu-Sánchez and Serebrisky, 2019; Suarez-Aleman, Serebrisky and Perelman, 2019). For now, performance is following a declining trend, with negative effects on an increasingly large share of the region's population, in particular the poor and, increasingly, the lower-middle class (about 40 million people, or 6.5 percent of the population, still have no access to safe water sources). In many major cities of the region, water scarcity is expected to become a reality within a decade. This, by itself, justifies a reassessment of regulations, since price signals do not seem to be doing the job. A closer look reveals further indications of a problem. For instance, water pollution is becoming an increasingly pressing issue (about 80 percent of the region's wastewater is discharged directly into rivers). The sector seems unable to finance the growing population's significant need for sanitation services, as the promise of massive private financing has not materialized.

Taking on regulatory design is not only a technical challenge; it is also political. The way water is produced and consumed and the way wastewater is treated in the region reflect, in part, the way political decisions have been implemented. For instance, the decentralization of water provision and treatment responsibilities has not always been matched by an assignment of regulatory mandates that accounts for obstacles to physical and political coordination. This in itself limits the ability of regulators to deliver on some of their core goals. Recent research on the Brazilian experience has shown that the extent to which political parties are aligned across government levels, from the federal to the municipal, strengthens regulators' ability to address water treatment requirements (Estache, Garsous, and Seroa da Motta, 2016; Colombo, 2019). It is possible that policy makers have focused too much on the formality of processes rather than on outcomes.

**Electricity.** Although the electricity sector may be doing better than the water and sanitation sector in many ways, a recent analysis indicates that poor households still face obstacles to access and affordability, and that the sector is excessively slow in adapting to environmental change (De Halleux et al., 2018a). Both problems have been linked to the design of institutions and particular the sector's governance.<sup>1</sup> As of 2018, regulatory governance choices made in the region focused

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<sup>1</sup> The concept of governance covers a wide range of criteria. Depending on which are measured, the very same sector in a given country may appear to enjoy good governance or suffer from bad governance. Jordana,

more on improving technical quality than providing access for all. The social achievements of the sector are more likely due to fiscal interventions (i.e., tariff structures or the targeting of low-cost technological or service options to the poorest) than regulatory design. A significant fine-tuning of price structures and of the targeting of subsidies should be on the agenda.

The sector is also trying to adapt to the increased digitalization of several of its activities. Smart grids and smart meters are changing the nature of the business. This promises many payoffs in the medium to long term. Meanwhile, the data-intensive transformation of the sector is increasing the scope for operational synergies with other sectors. For instance, joint investment with telecommunications companies to collect data or with financial or insurance companies to use the data collected is an increasingly attractive option for energy operators. This raises a new set of issues to be internalized in regulatory design. Indeed, as electricity utilities diversify into nonregulated activities, the risks of anticompetitive cross-subsidies and dumping cases increase even amid the entry of new, specialized competitors.<sup>2</sup> The trend toward diversification is also blurring the division of regulatory mandates across agencies.

**Transport.** Despite the significant role of the private sector in the operation and financing of key transport infrastructure and services, as in most other emerging markets, the role of the public sector continues to be quite significant in Latin America and the Caribbean (Estupiñan et al., 2018). This is not a problem in and of itself, but growing congestion and poor performance across modes suggest that something is not working. Yet governments have been quite good at sequentially increasing investments over the past 20 years (Infralatam, 2018). Instead of investment, the likely culprit is regulatory governance. Planning, pricing, and monitoring are failing to deliver on the fast-growing and constantly evolving demand for mobility (Marcsak et al., 2016; Fay et al., 2017; Yáñez-Pagans et al., 2018; Chauvet and Baptiste, 2019). As with other sectors, this governance problem has social consequences, particular for the poor (Rivas, Suárez-Alemán, and Serebrisky, 2018). And it also has implications for the region's competitiveness. International business is indeed losing out amid shipping and logistics failures. In some parts of Latin America, packages can take much longer to reach their destinations than in advanced economies in the Organisation for International Co-operation and Development (OECD).<sup>3</sup>

As in the case of electricity, the sector is looking for new technological solutions to process the large volumes of information handled by transport companies. Despite some progress, the adoption of new artificial intelligence (AI) technologies has been slower overall than in other regions, notably Asia (e.g., Opertti, 2019). For instance, the electronic exchange of trade-related data is yet to be systemized. But to be able to do this at the regional level requires a coherent approach to new forms of regulation that protect both traders and consumers (Giordano et al., 2017).

**Cross-sectoral issues.** Financing continues to be an issue for all sectors, and subsidies continue to be larger than were anticipated when the reforms of the 1990s were launched. If the governments of the region were to consider increasing the scope for self-financing allowed by sectors'

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Fernández-i-Marín, and Bianculli (2018) show this in an analysis of the institutional features of 799 agencies in 115 countries and 17 sectors, including many in Latin America and the Caribbean. Their study focuses on regulatory responsibilities, managerial autonomy, political independence, and public accountability.

<sup>2</sup> Farboodi et al. (2019) show that data accumulation can increase the skew results according to the distribution of firms' sizes, since large firms generate more data and invest more in active experimentation. On the other hand, small data-savvy firms can overtake more traditional incumbents, provided they can finance their initial money-losing growth.

<sup>3</sup> At the global level, improvements in border administration, transport, and communication infrastructure could increase global GDP by 4.7 percent (\$2.6 trillion in 2013) according to the World Economic Forum (2013).

consumption characteristics, they could do so through various forms of price discrimination. But this solution has been underused in the region, even though it could reduce the distortions associated with relying on public financing (Estache, Serebrisky, and Wren-Lewis, 2015). Any regulatory reform in the region should systematically account for the opportunity costs of subsidies, which are too often ignored in the region. This would, among other benefits, help make the case for regulated, targeted price discrimination to improve both equity and efficiency as well as to reduce the sector's fiscal burden. The exact size of this burden needs to be measured if effective regulation is to be achieved. Digitalization should help a lot in the process, but the data involved need to be supervised closely. Indeed, digitalization will also make it easier for firms to identify and target high-value or low-cost users.

***How could the region do better?*** A new wave of regulatory reforms of the infrastructure sector has various challenges to address. The sector needs to fine-tune the way it regulates prices and profits to make the most of available data. It also needs to more closely monitor the financing strategies adopted by both the public sector and service providers. These needs in turn call for a restructuring of governance and institutional organization, and possibly a reevaluation of mandates across agencies and government levels.

These actions are necessary if the public's long-lasting tolerance for (in many countries and sectors) inefficient and unequitable service delivery is to be addressed. And their implementation will be eased by the new technologies on offer. The public has an important role to play in ensuring that policy makers are held accountable for the implementation of regulation. A vocal civil society can have significant political effects.

Redesigning institutions is also essential, to ensure the political viability of the more technical sector reforms likely to follow expected technological changes. The region has been experimenting for over 20 years now with a relatively standardized approach to institutional governance that includes the creation of separate regulatory agencies, the increased decentralization of mandates, and notable efforts to attract private sector players to invest in the sector. But the results of this approach have not delivered on policy objectives. Why? Institutional design can't be the only culprit. Some of the problems also stem from depending on a fairly rigid set of regulatory tools. Most regulators in the infrastructure sector have been less keen than those in other sectors in the region, and certainly than infrastructure regulators in other regions, to adopt new lessons in behavioral economics. Broadening the regulatory toolkit should thus also be part of the reform agenda if the region is to improve its ability to deliver on social, financing, and sustainability goals.

### 3. Emerging regulatory priorities

The evidence reviewed in section 2 suggests four key dimensions of regulatory reforms:

- (i) Leverage the possibilities offered by new data processing technologies to improve regulatory effectiveness;
- (ii) Address the mismatch of institutional design, governance rules, and regulatory tools to close the gap between formal and effective regulation;
- (iii) Rethink how the investment financing decisions of both public and private sector actors are monitored to improve infrastructure financing options; and
- (iv) Experiment with alternative regulatory tools, in particular those emerging from applied research in behavioral economics, to close the performance gaps allowed by the more traditional instruments.



These four dimensions are clearly not equally relevant to all infrastructure sectors or all countries in the region, but they are applicable in the majority of cases. Any specific recommendations based on analysis of these dimensions will have to account for the local fiscal and institutional capacities of each country and also each of its sectors.

***The regulatory impact of technology.*** The evolving role of digitalization, the many applications of AI, and the growing presence of mobile applications are having significant effects on the production and consumption processes of most regulated services. And much related learning has already been internalized by service providers.<sup>4</sup> Smart meters, smart billing, and smart phone applications are standard management tools in regulated industries, and have been proven to increase profit levels.<sup>5</sup>

Although hard data on the payoffs of adopting comprehensive digital strategies for infrastructure are not yet available for the region, it is useful to consider global estimates.<sup>6</sup> First, as background, according to the World Economic Forum (WEF, 2019), worldwide investment in infrastructure is expected to rise to \$79 trillion by 2040, though actual needs will be closer to \$97 trillion. Almost three-quarters of this global infrastructure investment gap of \$18 trillion can be attributed to the road and electricity sectors. On an annual basis, this means that every year, about \$3.7 trillion should be invested in these sectors to meet the demand of a rapidly growing global population.

Consider, first, the case of the **energy sector**. According to the International Energy Agency (IEA, 2017), the sector's digitalization will enable global savings in the order of \$80 billion per year over the 2016–40 period, or about 5 percent of total annual power generation costs. About 25 percent of these gains will be achieved through a drop in operation and maintenance costs (notably thanks to better predictive maintenance). Better efficiency in planning and loss and outage managements will further cut costs. In the long term, digitalization will also extend the operational lifetime of power plants and network components. On average, reduced investment needs in power plants and in networks would explain about 42 percent and 25 percent of annual gains, respectively. These medium- to long-run benefits would involve significant short-run annual investments, however. According to the same source, global investment in digital electricity infrastructure and software reached \$47 billion in 2016. This was about 40 percent higher than investment in gas-fired power generation worldwide at a time when many governments were cutting spending rather than increasing it, at least in the short run.

In the **water and sanitation sector**, many processes have already been largely automated, and remote control technology and also digital office communication have been well integrated in best management practices. There are no global estimates that allow the cost savings to be compared to those in the energy sector. But already there are good indications of improvements on both the demand and supply side of the market. On the demand side, service providers are using digital technologies to improve the strength of price signals for water across competing uses (from agriculture—which represents about 70 percent of water use in the region—to residential consumption). On the supply side, the smart integration of information and operational technology is cutting costs by smoothing the production chain, from “upstream” supply management at the extraction stage (basins, aquifers, potable reuse, or desalination) to real-time monitoring of water treatment “midstream,” to “downstream” utility operations. At the level of water utilities,

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<sup>4</sup> See Goldfarb and Tucker (2019) for an economic survey of the various ways this can be cut thanks to digitalization.

<sup>5</sup> See Jamasb, Triptar, and Baidyanath (2018) for more on the use of smart technologies in the electricity sector of developing countries.

<sup>6</sup> Jorisch et al. (2018) provide a detailed overview of technology's environmental payoffs—a key dimension that will also need to be internalized in regulatory assessments.

technological improvements should help reduce the significant amounts of water lost in leaks and bursts, estimated at 25–35 percent of total available water supply. Liemberger and Wyatt (2018) estimate the global volume of water that is not accounted for at about 346 million cubic meters per day, or 126 billion cubic meters per year. This amounts to a loss of about \$39 billion per year, if water is valued at \$0.31 per cubic meter. For Latin America, they estimate the loss at \$8 billion/per year. Keeping in mind that to achieve the United Nations’ Sustainable Development Goals for 2030, the sector’s annual investment needs (water and sanitation) are \$115–\$120 billion, these are not minor savings. Also, these payoffs provide a lower bound of potential economic gains since they do not account for any reduction in the aggregate water footprint. Ongoing efforts to reduce this footprint, and water losses, will be aided by the sector’s digitalization.

In the **transport sector**, there are no estimates of the global payoffs due to the sector’s technological evolution, but there are a few helpful indicators. Looking first at **public transport**, recent estimates put forward by the Global Mobility Report (2017) suggest that the gains from making services more sustainable and efficient, thanks to information technology, could add up to \$70 trillion by 2050, or about \$2 billion annually. An increase in shared transport is essential to achieve these gains.<sup>7</sup> For **freight**, a study of Europe conducted by PricewaterhouseCoopers (PwC 2018) suggests that between 2017 and 2030 digitalization will cut the costs of trucking logistics by 47 percent (largely by reducing demand for labor amid increased automation) and delivery lead times by 40 percent. Trucks’ efficiency, as measured by the percentage of time on the road, will also rise markedly, from 29 percent to 78 percent. Looking into the future, many analysts predict the gradual replacement of long-distance drivers and freight forwarding companies with automated solutions. These trends have regulatory implications, since they point to an increased concentration of markets and a bigger role for large tech companies.

Regulators have been slower in internalizing the significance of these trends than have service providers. Not only do they underestimate the rate of return on short-term investments in digitalization but also the regulatory challenges likely to be stirred up by technological transformation. Early evidence from the OECD points to the likelihood that digitalization and many related changes will prompt higher mark-ups in infrastructure sectors if there is no change in how regulated industries are being monitored (Gal et al., 2019). And this will be in response to the multiple ways that fundamental costs will be cut—that go well beyond straightforward reductions in production costs (Goldfarb and Tucker, 2019). Many channels of costs savings will be hard for regulators to track. Yet at least some of these cost cuts should be passed on to the users and taxpayers subsidizing infrastructure. Unless this is done, technology will simply become a source of tension between operators and consumers, and hence governments, in the region.

Regulating the changes emerging from the increased role of AI and the digitalization of processes is going to be a complex challenge for each infrastructure sector in the region and will demand a lot of pragmatism since it will involve many regulatory concerns simultaneously. For instance, in the case of transport, the changes go beyond smart traffic management and new price discrimination options made possible because usage is easier to measure. It will also be necessary to rethink safety, pollution, traffic coordination, and data-sharing practices. This is in addition to the management of new approaches and forms of multimodal transport, for both passengers and freight. Regulation will have to be far more detailed and dynamic than in the past.

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<sup>7</sup> Shared mobility includes (i) shared public and private transportation (with shared financial or physical ownership); (ii) product innovation (next-generation vehicles and transportation equipment relying on data analysis); (iii) real-time customer services (including timetables, fares, travel times); and (iv) data-driven assistance in decision making (Canales et al., 2017).

Most of these changes are likely to be welcome if regulators manage to ensure that some of the cost savings are shared. But they will also raise questions about data privacy and ownership. For instance, demand response technologies rely on large quantities of consumer-specific, real-time usage data. Anyone with access to the data can glean a lot of information about household members' personal daily routines. How much of this should be confidential, how well it should be protected (e.g., how much data collection may be outsourced or shared, and under what conditions), and who has ownership rights over these data are all topics to consider in the redesign of regulation.

Similar questions around pricing techniques, market structures, and governance and institutional arrangements are likely to arise across all regulated industries. For instance, in electricity, digitalization is accelerating a shift toward a multidirectional, distributed energy system. Demand sources will increasingly participate in balancing supply at all scales as improved connectivity makes it easier to link, aggregate, and control energy production and consumption units. This will change the traditional distinction between suppliers and consumers built into traditional forms of price regulation.

The increased integration of networks allowed by AI solutions will also raise new security concerns. Harmonizing countries' approach to cybersecurity will help minimize the risks of a weak link in interconnected networks and resource pools. It will also be increasingly important to anticipate and develop common response plans to cyberattacks, for instance. And all of this comes at a cost that the region will have to account for. Policy makers will need to consider how these costs might impact pricing or the level of subsidies to be allocated to sector producers and users. At the same time new technologies are likely to increase the reliability of supply and the penetration of renewable energy sources, which will themselves reduce operating and capital expenditure (OPEX and CAPEX).

What specific regulatory decisions are made will help decide how much can be done with emerging technologies. Differences across countries will increase if the changes are not coordinated. One of the most basic decisions is the degree to which user data can become a source of rent for an operator. The maximum consumer protection is provided by "opt-in" programs, by which clients must authorize which data are shared. This is likely to be the preferred by a fair share of users—though there is the possibility of a generation gap in this. Meanwhile, most firms are likely to prefer "opt-out" programs because this allows them to collect data that can then be used for pricing and service targeting to maximize profits.

The regulator's choice does not have to be binary, however. It is possible for clients to self-select confidentiality options ranging from "minimal," or sufficient to allow essential smart operations (including for regulated prices and quality preferences), to "full" or "maximal" within specified ethical limits to be defined by the regulator. The regulator thus has some margin to acknowledge the interest of both consumers and suppliers.

The diversity of changes wrought by new technologies is already impressive but it is not clear how much of this has been internalized in either formal or effective regulations. Regulators would do well to formalize their awareness of the challenges ahead and to identify strategies and instruments that will best reach their goals. It is remarkable, for instance, to note how little has been done to think through how the new technologies could be used to help regulated firms address the needs of the poor or growing environmental concerns. And unequitable service and environmental damage were identified as key challenges in various recent surveys of the state of infrastructure sectors in Latin America and the Caribbean. As discussed below, solutions are being tested in a few countries of the region (most notably Chile and Colombia) but the scale of trials remains small—too

small to suggest that any real change is coming in the way regulators are using new tools to deliver on their mandates.

Another needed response is to rethink the institutional architecture of regulation. If new mandates associated with the growing role of data are needed, they have to be recognized formally and assigned to a specific regulatory agency. Since data are often provided and managed by firms subject to the oversight of the telecommunications regulator but end up being used by electricity, transport, and water regulators, the division of mandates becomes blurry. And to the extent that data management is subcontracted to various, often small, companies, it can also raise competition issues. Collaboration across institutions becomes more important, and may call for a reassignment of mandates across institutions. One option is to assign authority for all data-related issues to the competition agency. Another option is to set up a separate agency for data regulation.

The number of regulatory changes required is unavoidable, and may be hard to digest in practice. Improving and adapting countries' regulatory capacity to internalize the potential gains of technological change will indeed demand an effort to educate all stakeholders (e.g., WEF, 2018b), including regulators, users (across all demographics), and producers. The transition to new technologies poses a challenge to users of all ages.<sup>8</sup> For regulators and consumers who are now lagging the sector's frontier companies catching up is a must.

Yet big data literacy has not been high on the regional policy agenda. In 2016, only 45.5 percent of Latin American households had an Internet connection. Even if the region's connectivity rates are catching up, this figure is still far below the OECD average of 86.3 percent. Similarly, in 2016, only 64 percent of households relied on mobile broadband and 11 percent on fixed broadband as compared to 85 percent and 46 percent in OECD countries, respectively. Latin America and the Caribbean continues to have the lowest mobile data traffic rates in the world, with an average of 449 terabytes per month, or seven times less than in the Asia-Pacific region. Access rates are particularly low among the lower-middle class and the poor. In 2016, the ratio of households with Internet access in the richest income quintile as compared to households in the poorest was close to 2 in Costa Rica, Chile, and Uruguay; between 2 and 10 in Brazil, Bolivia, and Ecuador; and over 20 in Paraguay and Peru. This is a regulatory issue. It points to regulators' inability to address equity concerns, with brutal consequences for efficiency—since a lack of access makes it harder for countries to exploit the gains of technology. And it is also politically costly, since it fuels inequality and hence social instability.

Enhancing regulatory capacity is thus not a minor challenge. It involves both training and the development of access to the latest technologies. It may indeed have to start with a significant effort to make access to online and information and communication technology services more affordable, as stated by the Economic Commission for Latin America and the Caribbean (ECLAC, 2018). How fast and how well this is done will make a difference. Time management is at the heart of the transition to new technologies and appropriate forms of regulation. The change will have to be progressive and may require creativity to reach all the populations excluded so far. Utilizing media, TV shows (even including *telenovelas*), or free massive open online courses would help. This may also require

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<sup>8</sup> The potential contribution of education is strong, but the evidence suggests its effectiveness is mixed. The need to train both trainers and educators to make the most of new technologies and to share this ability is a key but often underestimated driver of success (e.g. Eshet-Alkalai and Chajut, 2010). Education is particularly important for older populations (e.g., Sunkel and Ullmann, 2019), and is also necessary for regulators and policy makers (Dunlop and Radaelli, 2016).

some fiscal support, as is often the case with the implementation of industrial policies. And this needs to be factored in as well in the design of regulatory budgets and efforts to target subsidies.<sup>9</sup>

Overall, what this discussion implies is that a change is needed in the design and implementation of regulation. Standardized regulatory solutions are likely to be even more distorting now than they were in the past. New data should allow more evidence-based assessment of the potential adverse effects of specific behaviors and practices. And new, associated methodological developments should allow both better ex ante and ex post diagnostics of potential or actual harm identified by market- or firm-specific audits. This does not change the purpose of regulation, but should allow it to be more effective in reaching its goals.

***The regulatory impact of governance.*** In spite of the significant changes in the political sphere in the past 25 years, most countries in Latin America and the Caribbean have not yet adopted a governance structure that ensures strong performance and administrative accountability (Trillas and Modiano, 2011). Evidence shows that the prevailing governance and institutional choices have not delivered the expected performance levels in infrastructure (e.g., Estache, 2020). The sectors have evolved; the institutions have not. Decisions are influenced by the capture or corruption of politicians or regulators and collusion between service providers. The forms of capture, collusion, and corruption (CCC) are endogenous, and policy makers have to keep up with the creativity of corrupt players. But policy makers and regulators have been slower to adjust to changes in context and behaviors than have either producers or consumers. This is why the influence of politicians and bureaucrats is emerging as an ever-larger obstacle to solving the ineffectiveness issues of infrastructure sectors.

To handle these failures of regulatory governance, it is important to consider the interactions between regulated firms and politicians. At the institutional level, the focus has often been on the creation of separate regulatory institutions and the opening up of processes to greater civil society participation to improve accountability. At the political level, the sector-specific consequences of decentralizing key mandates are increasingly well understood (Estache, 2020).

There is robust evidence on the budget overruns, delays, or white elephants (i.e., expensive projects without use or value) caused by corrupt decision-making processes (which most often center on excessive red tape, or complex administrative procedures that enable subjective ad hoc decisions influenced by bribes). This situation was recognized in academic circles (e.g., Locatelli et al., 2017) long before the recent Odebrecht scandal served as an eye-opener for the more casual analysts of infrastructure activities.<sup>10</sup> The scandal placed infrastructure-related corruption on the front pages of newspapers around the world, and fueled Latin Americans' growing unhappiness with the region's powerful public service providers, civil servants, and politicians.<sup>11</sup> The crisis also revealed regulators' limited ability to protect infrastructure sectors from political interference.

CCC is prevalent because many of the standard tools used by regulators and policy makers are easy to manipulate or instrumentalize at all stages of the infrastructure service value chain (including

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<sup>9</sup> Though beyond the scope of this paper, it is worth noting that the labor markets of most countries will have to undergo a critical transformation. The growing importance of the platform economy made possible by new types of work arrangements is a serious challenge. This topic may eventually trickle down to regulators as they benchmark firm performance to labor productivity.

<sup>10</sup> Odebrecht is a Brazilian construction giant that admitted to paying bribes in more than half the countries in Latin America, as well as in Angola and Mozambique in Africa. It was associated with the financing of election campaigns in exchange for large construction contracts.

<sup>11</sup> See OECD (2018b) for a recent analysis of the drivers of the growing discontent of the middle class and the poor, especially with regard to public service delivery.

planning, consultation, procurement, financing, auditing, and regulatory processes).<sup>12</sup> The failure of existing administrative structures helps explain why, as of 2017, close to two-thirds (63.9 percent) of Latin American citizens had no confidence in their national governments (OECD, 2018b). Also to blame is growing awareness of the power large infrastructure firms have over politicians through their willingness to finance (re-)election campaigns (e.g., Casas-Zamora and Zovatto, 2015).

Perhaps the designers of regulatory processes have, to date, underestimated the complexity of regulatory tasks. A failure to match regulatory mandates, tools, and processes with local capacity, implicit in the extensive adoption of imported, standardized approaches, is likely one of the main reasons for subpar outcomes.<sup>13</sup> Further, more transparent processes are required throughout the value chain to minimize the risks of Odebrecht-like scandals. Designing these processes should be eased by digitalization. Coming up with an algorithm to identify the odds that a project or a regulatory decision is likely to be corrupted should not be too difficult.

More data will, however, come with their own share of problems. Beyond the question of which agency will regulate their use, their ethical treatment should be addressed as part of reforms.<sup>14</sup> More precise measurement of production and consumption decisions in regulated industries would make it easier to assess compliance with obligations throughout the value chain. However, producers' and users' right to privacy must be recognized. Meanwhile, the counterproductive information overload allowed by big data could increase the scope of regulatory manipulation. For instance, increasing disclosure requirements without supervision might prompt a regulated firm to deliberately inflate the flow of information to focus the regulator's attention on the less relevant dimensions of its cost accounting. This may also be done to mislead consumers (e.g., Persson, 2018). Both these problems could be dealt with through a reform of the auditing mandate of regulatory institutions. This reform would be part of the technical changes to be brought about by the digitalization of information. These in turn will also have to account for the cybersecurity risks that could easily erase all the potential payoffs of regulatory reform processes (e.g., WEF, 2018a).

One of the most obvious parts of the regulatory process to be reformed is the design of procurement rules in the region. The adoption of e-procurement has become the norm in many public administrations at the national level, and in some at the subnational level, and it has delivered many advantages. But there is significant scope for improvement. In most countries, current practices still allow for bid rigging (including arrangements that involve direct contracting). Too often, new entrants, including local ones, are excluded because of collusion (with firms competing in some markets and making joint bids in others), mispricing (based on outdated or biased benchmarks), and mismatches of quality standards (for both goods and services, including those offered by consultants to governments and regulators trying to comply with mandates for which they do not have the internal capacity).<sup>15</sup> Most of these weaknesses have contributed to the ongoing prevalence of CCC in the region, as illustrated by the Odebrecht crisis.

To address these issues, processes will have to be simplified to match local implementation capacity, and upgrades should be considered only as and when capacity is actually reinforced. This

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<sup>12</sup> For an assessment of the way contract renegotiation processes have been distorted in eight countries of the region, see Campos et al. (2019).

<sup>13</sup> See Estache (2020) for a recent survey.

<sup>14</sup> See, for instance, Le Ray and Pinson (2019) for a stimulating discussion of the role of ethics in the development and use of smart meters. For a more general conceptual survey of issues related to privacy and machine learning, see Ji, Lipton, and Elkan (2014); and for a more policy-oriented approach, see Kahn, Baron and Vieyra (2018).

<sup>15</sup> See, for instance, Estache and Iimi (2010) for a discussion of potential new entrants.

also demands the more systematic coordination of stakeholders, including sector regulators, competition agencies, and procurement agencies.<sup>16</sup> These lessons are relevant to more than the procurement of infrastructure: similar adjustments are needed to correct the historically poor performance of the region's institutions, and to harness the promise of new technologies (e.g., Querbach and Arndt, 2017).

The drawbacks of poor institutional quality should inform the new wave of regulatory governance. Reforms would do well to focus on the specific role of institutions responsible for the design and implementation of decisions. According to Djankov, Georgieva, and Ramalho (2018), a 10 percent improvement in a country's institutional quality (using the World Bank's Doing Business indicators as a proxy) results in a 2 percentage point reduction in the poverty headcount. It can also attract private financing. For instance, the extent to which the creation of a separate economic regulatory agency, national or subnational, will improve governance so as to attract large-scale private operators to engage in public-private partnerships or reduce corruption has been a recurring topic among analysts and policy makers for more than 25 years. But the evidence is mixed. Such a regulatory agency is typically not a necessary nor a sufficient condition to attract investment, although it has done more in several Latin American countries than in developing countries of other regions to attract private investment in the water sector (e.g., Bertoméu-Sánchez, Camos, and Estache, 2018) and to reduce corruption in the electricity sector (Wren-Lewis, 2015).

Political scientists have highlighted that the effectiveness of these agencies is contingent on the factors determining their formal independence (e.g., Gilardi and Maggetti, 2011). Independence depends, among other dimensions, on the way regulators are nominated (e.g., they are appointed rather than elected officials), are audited (e.g., by parliament, ministries, or independent auditors), or are financed (e.g., through taxes or regulatory fees paid by users). Differences in any of these dimensions across agencies may explain why outcomes vary across countries or sectors (as in Latin America) (e.g., Pavón Mediano, 2018).

The first step for countries willing to engage in the next wave of regulatory reforms is to undertake a detailed diagnostic covering the full spectrum of agencies, mandates, tools, and processes (e.g., Estache, 2020). This is to understand the strengths and weaknesses that need to be accounted for, including the degree to which mandates, tools, and processes are matched (e.g., Estache and Wren-Lewis, 2009). Over the past 25 years, many reforms have tended to overestimate the good and underestimate the bad, resulting in formal regulatory designs that were at best naïve or simply unable to deliver on expectations. This has also slowed down efforts to match tools and processes. Simpler solutions will often deliver greater efficiency, equity, financial viability, and accountability than will standardized and more complex solutions tested in stronger institutional contexts or alternative legal systems.

Not all potential solutions are administrative or bureaucratic, however.<sup>17</sup> The political decision to decentralize regulation offers an additional way to match the regulatory framework with local capacity and constraints (when there is no reason to keep it centralized). This usually demands institutional changes in the definition of regulatory mandates, authority, and resources, and their distribution across government levels, within countries, and sometimes across countries.<sup>18</sup> But a lack

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<sup>16</sup> Ecuador offers a useful example of this approach to reform with its creation of the Unit for Regulatory Improvement and Control and its mandate to assist the National Transport Agency in simplifying transport regulations.

<sup>17</sup> See Mookherjee (2015) for a survey of political decentralization.

<sup>18</sup> It also demands a careful design of election rules. As Ferraz and Finan (2011) show in the case of Brazil, there is significantly less corruption in municipalities where mayors have the chance of getting reelected.

of integrity at the subnational level or an overestimation of implementation capacity is also a possibility to account for when considering decentralization.

In practice, for political reasons, hybrid decentralization arrangements in which responsibilities are shared across government levels are quite common in the water and sanitation and transport sectors. While these arrangements are often the outcome of complex political negotiations that sometimes end up being built into laws or constitutions, they can make it harder to assess the performance of each of the government layers involved. Information about the vertical (across government levels) or the horizontal (across various subnational governments) distribution of power may be imperfect and lead to underperformance in service delivery. They may also have political consequences as voters may end up blaming politicians for the poor design of decentralization decided by earlier administrations (e.g., Joanis, 2014; Mookherjee, 2015). As shown by the Brazilian experience, it is easier to play the blame game if politicians at the various government levels are not from the same party (Estache, Garsous, and Seroa da Motta, 2016), or easier to collude if they are from the same party (Colombo, 2019).

As with institutional quality, the next step is a diagnostic of the extent of the mismatches between mandates and actual implementation. This may be difficult to accomplish amid the explosion of data resulting from e-government and digitalization. Instead of resolving moral hazard and CCC problems, more data to parse might end up making responsibilities less clear. Strengthening the integrity of data should help, as should more systematic audits of formal checks and balances to test their reliability (Avis, Ferraz, and Finan, 2018). Among other benefits, these boost popular support of further reforms.

Overall, the discussion of governance dimensions has highlighted the costs of not dealing with factors that, in retrospect, should have been addressed long ago. Many of these omissions can no longer be ignored. This review also highlights the diversity of dimensions that should be considered. Even if similar issues are being faced across the region, their relative intensity may vary significantly by country. This implies that standardized solutions are unlikely to be effective.

The next wave of reforms should probably start with a detailed country- and sector-specific governance diagnostic that cuts across themes, the details of regulation and its interaction with the political sphere, the structure of institutions and the allocation of mandates across stakeholders, and the political fine-tuning of decentralization preferences. The interactions of these dimensions are likely to be just as important as the performance of each on its own. In view of the continuous changes brought about by adjustments to new data and new uses of these data, policy makers should account for the possibility of having to switch from broad-brush *ex ante* legislation implemented by sector-specific regulators to *ex post* enforcement by a competition agency or an agency specializing in monitoring data-related abuses.

***The regulatory impact of corporate financing strategies.*** The impact of changes in technology is a forthcoming challenge, and regulators need to quickly address the relevance of corporate financing strategies to face it. The financing structure of Latin American firms is influenced by a number of predictable factors (size, tangibility, current liquidity, and returns on assets, for instance) that are similar to those of economically and politically stable regions (e.g., Valcacer Rodrigues et al., 2017). But the degree of uncertainty regarding returns and limited access to capital markets lead to a greater dependence on equity and short-term funds in Latin America than in more stable regions. Industries dealing with long-term assets are seldom addressed by regulatory debates in the region.

The widespread failure of regulation to internalize the importance of financing strategies for basic regulatory functions such as costing, pricing, and ensuring compliance with investment obligations is unusual in a region that still needs to invest significant amounts in its infrastructure to meet demand (Serebrisky et al., 2018). If we include the telecommunications sector, these needs are



estimated to be 4–5 percent of GDP on average per country over the next 15 years at least (accounting for the cost of adjusting to environmental concerns). These are significant figures, but they are lower bounds at least in the short run as they underestimate the short-term costs of adjusting to new technologies. This is because most of the investment needs assessments available to policy makers are based on backward-looking best practice costs, which do not factor in the costs of improving technologies in the sector.

Up to now, most of the discussions on financing strategies have focused on contract design, risk assessments, and risk levels with the cost of capital as a proxy for the minimum expected rate of return to investors. This is very similar to the way most countries have adopted private financing options for infrastructure sectors. Recent regulatory debates in the United Kingdom reflect some of the infrastructure financing concerns in Latin America and the Caribbean, and illustrate why regulators and policy makers should also weigh in on corporate financing strategies.<sup>19</sup> The debates were triggered by the observation that water companies in England have been borrowing to increase dividend payments and, to a lesser extent, payments to chief executive officers and board member, rather than to finance investment needs. De facto, investments been lagging targets and service quality has been dropping in various dimensions.

The current financing strategies of most utilities and large-scale public service operators in Latin America and the Caribbean raise similar issues. Many (if not most) rely on a model of debt financing anchored in the securitization of revenue flows. Under current regulatory practices, this model has tended to favor shareholders and financial intermediaries over consumers by allowing sizeable steady dividend payments over time, a long-term characteristic of the corporate financing strategies of the region. For instance, Benavides, Berggrun, and Perafan (2016) and Von Eije et al. (2017) show that the target dividend payout ratios (and their speed of adjustment) are much higher in Latin America than in North America, for instance. Benavides, Berggrun, and Perafan (2016) argue that in Latin America and the Caribbean, the target dividend payout ratio is positively related to governance indicators at the country level but that the speed at which firms adjust their dividends to changes in earnings is lower in those countries where governance is relatively better. In other words, since good regulation tends to be associated with good governance, there is an endorsement of high dividends from good regulators.

A strong commitment to dividends is not necessarily an issue in itself, but in the current context it is an unusual strategy since it suggests that firms do not rely on retained earnings to finance much-needed investment. A regulatory tolerance for this type of bias would be particularly inappropriate in a risky environment where the cost of borrowing is the least desirable option to minimize financing costs. Yet this bias is confirmed by Benavides, Berggrun, and Perafan (2016), who observe a negative impact of retained earnings on dividends. The consequences of this bias are further observed if new debt is used to fund dividends instead of financing investment.<sup>20</sup> This seems unjustified especially in regulated industries, in view of their ability to rely on steady cash flows and their greater potential to self-finance.

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<sup>19</sup> See Bertoméu-Sánchez and Estache (2019) for a recent survey of the relevance of omitting the role of dividends in the design of infrastructure regulation.

<sup>20</sup> Blaiklock (2012: 28–29) made a similar observation in a public hearing in the United Kingdom: “. . . the non-UK Companies have been shrinking in capital terms. Their financial strength has been weakened by owners paying to shareholders dividends, which cannot be fully paid out of ordinary profits, so owners have turned to debt to finance the shortfall, which in turn increases the leverage in the Companies’ balance sheets.” Blaiklock defined this as asset stripping in the British context in media interviews.

An explanation for this unusual pattern may lie in the degree to which ownership is concentrated, and in what parties. This is of potential concern in Latin America and the Caribbean, where, as in other regions, investors in infrastructure are increasingly large investment and pension funds with significant lobbying leverage with the political and regulatory authorities and the management of regulated firms. While this has not yet been studied specifically in the context of regulated industries, Gonzalez et al. (2017) provide some relevant insights when studying the effect of ownership concentration on dividend policy in six Latin American countries. They find that in regulated industries it is increasingly observed that if the largest shareholder of a firm with a highly concentrated ownership is based in a common-law country, the dividend paid is significantly higher than the average.<sup>21</sup> Therefore, matching the evolution of dividends in regulated industries with the evolution of ownership should be of interest to regulators and policy makers as it will impact the costs and investment prospects of infrastructure sectors. For instance, if investors manage to bias corporate financing decisions in favor of borrowing to pay dividends, in a context of rising interest rates (e.g., due to higher risk premia associated with an uncertain political or foreign exchange context), the bias will result in higher borrowing costs and further lower the margin of retained earnings for financing CAPEX or even OPEX. This is something regulators should focus on when defining service or operational obligations.

An additional interesting detail revealed by a diagnostic of reform options conducted by Gonzalez et al. (2017) is that increasing the ownership of the second-largest shareholder leads to a decrease in firm dividends. This can be explained by this shareholder's stronger monitoring role. It remains unclear whether this shareholder being private or public makes a difference, particularly in a context where adjustments are needed to increase the scope of the regulated firm's self-financing. In the current context, investors' interest in a sector is bound to be sensitive to the risks of new regulatory decisions interfering with their financing strategies.

The largely unsupervised decisions made to date regarding leverage and dividend payments may have underestimated implications for the concrete operational demands of sectors in which the balance between OPEX and CAPEX is particularly important to address during regulatory monitoring. Most of the arguments against the regulatory monitoring of corporate financing strategies revolve around the need to avoid micromanagement. This concern would be reasonable if it were not for the lack of investment and insufficient service quality in the infrastructure sectors. Penalizing noncompliance ex post is the most common practice in the field, but correcting mistakes takes time. Sectors associated with environmental concerns and a strong commitment to making the most of technological improvements require both an ex ante and a short-term ex post approach to corporate financing decisions. The next generation of regulatory mandates in the region should account for both.

***The regulatory impact of behavioral economics.*** As has been noted, the three key structural changes that infrastructure sectors are undergoing suggest that not only does the institutional design prevailing in the region require fine-tuning but also the common regulatory toolkit. A focus on prices, taxes, subsidies, and quality standards flows from the assumption that consumers and producers are rational at all times. If this were the case, these tools would indeed be enough to get firms to deliver and consumers to behave as expected. In many countries, they have certainly succeeded in generating the cash needed to get firms going, and in convincing investors that the market is worth their long-term commitment. But the slow pace of investment, the continuous exclusion of the poor and lower-middle class, and the growing environmental consequences of

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<sup>21</sup> Gonzalez et al. (2017) also show that the opposite happens when ownership is concentrated in the hands of an individual, who will tend to extract benefits from minority shareholders.

underinvestment in wastewater treatment, in cleaner vehicles, and in cleaner energy sources, all confirm that the signals sent by the current regulatory approach do not trigger needed behavioral change. Policy makers at the national and subnational levels may want to revisit conceptually attractive pricing methods such as peak-load or congestion pricing and widespread subsidies, and consider alternative or complementary tools.

Similar observations were made about a decade ago in OECD countries. Traditional instruments were not enough to get consumers and producers to align their private interests with the wider public interest. Multiple sector diagnostics across OECD countries showed that few energy users demanded green energy, and few service providers were willing to make the investments needed to cater to the needs of the poorest. Even when regulators priced things correctly to send the right signals, consumer behaviors were slow to adjust, as many held on to the status quo.

In response, OECD governments have been experimenting for close to a decade now with alternative ways of changing the behavior of consumers, producers, and investors (Lunn, 2014; OECD, 2017). Many of the lessons learned from their adoption might be relevant to Latin America and the Caribbean. Several of the new regulatory tools adopted and scaled up in OECD countries have internalized lessons from research on nonrational behaviors in consumption, production, and investment. A diversity of cognitive, emotional, cultural, and social biases can help explain the inadequate performance of traditional regulatory instruments. For instance, there is strong evidence that water consumption patterns are in large part driven by societal values, emotions, and social identities (e.g., Seyranian, Sinatra, and Polikoff, 2015). These can differ across cultures or across income or age groups.

Integrating research-based considerations in regulations is relatively easy, and at a relatively low administrative cost. Behavioral economists have developed various methods to identify, analyze, and use relevant nonprice dimensions in the design of policies, including regulatory ones. The most popular of these methods is the “nudge.” Its application is relatively nontechnical, and gets generally positive media coverage, which means it is likely to receive political endorsement.

Often used as a complement to more traditional incentives (e.g., Thaler and Sunstein), the “nudge” encourages consumers or producers to make an optimal choice without restrictive regulation and usually without income- or price-driven incentives. It has become one of the most popular ways of encouraging consumers to make rational decisions. One method of doing this is to remind consumers—and producers—of social norms. Defined as widely shared beliefs about how members of society should behave in the interest of the group rather than the individual, social norms have been used in regulation, with a significant degree of success, to stimulate efficiency and conservation. They have also been used to make the most of people’s interest in “fairness” to improve social or financial performance. Because their design must be suited to particular contexts and cultures, it varies across countries and often across regions within countries (Sunstein, Reisch, and Rauber, 2018).

Advances in technology, including mobile technology, are making it easier to reach consumers and monitor producers to improve the effectiveness of regulation in many ways. For instance, messages delivered through regular and social media, targeted to specific concerns and behavioral biases or delivering comparisons between user groups, can be designed to prompt people to use less water or energy. In several experiments, these nonprice stimuli reduced consumption in an amount equivalent to a significant price increase—simply by correcting misperceptions, making a specific

behavior more salient, or raising social awareness of possible actions to take.<sup>22</sup> This suggests that these new tools not only complement traditional tools but can be useful substitutes.<sup>23</sup> Given that affordability is an ongoing challenge, a behavioral intervention is worth considering as long as it is used in a regulatory toolkit that also improves the financial viability of the service.<sup>24</sup>

In Latin America and the Caribbean, as in the rest of the world, people change their minds about what they want (for a number of varied reasons, including changing emotions, contexts, or information), hold biased beliefs (perceptions), tend to prefer receiving benefits sooner rather than later, can be pressured by peers in their communities, are uncertain regarding their perceptions of key dimensions (notably quality), and are afraid of switching providers (because they fear the unknown or simply because they procrastinate even when offered good deals). Consulting firms tend to advise service providers to use these biases in their commercial policies (neuro-marketing is now a dynamic field), including in regulated industries. Even though most related research is of North American and European companies operating in their home regions, the findings are indeed relevant to many contexts in Latin America and the Caribbean where infrastructure services are comparable. Related analysis has shown that pricing is easier to manipulate in categories of users with the largest degree of cognitive biases and, unless controlled, firms may use framing techniques to influence consumers' inertia and in the process increase profits. These biases also favor collusion in many situations in which policy makers hope for competition. And this is not only about pricing, since firms' assessments of the relative significance of cognitive biases also drive monopolists' decisions regarding the quantity-quality trade-off.

Latin America and the Caribbean has a significant margin to adopt many of these instruments and adapt them to try to tackle some of the factors behind the disappointing performance of the region's infrastructure regulations. The few trials conducted in Colombia and Costa Rica, mostly in the water sector, suggests likely payoffs in the region. For instance, in a village in Costa Rica, Datta et al. (2015) show that neighbors who were notified of how their water consumption volumes compared to those of neighbors reduced consumption from 3.4 percent to 5.6 percent. Torres and Carlsson (2016) consider the impact of information campaigns in Colombia and find that they induced a drop in water demand of 6.8 percent in the targeted population and also a 5.8 percent drop in households that were not targeted, thanks to the informal spread of information by word of mouth. Lopez (2017) finds similar effects for another "nudge" experiment in Colombia, although with a larger difference between targeted and untargeted populations (7.0 percent versus 4.4 percent),

Unfortunately, these experiments are outliers in the region. A quick glance at the websites of key infrastructure regulators in Latin America and the Caribbean shows that few have internalized behavioral economics except in upgrades to communications and user education. Many countries have experimented with using behavioral research in education, health pensions, or tax collection

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<sup>22</sup> The possibility of perverse effects should not be discounted, however (e.g. Schultz et al., 2007 and Schubert, 2017).

<sup>23</sup> Sudarshan (2017) shows how, in urban India, weekly reports comparing the recipient household's electricity usage with that of peer households reduced summer electricity consumption by 7 percent. This represents cost savings equivalent to increasing tariffs by about 12.5 percent. In the United States, these types of reports have been shown to prompt savings of about 1 to 2. percent of total consumption. The impact is greatest among above-average consumers.

<sup>24</sup> Nauges and Whittington (2019) identify sources of uncertainty associated with the adoption of social norms when compared to price-based instruments for residential users.

efforts but little has been attempted in infrastructure sectors, at least on a scale significant enough to be statistically robust.<sup>25</sup>

This may be the right time for infrastructure regulators in the region to join the efforts made by their colleagues in other sectors. This will demand trials, initially, to fine-tune the design and targeting of tools. And once the specific design of new tools has been decided, it is often necessary to introduce legal and administrative changes to accommodate the adoption of new instruments in the general regulatory framework (Alemanno and Spina, 2014). This would help protect citizens from the possible abuse of data collected through behavioral instruments.<sup>26</sup> This is important because cognitive, emotional, or cultural biases are relatively easy to instrumentalize for the wrong reasons if information is not ring-fenced (an issue similar to the regulatory risks associated with the increased digitalization of information). But this is not the only challenge to the adoption of behavioral regulation in the sector. As argued by Trillas (2016), it is also important to account for the fact that regulators are likely to have cognitive, emotional, and cultural biases. One of the most common concerns is the expression of personal bias in experts' design and implementation of regulation (Perez, 2015).

Being aware of the limitations of the new tools produced by behavioral economics does not make them irrelevant. It points to the need to commit to doing what it takes to use them correctly. This new generation of regulatory tools is to become an essential complement to the older generation. Ignoring the insights of behavioral economics boils down to accepting that effective regulation will continue to differ from formal regulation and that the gap between goals and achievements will continue to grow as the old tools continue to underperform.

#### 4. Concluding comments

The 25 years that have followed the liberalization and institutional transformation of infrastructure sectors in Latin America and the Caribbean have brought significant technical improvements. Many users enjoy a better level of service than did their parents a generation ago. But many potential users, especially the poor and vulnerable, remain excluded—and unless investment picks up to match demand, many more will be excluded. Looking ahead, the next generation may be worse off than its forebears if these sectors do not quickly find a way of tackling ongoing environmental deterioration. Something has to change, and regulations are at the core of this change.

The needed adjustments to regulations will have to take place in a dramatically shifting technological, institutional, and financing environment. In a domino effect, as new technology prompts changes in market structures, these will in turn lead to institutional and governance changes. Eventually, all these changes will influence the way the sector is financed. The specific solutions adopted will necessarily be country, time, and context specific. It is therefore difficult to provide clear recommendations. Upcoming changes will affect, in significant ways, the role of

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<sup>25</sup> In a recent meta-analysis of 117 studies from 1975 to 2017 that studied the effect of providing nonprice information on residential customers' consumption of electricity (94 studies), gas (10 studies), and water (23 studies), Nemati and Penn (2018) identified only four studies that focused on Latin America and the Caribbean (two on Ecuador and one each on Colombia and Costa Rica).

<sup>26</sup> As discussed by Brennan (2018) in a recent evaluation, behavioral economics is likely to continue to be a complement to more traditional forms of regulation rather than a substitute. But as suggested by Robinson and Hammitt (2011a, 2011b), it is still useful in this role by pointing to new factors that influence costs and benefits.

coordination across sectors, users, producers, and institutions. They may, as well, demand the redistribution of regulatory mandates across agencies and possibly the creation of a new agency devoted to overseeing the big data increasingly being collected and used in the sector. And finally, they will make a case for adopting the new set of tools provided by behavioral economics.

There is little doubt that within less than a generation, the way public infrastructure services are produced, financed, delivered, and consumed in Latin America and the Caribbean, as around the world, will be quite different from what we observe today. Critically, unless a new wave of regulatory reforms is designed and implemented, the share of rationed users, the environmental damage, and the deterioration of sector governance will continue. Importantly, and in a departure from past practice, these changes should not only be formal and process oriented. They need to be effective, and outcome-oriented, for the sector to deliver on its essential social and economic role. This means that real-life needs should drive formal regulatory reforms. This is possible only if all stakeholders are consulted in the design of the next generation of sector reforms. And this consultation should probably start now in each country, informed by the large volume of research forecasting the coming changes.

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