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# What Works to Improve Lives?

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What Works for

**TRANSPORT, WATER AND  
SANITATION, AND URBAN  
DEVELOPMENT**

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## PREFACE

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This publication is one of a five-monograph series produced by the Inter-American Development Bank to take stock of the lessons learned from impact evaluations of investments supported by the IDB Group for over a decade across a wide range of economic and social development sectors. The aim of the evaluations and these five monographs is to identify policies and programs that work, enhance the use of rigorous evidence for decision-making, and ultimately improve the lives of the people of Latin America and the Caribbean.

The coverage of IDB Group impact evaluations discussed in the five monographs is not meant to be exhaustive of all evaluations supported by the Group, but rather to summarize lessons on topics with multiple completed evaluations on a common intervention or outcome.

This monograph is authored by Ana María Cuesta, Oscar A. Mitnik, Lynn Scholl, Cecilia Vidal, and Patricia Yañez-Pagans. Carola Álvarez, Leonardo Corral, Andrés Gómez-Peña, and Sebastián Martínez coordinated the production of the five monographs and provided strategic input and guidance throughout the process. Paloma Acevedo, Jason Hobbs, Fabiana Machado, Kleber Machado, Cristina Mecerreyes, Robin Rajak, María Eugenia Rivas Amiassorho, Tomás Serebrisky and Ben Solis provided valuable comments on earlier drafts and Solis Winters provided outstanding research assistance. The monograph series was edited by David Einhorn. Gaston Cleiman led art direction and graphic design of this publication.

This monograph series would have not been possible without the valuable time and contributions of the many IDB Group colleagues, researchers, counterparts in governments, survey firms, partner organizations, and, above all, participants in the evaluations discussed in this volume.

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# INTRODUCTION

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Inclusive and sustainable development cannot be achieved without resilient infrastructure that fosters economic growth, integration, and well-being.



Inclusive and sustainable development cannot be achieved without resilient infrastructure that fosters economic growth, integration, and well-being. In Latin America and the Caribbean, despite significant progress, basic infrastructure such as roads, electricity, public transport, water and sanitation services, and housing remains far from adequate in many countries, particularly for the most vulnerable and poorest populations. For example, only 23 percent of the roads in the region are paved (IRF 2019); average commuting time in the region's megacities is close to 90 minutes (IDB 2020b); only 3 in 10 people use a safely managed sanitation service (WHO and UNICEF 2020); and almost 5 out of 10 people have a housing deficit (Boullion 2012). A critical problem is that infrastructure and service provision has not kept pace with rapid urbanization. Today, 20 percent of the most vulnerable and low-income people in the region live in peripheral urban areas where infrastructure deficits are more critical and there is limited access to basic services such as transport and water and sanitation (World Bank 2020).

In short, the Latin America and the Caribbean region still faces enormous challenges going forward to reduce inequality and achieve universal access to basic infrastructure services. In addition to closing the remaining gaps to access, there is a critical need to improve the quality and affordability of services (IDB 2020a). Furthermore, during the recovery phase of the COVID-19 crisis, investments in infrastructure could be crucial to incentivize productive investment, create employment, and accelerate economic recovery.

To help the region address these challenges, the IDB Group has supported countries' efforts to build services infrastructure, with an emphasis on investments that are more efficient, sustainable, and resilient to disasters and climate change. This monograph presents evidence of the effectiveness of these interventions from impact evaluations of operations in the transport, water and sanitation, and housing and urban development sectors.<sup>1</sup> Specifically, the aim is to present lessons from evaluations on how to **(1)** promote inclusion and development in

<sup>1</sup> The monograph discusses interventions in these particular sectors because these are the ones for which the IDB Group, among its interventions related to service infrastructure, has generated evidence that could be used to derive policy recommendations.

transport system investments, **(2)** boost trade and economic activity by strengthening transport infrastructure, **(3)** scale up the scope of water and sanitation programs in rural communities, **(4)** encourage connectivity to sanitation services in urban areas, **(5)** improve access to improved urban infrastructure and services in neighborhoods, and **(6)** expand access to adequate housing.

Key lessons on “what works” for transport, water and sanitation, and housing and urban development include the following:

- **Transport systems can promote inclusion and development.** Investments in transport systems can have significant impacts on access to employment opportunities and key services such as education and healthcare. Impact evaluations in the region have shown that expanding transport services such as bus rapid transit (BRT) systems, metro systems, and cable car lines can significantly increase the probability of people working and the number of hours worked. By saving time spent commuting, these investments have enabled beneficiaries to spend more time on other activities such as education and recreation. The evidence indicates that better public transport systems have particularly benefited women, the poor, and indigenous populations, contributing to greater inclusion and reducing inequities.
- **Transport infrastructure can boost trade and economic activity.** Productive transport infrastructure (air, water, and land) fosters dynamic and competitive economies that can generate employment and income. Impact evaluations of operations supported by the IDB Group that improved road infrastructure have demonstrated that domestic and international roads can increase firms’ exports, primarily by reducing transportation costs. Beyond the effect of these operations on trade outcomes, impact evaluations have also explored the effects of investments in transport infrastructure on overall economic performance. Using novel methods and data sources to capture economic activity and approximate measures of GDP per capita, these evaluations identified effects of improved infrastructure on economic growth, in some cases even before projects were fully implemented.

- **Community-based water and sanitation infrastructure can increase access to services in rural areas but might not be enough to improve health and other development outcomes.** The evidence from impact evaluations in the water and sanitation sector has shown that, in rural areas, targeted investments in water and sanitation systems have successfully extended services to small and dispersed communities. In this setting, however, the provision of infrastructure alone has not been enough to achieve improvements in well-being. Evaluations have demonstrated that service infrastructure investments have produced significant improvements in the availability, accessibility, and quality of services, yet generated mixed results in final development outcomes, including health and education. Complementary and impactful interventions to drive behavior change might be needed to harness the benefits of these programs.
- **Greater connectivity to sanitation services is needed in urban areas.** Physical access to services, especially sanitation, remains a critical problem in the region's urban areas. Even where there have been investments to expand access to growing, often low-income, peri-urban populations, countries still face the challenge of increasing the take-up of services. Studies suggest that lack of connectivity is caused by different barriers associated with individual circumstances and institutional factors that go beyond financial constraints. In fact, impact evaluations of interventions that use nonmonetary incentives to encourage residents to connect to sewerage systems have shown this approach to be effective in increasing connectivity.
- **Better neighborhoods bring about better opportunities.** Neighborhood upgrading programs have proven effective in addressing the problem of lack of access to basic neighborhood infrastructure and services. Overall, evaluations of large-scale investments in neighborhood upgrading in the region have shown positive effects on the quality of road infrastructure and access to public services such as potable water, drainage and sewer systems, and public lighting. However, recent studies that have examined the results of these interventions over time highlight the importance



of adequate maintenance to sustain the benefits in the long term. Evaluations have also demonstrated that better neighborhood conditions are not always valued by markets (as measured by property values), which points to the need for further research to understand the dynamics of these programs, including the role of formalizing property rights.

— **Access to adequate housing is critical.** Impact evaluations in this area offer two important lessons. First, more evidence is needed to understand the mechanisms through which economic shocks and subsidies affect qualitative and quantitative housing deficits. Second, home upgrading interventions that incorporate innovative clean-energy and energy-efficient technology need to consider not only environmental conditions, but also socioeconomic factors and human behavior. Impact evaluations suggest that when these elements are not considered, investments may be less effective than expected.

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# What Works in **TRANSPORT FOR INCLUSION AND DEVELOPMENT**

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High-quality, accessible, affordable, and safe transportation systems are essential for inclusion and development as well as to increase the productivity of economies.



**B.**

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High-quality, accessible, affordable, and safe transportation systems are essential for inclusion and development as well as to increase the productivity of economies. Transport infrastructure projects often constitute some of the largest investments in a country, and they can reshape the spatial organization of economic activity, leading to multiple development impacts (Redding and Turner 2015). However, despite significant investments in transport over the past decade (1.2 percent of GDP per year on average, based on data from Infralatam),<sup>2</sup> Latin America and the Caribbean still faces multiple challenges in this sector (IDB 2020a, 2020b). Limited infrastructure and high logistics costs negatively affect access to job opportunities, gender equality, and gains from international trade in the region.

In a context of rapid urban growth, unplanned development patterns have made it difficult to adequately provide transport infrastructure and services to meet the mobility needs of urban residents, particularly those living on the outskirts of cities. As urban poverty tends to be concentrated in these peripheral areas, lower-income citizens experience longer travel times to get to their jobs and other destinations (ITF, forthcoming). Poor local coverage of public transport leads to more time spent walking to bus stops and transit stations and to needing to make more transfers, increasing social and economic exclusion of the poor. People living in poverty often face trade-offs in the allocation of limited disposable income for transport and other essential needs, which can generate significant inequalities in mobility and access to employment, education, and other relevant social and cultural opportunities (Scholl et al. 2016).<sup>3</sup>

Deficiencies in urban transport have a disproportionate effect on women. Since women do more unpaid household work and care-related activities than men and are less likely to have access to a private vehicle, they are more likely to depend on public transport, travel during off-peak hours, and combine trips (Taylor and Mauch 2000; Schintler, Root, and Button 2000). In Latin America and the Caribbean these gender differences in mobility are heterogeneous, but for some cities they can be as large as

<sup>2</sup> Based on a simple average of all the countries represented in the Infralatam database from 2010 to 2019 ([www.infralatam.info](http://www.infralatam.info)).

<sup>3</sup> For a more detailed approach to the relation between poverty and transport, see Scholl et al. 2022.

17 percentage points less motorized trips and 23 percentage points more use of public transport for women compared to men (Rivas, Suárez-Alemán, and Serebrisky 2019a). Because public transit systems are frequently planned to cater to the needs of passengers commuting during peak hours, they are poorly designed to meet women's travel patterns, which tend to imply shorter trips with several stops, and not necessarily always during peak hours. In addition, high rates of crime and sexual harassment on public transit systems disproportionately affect women and reduce their available options for safe transportation (Zermeno et al. 2009). In Latin America and the Caribbean, more than 60 percent of women have suffered some form of physical or verbal sexual violence in public transportation (Setien 2021). Taken together, all of these factors significantly increase women's vulnerability to the deficiencies of a transport system and reduce their opportunities to participate in paid labor market activities and access educational opportunities.

High levels of public transport informality, an oversupply of freewheeling minivans, rapid motorization, and a lack of integrated and service-oriented transport policies (Rivas, Suárez-Alemán and Serebrisky 2019b) have also contributed to higher rates of congestion, pollution, accidents, and long travel times in urban areas in Latin America and the Caribbean. Recent data indicate that 4 of the 10 most congested cities in the world are in the region: Bogota, Mexico City, São Paulo, and Rio de Janeiro (INRIX 2019).

Inter-urban transport infrastructure in Latin America and the Caribbean is also very limited. In many countries, the road network has low coverage, quality, capacity, and connectivity. This is due to the lack of tools for sectoral planning, low investment levels with little private sector participation, limited integral management of infrastructure, and vulnerability to natural disasters and climate change, among other issues (IDB 2020a). Only 23 percent of the roads in the region are paved, compared to between 60 and 80 percent in the rest of the world's regions, with the exception of sub-Saharan Africa, where only 14.5 percent are paved (IRF 2019). Rural areas, which have the highest levels of poverty, are the most affected by limited connectivity, which further exacerbates inequality.

Finally, freight logistics costs in Latin America and the Caribbean account for between 16 and 26 percent of regional GDP, compared to

9 percent in member countries of the Organisation for Economic Co-operation and Development (CAF 2016). More than 70 percent of goods in the region are transported via roads, exposing the vulnerability of supply chains. Considering that the private sector has a predominant role in the transportation of services for goods and for the operation of ports and airports (IDB 2020b), it is important to continue working on creating adequate environments to increase private sector participation in financing and operating transport systems and infrastructure.

## EVIDENCE FROM IMPACT EVALUATIONS SUPPORTED BY THE IDB GROUP

In recent years, several countries in Latin America and the Caribbean have invested in large transport projects with support from the IDB Group. These projects contribute directly to the attainment of eight United Nations Sustainable Development Goal (SDG) targets and indirectly to another nine (IDB 2020a).<sup>4</sup> Understanding the most effective aspects of these projects is a crucial step towards more inclusion and better

**4\_** The IDB Transport Division Sector Framework identifies transport sector work as contributing directly to the following SDG targets: 3.3 - Halve the number of global deaths and injuries from road traffic accidents; 3.9 - Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination; 7.3 - Double the global rate of improvement in energy efficiency; 9.1 - Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure; 11.2 - Provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons; 12.c - Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances 13.1 - Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries; and 13.2 - Integrate climate change measures into national policies, strategies and planning. In addition, the framework identifies indirect contributions to targets 1.1, 1.2, 2.3, 5.2, 5.4, 5.c, 6.1, 11.6, and 12.3. For details on all the SDGs and their targets see <https://www.un.org/sustainabledevelopment/>.

economic opportunities in the region. Several IDB studies show that such investments have been effective in increasing mobility, promoting access to employment, and freeing up time for recreational and educational opportunities. Three of the lessons learned from evaluations of transport projects to date are outlined below:

- (1) Investments in public transport systems can have a significant impact on access to opportunities and time-use decisions, particularly for low-income populations and for women.
- (2) Transport infrastructure can play an important role in boosting trade and economic activity.
- (3) New and emerging technologies are improving our understanding of transport investments and services.

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### Investments in Public Transport Systems Can Have a Significant Impact on Access to Opportunities and Time-use Decisions, Particularly for Low-income Populations and Women

The role of urban transport in facilitating access to employment and other opportunities has been a key area of IDB research. Reduced travel times for people who live near public transit systems can increase access to a wider array of job opportunities, potentially leading to higher rates of employment, access to higher-quality jobs, and increased labor hours and earnings. They can also lead to other reallocations of time that can improve people's welfare. Given the challenges faced by women, investments in mass transit can also have disproportionate benefits for them. Two IDB evaluations assessed the effects of a BRT system ([IDB Project #PE0187](#)) and metro line on job market outcomes in Lima, Peru (Scholl et al. 2018; Martinez et al. 2020). Both studies used a difference-in-differences strategy (after selection of comparable areas by matching at the aggregate-block level) that compared individuals close to the new

systems with individuals further from them. Scholl et al. (2018) found significant benefits in terms of increased employment and hours worked, but no differential impacts for individuals living primarily in low-income areas. The complementary evaluation by Martinez et al. (2020) found increased use of urban transport systems by women as well as gains in their employment and hourly earnings, which are probably related to better access to faster and safer transportation. The evaluation also found that employment and hourly earnings did not change for men.

Two evaluations looked at the impact of a cable car mass-transit system in La Paz and El Alto in Bolivia called *Mi Teleférico*, ([IDB Project #BO-T1262](#)). Suárez-Alemán and Serebrinsky (2017) used an origin and destination survey to match trips with closely similar origins and destinations but that use different transport modes. They conclude that *Mi Teleférico* led to an average reduction of 22 percent in the travel time per trip. Martinez, Sánchez, and Yañez-Pagans (2018) used an instrumental variable methodology based on distance from residences to the nearest station and exploited a purpose-specific household survey that includes rich information about employment, income, and use of time of potential beneficiary populations of the project. The authors also found that cable car users enjoyed significantly reduced commute times per day, reporting spending 75 percent less minutes in transport per day than the average commute in the metropolitan area. In addition, the evaluation found that the cable car system increased access for the indigenous and poor population in El Alto to economic activities in neighboring La Paz. Those who used the system reallocated these time savings toward educational and recreational activities, and also increased self-employment activities.

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## Transport Infrastructure Can Play an Important Role in Boosting Trade and Economic Activity

Well-maintained roads can increase and sustain access to basic services such as health and education and improve access to markets and employment centers (van de Walle and Cratty 2002; Gertler et al. 2014;

Gonzalez-Navarro and Quintana-Domeque 2016; Behar and Venables 2010). The types of maintenance contracts could be key to keeping roads in good condition. According to an IDB study by Pérez and Pereyra (2020), performance-based road rehabilitation and maintenance contracts are positively associated with better road conditions.

Two IDB Group impact evaluations, one in Chile (Volpe and Blyde 2013) and another in Peru (Volpe, Carballo, and Cusolito 2017), confirm that domestic road infrastructure plays a key role in facilitating exports by firms. The Chilean evaluation used a difference-in-differences strategy to show that diminished transport infrastructure and increased transport costs due to the 2010 earthquake had a significant negative impact on exports by firms located in the most affected areas. A difference-in-differences strategy was also used for the evaluation in Peru, where 5,000 kilometers of new roads built between 2003 and 2010 amounted to a more than 10 percent net expansion in the country's main road network (MTC 2012). The evaluation found that the road expansion had positive effects on firms' exports and employment.

Another evaluation of the impact of international transportation costs (Volpe et al. 2014) used a natural experiment provided by the temporary closure of a main bridge connecting Argentina and Uruguay. It found that exports by firms declined 6.5 percent when transport costs increased by 1 percent.

Transport infrastructure can have an important role in promoting overall economic activity. An evaluation by the IDB Group measured the impact on economic activity of road rehabilitation programs in Haiti ([IDB Project #HA-0087](#), [#HA-L1019](#), [#HA-L1046](#), and [#HA-L1054](#), along with other projects funded by the European Union and the World Bank). Given the limited amount of data in the country, Mitnik, Sanchez, and Yañez-Pagans (2018) used nightlight satellite imagery to approximate changes in economic activity, drawing on the correlation between nightlight satellite data and GDP growth established by Henderson, Storeygard, and Weil (2012). The evaluation used a difference-in-differences strategy that considered the effects of all road rehabilitation programs in Haiti between 2004 and 2013 and exploited both the timing and location of these projects. The study found that road rehabilitation projects led



to an increase in luminosity values, which can be associated with GDP growth. Other ongoing IDB Group evaluations, including one in Paraguay ([IDB Project #PR-L1084](#)) by Cuesta et al. (2019), are using household surveys to better understand the effects of rural road programs.

Other IDB Group evaluations have been able to directly measure GDP impacts using synthetic control strategies. An evaluation by Lanzalet et al. (2018) quantified the impact of the expansion of the Panama Canal ([IDB Project #PN-L1032](#)). The study highlights the anticipation effects that large infrastructure investments can have by affecting investors' expectations and potentially changing a country's growth path. The canal expansion announcement, for example, caused a substantial increase in private investment and overall GDP in Panama, even prior to completion of the project.

Finally, an IDB-supported impact evaluation in the Dominican Republic that examined the impact of aviation reforms in 2006 ([IDB Project #RG-T2577](#)) found an increase in GDP per capita and a rise in the number of U.S. tourists and tourism spending (ICAO and IDB 2019).

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## New and Emerging Technologies Are Improving Our Understanding of Transport Investments and Services

One constraint to studying the different impacts of transportation-related projects has been the unavailability of data with appropriate geospatial coverage and enough periodicity. New technologies that facilitate automatic data generation and reduce the need to collect primary data have opened up opportunities to evaluate projects in situations where it otherwise would have been very difficult and costly. These new data types have also made it possible to design evaluations ex-post (Yañez-Pagans et al. 2019). For example, satellite data provide opportunities to proxy for economic activity, as seen in the evaluation of road rehabilitation programs in Haiti discussed above (Mitnik, Sanchez, and Yañez-Pagans 2018). The use of cellphone-generated data has also



**Well-maintained roads can increase and sustain access to basic services such as health and education and improve access to markets and employment centers.**

expanded the types of evaluations that can be conducted. The IDB Group has exploited data generated by the community-based driving app Waze—whose data are aggregated but have fine-grained geographic detail (i.e., street segments) and high periodicity—to evaluate the impact of several interventions and policies using a combination of difference-in-differences and matching strategies.

Martínez et al. (2021) used Waze data to evaluate the impact on traffic congestion of adaptive traffic lights (i.e., lights that change their cycle based on traffic conditions, as measured in real time) in the city of Medellín, Colombia. They found that the intervention increased speed and decreased the probability of severe traffic jams during afternoon peak-hour traffic. Salgado and Mitnik (2021) used similar data to evaluate the impact of traffic restrictions imposed in Lima, Peru in 2019 under the *Pico y Placa* policy.<sup>5</sup> They found small aggregate improvements in the speed of traffic flow in the areas of intervention, and larger increases in speed on high-capacity roads in the direct area of influence of the policy. They also found small increases in speed outside the direct area of influence, but only during the first month after implementation of the policy.

Big data provided by video analytics and machine learning have also been useful for measuring the effects of transport interventions.<sup>6</sup> Scholl et al. (2019) used an automated video analytics tool to evaluate the effectiveness of temporary low-cost traffic calming measures, such as curb bulb-outs and pedestrian crosswalks, at risky intersections in Cochabamba, Bolivia. They found that these measures can be effective in reducing the risk of traffic collision, injury, and fatality at four-way intersections.

In the presence of an unexpected shock such as the coronavirus pandemic, big data can facilitate a quick understanding of the immediate

<sup>5</sup> In July 2019, the Metropolitan Municipality of Lima enacted the *Pico y Placa* policy to prevent traffic congestion during the Pan-American games and continued it afterward until March 2020. The policy restricted the use of certain highly traveled traffic routes during certain hours of the day on four days a week (Monday to Thursday). Vehicles were restricted depending on the last digit of their license plate. Vehicles with an odd last digit were restricted from circulation on Mondays and Wednesdays, while vehicles with an even last digit were restricted on Tuesday and Thursdays.

<sup>6</sup> “Big data” is a term used to describe extremely large data sets usually generated with a high level of detail and through the normal operation of businesses or applications.

effects and trends resulting from the crisis. The IDB Group created the [Coronavirus Impact Dashboard](#),<sup>7</sup> which leverages the availability of Waze data, to analyze in real time the impact of social distancing measures on traffic congestion in 20 countries and over 60 metropolitan areas in Latin America and the Caribbean. The data show that there were large initial drops in traffic congestion, with a recovery of traffic levels to pre-pandemic congestion levels by the end of 2020 in many (but not all) countries. Also, a combination of cellphone-based data from the app Moovit,<sup>8</sup> which measures public transit routing requests, and administrative data on ridership from several cities shows similar patterns regarding public transit use during the COVID-19 crisis. Even though analysis of these data does not constitute a traditional impact evaluation of a project, it is a real-time evaluation of the impact of an exogenous shock and associated policies. For example, statistical analysis by Carabetta et al. (2020) on traffic congestion and public transport using the Coronavirus Impact Dashboard data suggests that disadvantaged individuals increased mobility faster after the initial lockdown measures imposed due to the crisis, probably associated with an inability to work from home. Calatayud et al. (2021) exploited Waze data to measure the economic cost of traffic congestion in 10 Latin American and Caribbean cities. They found that in the cities analyzed, congestion costs were between 0.5 and 1.1 percent of each city's GDP, which are large numbers compared to what each city spends on social services such as education and health. The availability of such real-time data has clearly shifted the frontiers of what is possible to measure and how often such measurements can be made. However, caution is warranted in using these data. Researchers need to be aware of the potential biases in data generation and should try to benchmark the data against other sources to better control for biases.

Finally, there is the need to evaluate the impact of new transport technologies such as the services offered by ridesharing companies.<sup>9</sup> Granada, Pérez-Jaramillo, and Uribe-Castro (2018) used administrative

**7\_** The dashboard can be accessed at <https://www.iadb.org/coronavirus-impact-dashboard>.

**8\_** See the Moovit website at <https://moovit.com>.

**9\_** Several recent studies have looked at the impact of transportation network companies such as Uber on the cities where they operate (Li, Hong, and Zhang 2017; Erhardt et al. 2019). See also Oviedo, Granada, and Perez-Jaramillo (2020) for a modal-shift analysis of the impact of transportation network companies in Bogota.

data and a difference-in-differences methodology to study the impact of the arrival of Uber in different Colombian cities on passenger vehicle fleet reallocation. They found that the entry of Uber increased the registration of small-size cars and reduced the registration of new taxis. Scholl et al. (2021) also explored the impact of the arrival of Uber in Colombia, and through a difference-in-difference analysis found that large observed drops in public transit ridership are not associated with Uber entry, but were consistent with public transport reforms implemented between 2007 and 2015.<sup>10</sup>

## IDEAS FOR FUTURE WORK

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The transport sector in Latin America and the Caribbean faces multiple challenges in terms of the quality, inclusion, and sustainability of urban and interurban mobility. These challenges include improving logistics infrastructure and services and taking better advantage of opportunities offered by new technologies (IDB 2020a). The region will need to make smart investments and regulatory decisions to improve the provision of transport services and access to them (IDB 2020a, 2020b).

Producing knowledge and evaluations on the effectiveness of the different emerging initiatives will be key to making informed decisions. Moving forward, a critical step will be to improve knowledge regarding the impact of new technologies (e.g., electric and autonomous vehicles and old-vehicle scrapping programs associated with fleet renewal), forms of service provision (e.g., the role of transportation network companies

**10\_** Understanding the characteristics of ridesharing users is also very important. Two IDB studies shed light on this. Bedoya-Maya et al. (2021) showed that in Medellín, women and wealthy and highly educated families with low vehicle availability are more likely to use ridesharing companies. They also found evidence of both complementary and substitution patterns with public transit. Sabogal-Cardonal et al. (2021) studied the primary forces behind the adoption of ride-hailing in Mexico City and found that age, education, and income have positive effects on it, and that women in households with higher numbers of elderly members depend more on this type of transport.



in modal decisions and ride sharing), and forms of payment (e.g., digital payments). It is also important to explicitly study how transport infrastructure and associated transportation services impact women and people with disabilities, particularly among low-income and vulnerable populations, and how services may affect the environment (e.g., how they increase or decrease pollution, or spur deforestation). The impact of the COVID-19 crisis on transport use has been enormous, as discussed above, and a key question that remains unanswered is what the permanent impact will be on modal use and motorization rates.

New technologies are resulting in changes and opportunities for the transport sector. Advances such as shared-mobility platforms, intelligent transportation systems, electro-mobility, and automation are transforming urban mobility and introducing a wider array of transport options. This technological progress is also opening doors to conduct more impact evaluations of the sector by enabling rapid and, in many cases, real-time data generation and collection in order to shed light on mobility patterns and travel behavior in ways never before possible.

However, there is still a considerable lag in knowledge in Latin America and the Caribbean about these new technologies and their implementation because of the public sector's limited institutional capacity and resources. In addition, limited access to data makes it difficult to conduct robust planning, supervision, and evaluation of transport projects (IDB 2020a). Therefore, increasing efforts to integrate technology solutions into the region's transport sector and leverage data collected through technological innovations will be important in the near future. Along these lines, the IDB and the Development Bank of Latin America (*Corporación Andina de Fomento* - CAF), through their Urban Mobility Observatory (*Observatorio de Movilidad Urbana* - OMU), are already gathering data for 29 cities in the region, including data generated by cellphone applications and digital surveys as well as geo-referenced data, to better understand mobility patterns, transport mode use, the quality of public transport service, and accessibility to services.

Finally, although technological innovation plays a key role in facilitating data collection and measurement of the impact of transport policies and interventions, by itself it is not enough. Studying the effects of IDB-

supported transport projects requires a concerted effort to incorporate impact evaluations in project design and to think ahead about how to answer the key questions that developments in the sector will pose in the future. In addition, impact evaluations should be conducted to understand policy and regulatory changes (i.e., changes in regulatory regimes for service provision, trucking regulation and deregulation, air transport deregulation, etc.).

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What Works  
to Improve  
Lives?

# What Works to **ENSURE WATER AND SANITATION SERVICES FOR ALL**

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More than ten years have passed since the United Nations declared clean water and sanitation a human right. Yet, as of 2017, more than 160 million people in Latin America and the Caribbean still lacked access to safe, accessible, and reliable water services.





More than ten years have passed since the United Nations declared clean water and sanitation a human right. Yet, as of 2017, more than 160 million people in Latin America and the Caribbean still lacked access to safe, accessible, and reliable water services (WHO and UNICEF 2020).<sup>11</sup> Access to water and sanitation services is essential to live a dignified and healthy life. The positive health effects of a clean water supply and adequate sanitation have been widely established in the literature. For example, studies in Latin America and the Caribbean find that access to piped water and adequate sanitation reduces child mortality (Galiani, Gertler, and Schargrotsky 2005; Gamper-Rabindran, Khan and Timmins 2008; Newman 2002; Rocha and Soares 2015; Schady 2015). Other studies and systematic reviews also indicate that interventions that improve water quality and sanitation can reduce the prevalence and duration of diarrheal diseases, particularly among children (Bancalari and Martinez 2017; Clasen et al. 2007; Duflo et al. 2015; Fewtrell et al. 2005; Jalan and Ravallion 2003; Kolahi, Rastegarpour, and Sohrabi 2009). Moreover, water has a crucial role to play for the achievement of the relevant SDGs in the region, and its cross-cutting importance has been acknowledged for improving education, reducing poverty and inequality, fostering economic growth, and facilitating peace, justice, and environmental sustainability (WWAP 2015).

Recognizing that the main barrier to access to an adequate water supply and sanitation is still the limited availability of services, countries in the region have made large-scale investments to increase physical access to these systems in both rural and urban areas. The need for services has been most urgent in rural communities, where, in 2017, 58 percent and 30 percent of the population lacked access to safely managed drinking water and basic sanitation services, respectively (WHO and UNICEF 2020). In urban settings, providing universal access to fast-growing peri-urban areas is also an ongoing challenge.

Expanding physical access to infrastructure has proven to be only part of the solution, particularly for sanitation. Despite a rise in the availability of piped sewerage systems, take-up of services remains less than optimal,

<sup>11</sup> Safely managed services refer to water sources that are accessible on premises, available when needed, and free from contamination.

producing operational inefficiencies and preventing many of the health and social benefits from such systems. Data from sewerage projects in the region show that even 48 months after completion of the interventions, the proportion of households connected can be as low as 33 percent, with connection rates diminishing over time and varying greatly across and within countries (Sturzenegger, Vidal and Martinez 2020).

## EVIDENCE FROM IMPACT EVALUATIONS SUPPORTED BY THE IDB GROUP

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Ensuring universal and sustainable access to high-quality water and adequate sanitation is essential in Latin America and the Caribbean. To support efforts in the region, IDB Group investments have focused on expanding access to quality services for low-income and vulnerable populations and promoting comprehensive and sustainable solutions. Also, to fill critical knowledge gaps in terms of water and sanitation, the IDB Group's impact evaluation agenda has aimed to provide answers to two main questions. First, how can access to affordable and sustainable water and sanitation services be expanded in rural and dispersed communities? Second, how can the use of existing services in urban areas be promoted to improve the efficiency of sanitation infrastructure?

While the evidence base continues to grow, two main lessons have emerged to date:

- (1) Community-based water and sanitation infrastructure can increase access to services in rural areas but might not be enough to improve health and other development outcomes.
  - (2) Well-designed incentives and awareness campaigns may be effective tools to promote sewer system connectivity.
-

## Community-based Water and Sanitation Infrastructure Can Increase Access to Services in Rural Areas But Might Not Be Enough to Improve Health and Other Development Outcomes

Over the last decade, the IDB Group has financed investments totaling US\$1,770.9 million to support projects that helped bring water and sanitation services to people living in rural communities in 15 countries in Latin America and the Caribbean. While the region continues to make progress towards universal access, the IDB Group's evaluation work has focused on assessing the effectiveness of scaling up water and sanitation interventions and evaluating their effects under real implementation conditions.

Lessons from impact evaluations in Bolivia and Guatemala demonstrated that these investments have successfully increased access to services. In Bolivia, the Water and Sanitation Program for Small Localities and Rural Communities (*Programa de Agua Potable y Saneamiento para Pequeñas Localidades y Comunidades Rurales*) ([IDB Project #BO-L1065](#)) provided piped water infrastructure and ecological (dry) latrines to families in 188 communities with populations of 500 or less in 24 of the country's poorest rural municipalities. In addition, the program promoted the creation and strengthening of local water committees to improve infrastructure maintenance and service sustainability. The program's impact evaluation randomly assigned eligible communities to treatment and control groups using public lotteries. One year after the program's completion, data showed that the intervention had a large and positive effect on the availability, use, accessibility, and quality of services in treated communities. Specifically, it increased the proportion of households using an improved water source and sanitation facility, reduced time for water collection, and improved water quality, as measured through the presence of E.coli (Celhay et al., 2021). Similar results were found in the evaluation of investment projects financed by the Social Investment Fund in Guatemala. In that evaluation, the authors used census data and matching techniques to compare rural villages with and without investments from the fund. Local investments in water and sanitation projects were found to have significantly improved access to water services (Ibarrarán, Sarzosa, and Soares 2008).





**Community-based water and sanitation infrastructure can increase access to services in rural areas but might not be enough to improve health and other development outcomes.**

Learning about the effectiveness of these interventions to expand access is a critical first step, but understanding their impact on final development outcomes such as health and other welfare measures is equally important. Growing evidence from IDB Group evaluations suggests that expanding access is not always enough to drive behavior change and achieve improvements in health or other socioeconomic outcomes. The evaluation of the program in Bolivia showed that, although it was very effective in improving service coverage and quality, it had mixed effects on the prevalence of diarrhea. When disaggregating by age and sex, the study found detectable effects on self-reported diarrhea among children 6 to 17 years of age and among men 18 to 49, but no effects among children under 5. This suggests that health benefits should not be assumed, especially when precarious initial conditions exist. To reinforce this idea, another impact evaluation of a potable water and sewerage expansion project in Quito, Ecuador ([IDB Project #EC-0025](#)) found that while the provision of services caused an average decline in child mortality, there was no improvement among the poorest population unless the woman in the household had at least a primary education (Galdo and Briceño 2005). Such findings reveal that input complementarities might be important to fully realize health benefits. Factors including water quality, continuity, and storage practices are also relevant to understand health gains from improved access.

Similarly, mixed impacts were reported by another evaluation that examined the effect of a program that provided access to water in 299 schools and sanitation services in 80 schools in small rural communities in Uruguay ([IDB Project #UR-X1007](#)) between 2009 and 2016. Positive effects on educational outcomes (e.g., pupil absence, academic performance, etc.) would be expected if better water and sanitation reduced episodes of illness among students. However, using school-level data and fixed-effects models, the study found no effect of the program on school enrollment or attendance, although there were detectable effects on repetition rates and on the number of teachers per school, particularly in smaller schools (Gerardino, Bando, and Zegarra 2017).

Evaluations of rural programs have also showed that promoting the adoption of good hygiene practices demands action beyond increasing access to services. In the case of the rural water and sanitation program

in Bolivia, increasing the availability of piped water and handwashing stations had no effect on handwashing (Celhay et al., 2021). Having a place with soap and clean water to wash hands was not sufficient to change the population's perception about the importance of hand hygiene or of washing the hands. These results suggest that water and sanitation infrastructure projects might need to strengthen effective evidence-based social strategies geared towards modifying behavior. The massive COVID-19 public information campaigns urging washing the hands might have spurred this change in behavior.

Future research in the sector will help uncover what key factors and strategies are useful to increase the likelihood that water, sanitation, and hygiene interventions will have an impact on final development goals.

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## Well-designed Incentives and Awareness Campaigns May Be Effective Tools to Promote Sewer System Connectivity

Countries in the region are facing the vast challenge of expanding sewerage services to the rapidly growing number of people living in peri-urban areas. The need for increased access to sewer systems for urban populations has demanded an enormous amount of resources in recent years. However, some of these efforts have proven inefficient, as some households have failed to make the final investments to connect. How to efficiently achieve sewerage connectivity to address the “last mile” problem of physical access remains a persistent and relevant question, but few studies provide insight on effective strategies. Drawing on recent IDB Group impact evaluations and analytical studies, this section highlights some of the key lessons learned surrounding this question.

Financial constraints are important but not the sole factor influencing a household's decision to connect to a sewer system. Other barriers that prevent households from connecting include incomplete information on



benefits, behavioral obstacles, and institutional barriers, among others.<sup>12</sup> To explore the relative importance of liquidity constraints, a pilot study in four small cities in Bolivia tested alternative economic incentives to promote connectivity to new sewer systems by allowing beneficiaries to choose between a subsidized credit scheme and a one-time subsidized cash payment option to finance the connection (Martinez et al., forthcoming).<sup>13</sup> Almost half of households (45 percent) opted to take the credit option and 15 percent decided to pay cash. The remainder decided to not take either offer and to connect on their own (12 percent), or to not connect at all (27 percent). These results suggest that liquidity constraints are an important barrier, but credit and subsidies alone are unlikely to lead to universal connection.

Two analytical studies carried out in Bolivia and Uruguay provide additional insight into what factors influence a household's decision to connect. Using prediction models and household survey data, the study in Bolivia found that households with fewer children, with household heads with formal employment, and with women participating more actively in household decisions had a higher propensity to connect (Bancalari, Gertner, and Martinez 2016). In the study in Uruguay, which employed similar methods, household income, age of the household head, owning a house (as opposed to renting), neighborhood participation, and having a female household head were among the key factors positively associated with higher connectivity (Yarygina et al. 2020).

Given that the evidence suggests that factors other than liquidity constraints are associated with low take-up of sewerage services, a program to expand access to sewer systems in peri-urban areas in Bolivia ([IDB Project #BO-L1034 / #BO-X1004](#)) conducted a randomized evaluation to test the effects of nonmonetary incentives to promote connectivity in the city of El Alto. The program used an innovative approach to change perceptions, educate people about the benefits of sanitation, and promote connectivity through a combination of standard capacity-building activities and entertainment education or

<sup>12</sup> For a review of barriers to connecting to sewerage systems see Sturzenegger, Vidal and Martinez (2020).

<sup>13</sup> For the credit option, the subsidy was equivalent to approximately 40 percent of the connection cost, and for the cash option it was close to 60 percent of the cost.

“edutainment,” including street and school music and theater, games, and fairs. The impact evaluation randomly assigned edutainment activities to treatment and control neighborhoods. After 14 months, households in treatment neighborhoods were 14 percentage points (34 percent) more likely to connect to the sewer system than in control neighborhoods, suggesting that the “edutainment” component was an effective tool to promote sewerage connectivity (Vidal, Martinez, and Mecerreyes, forthcoming). This finding contributes to the growing evidence showing that interventions that deliver educational content through entertainment can be effective in changing behavior and social norms (Banerjee, La Ferrara, and Orozco-Olvera 2019; La Ferrara, Chong, and Duryea 2012).

## IDEAS FOR FUTURE WORK

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Evidence produced by the IDB Group in the last decade demonstrates that well-designed community-based water and sanitation projects have contributed to a significant increase in access to these services. Despite this progress, evaluations in rural areas show that other inputs such as the adoption of healthy practices relating to water, sanitation, and hygiene are critical to fully realize the benefits of investments. In this area, the IDB and partners such as the Spanish Water and Sanitation Cooperation Fund will continue to explore opportunities to rigorously measure the effectiveness of interventions and operational models that seek to maximize the effectiveness and efficiency of services. Some of the main questions on the evaluation agenda include what the most impactful interventions are to promote behavior change and ensure the sustainability of rural water and sanitation systems.

The rapid expansion of peri-urban areas in cities has posed enormous challenges to scaling up services, particularly sewer systems. Even where large investments have been made to extend access, low service take-up, especially in low-income areas, has affected the efficiency and sustainability of these investments. In response, some countries have



designed connectivity plans as integral components of social strategies and infrastructure projects in urban contexts. In some countries, the IDB Group has directly contributed to incorporating these plans into the water and sanitation sector's regulatory framework. Another area of interest is the evaluation of interventions to foster efficiency in service provision, including new technologies to increase the technical efficiency of water systems.

The lessons emerging from recent studies and evaluations suggest that financial constraints are not the only relevant factor explaining low service connectivity. The IDB Group evaluation agenda will continue to focus on expanding the knowledge base in this area through ongoing evaluations that provide additional insights on what types of incentives or mechanisms work best to promote connectivity.

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What Works  
to Improve  
Lives?

What Works to  
**EXPAND ACCESS  
TO BASIC  
SERVICES, URBAN  
INFRASTRUCTURE,  
AND ADEQUATE  
HOUSING**

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There should be no place like home, but for millions of citizens of Latin America and the Caribbean the conditions of their neighborhoods and dwellings may make it difficult to feel that way.



**D.**

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There should be no place like home, but for millions of citizens of Latin America and the Caribbean the conditions of their neighborhoods and dwellings may make it difficult to feel that way. Cities can provide a wide range of benefits –such as better economic opportunities, and access to transportation, health, education, and other services– and an adequate urban environment can facilitate interactions that drive innovation and creativity. However, a significant proportion of the urban population in Latin America and the Caribbean does not enjoy these benefits. More than 80 percent of people in the region live in cities (Libertun de Duren, Gallego Lizon, and Osorio 2019), and among those, 20 percent live in informal neighborhoods where there is limited access to the most basic of services such as clean water, sanitation, and waste collection (World Bank 2020). These neighborhoods also have limited transport infrastructure and services, so residents are usually the most affected by mobility problems (Cervero 2013). As presented in Section B in the case of Lima, urban transport can play an important role in facilitating access to employment (Martínez et al. 2020; Scholl et al. 2018)

A significant proportion of the population of Latin America and the Caribbean is poorly housed. Boullion (2012) estimates that 45 percent of the population has a housing deficit. Moreover, three-quarters of these households have what are known as qualitative deficits, including a lack of access to infrastructure (electricity, sanitation, or piped water), poor materials (inadequate roof and walls, a dirt floor), lack of secure tenure, and overcrowding (Rojas and Medellín 2011). The remaining quarter have what are known as quantitative deficits, which include improvised dwellings or cohabitation.

Though much clearly remains to be done, it should be noted that countries throughout the region have undertaken large-scale investments to upgrade underserved and informal neighborhoods and enhance housing conditions. As discussed below, comprehensive neighborhood upgrading programs have improved access to quality infrastructure and urban services. Housing interventions have promoted universal access to quality housing, aiming to reduce the global housing deficit, which is split between quantitative and qualitative deficits. These focus areas are aligned with [United Nations Sustainable Development Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.](#)

## EVIDENCE FROM IMPACT EVALUATIONS SUPPORTED BY THE IDB GROUP

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In recent years, the IDB Group has contributed to the body of evidence on how to ensure access to basic services and adequate housing in Latin America and the Caribbean based on the Group's longstanding work in the region. IDB Group operations have focused on four fronts: (1) urban governance, (2) urban infrastructure and public services, (3) housing, and (4) urban habitats. Solutions are jointly designed with local communities to include holistic territorial concepts for urban-rural linkages, promoting land-based municipal financing instruments, increasing private sector participation in infrastructure provision, strengthening local economies, and promoting metropolitan governance across sectors and jurisdictions (Libertun de Duren, Gallego Lizon, and Osorio 2019.)

The evidence from the impact evaluation research agenda on housing covers a range of interventions. However, this section covers the areas with the most evidence to date from operations supported by the IDB Group, including upgrading programs to address the needs of neighborhoods as a whole, and adequate housing interventions to improve the supply of housing or undertake specific housing improvements.

Four lessons have emerged from the impact evaluation agenda in this sector:

- (1)** Investments in neighborhood upgrades can substantially improve the quality of infrastructure and access to services, but long-term sustainability is a challenge.
- (2)** Investments in urban infrastructure and access to basic services result in better neighborhoods, but further research is needed to understand the effect of formalizing property rights on housing markets.

- (3) More evidence is needed to understand the mechanisms through which economic shocks and subsidies affect qualitative and quantitative housing deficits.
- (4) Innovative clean-energy and energy-efficiency interventions need to consider specific implementation conditions, including socioeconomic factors and human behavior.

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## Neighborhood Upgrading Programs

Neighborhood upgrading programs are an important tool for social and urban integration and for poverty reduction because they take a comprehensive approach to implementing solutions to the problem of fast-growing informal and underserved urban settlements. Neighborhood upgrading programs improve urban infrastructure such as roads, sidewalks, and community centers; increase access to basic services such as water, sanitation, and electricity; and provide access to formal property rights. To assess the effectiveness of these interventions, impact evaluations of IDB-supported operations have explored their impact on access to and the quality of services, as well as on final welfare outcomes.

*Investments in neighborhood upgrades can substantially improve the quality of infrastructure and access to services, but long-term sustainability is a challenge.*

The impact evaluation of the *Hábitat Program* in Mexico ([IDB Project #ME-L1019](#)) provides large-scale experimental evidence of the effectiveness of multisectoral investments in improving the quality of neighborhood infrastructure and access to it. Between 2009 and 2011, the program provided federal subsidies for local infrastructure such as water and sewerage systems, electricity, street lighting, sidewalks, paved roads, community centers, parks, and sports facilities. Infrastructure spending was allocated at random across low-income urban neighborhoods in 60 Mexican municipalities. Comparing beneficiary and nonbeneficiary areas,

the evaluation showed that the program resulted in large improvements in neighborhood attributes that had low baseline values, including paving and walkability, but had no detectable effects on the availability of utility infrastructure that was nearly universal at baseline, such as piped water and electricity (McIntosh et al. 2018).

An impact evaluation of the second stage of the *Favela-Bairro* (FB II) program in Rio de Janeiro, Brazil ([IDB Project #BR-0250](#)) also identified positive impacts on neighborhood infrastructure and access to services. The program upgraded basic infrastructure and provided public services to 62 favelas and 16 informal settlements (*bairros*). Using instrumental variables and matching techniques to estimate a counterfactual scenario, the impact evaluation found that, nine months to four years after the program,<sup>14</sup> households located in beneficiary neighborhoods were more likely to receive mail and to have access to water, sewerage, and public lighting services (Atuesta and Soares 2018). These findings were consistent with those reported in the evaluation of the first stage of the program, which showed improvements in access to basic services, particularly for the poorest income groups (Soares and Soares 2005).

The evidence generated by these evaluations shows promising results in terms of the quality of neighborhood services and access to them. But are the estimated benefits sustainable over time? A recent study by the IDB Group revisited the neighborhoods improved by FB II to learn more about long-run challenges. The study included a formal inspection of the state of the infrastructure and surveyed beneficiaries' perceptions using qualitative methods.<sup>15</sup> As controls, the analyses were also performed in nonbeneficiary neighborhoods. Ten years after the program, beneficiaries reported issues with the condition of street pavement, sewer and drainage systems, and street lighting, in addition to other problems related to rapid population growth in these neighborhoods. The study points to the importance of optimal design of interventions for sustainability, adequate

**14\_** The interventions took place at different points in time for the different communities, so when the endline survey was implemented, more or less time had lapsed since the program was implemented in different communities.

**15\_** As stated in Libertun de Duren and Osorio (2020a, 26), "A team of technical experts was sent to visually check and grade the state of maintenance according to an established methodology known as Participatory Rapid Mapping (MRP)."





**A significant proportion of the population of Latin America and the Caribbean is poorly housed.**



maintenance budgeting, the education of residents, and the permanent involvement of relevant stakeholders to improve long-term sustainability (Libertun de Duren and Osorio 2020a).

*Investments in urban infrastructure and access to basic services result in better neighborhoods, but further research is needed to understand the effect of formalizing property rights on housing markets.*

Investments in urban infrastructure, access to services, and formalization of property rights can lead to better neighborhoods. Changes in the quality of neighborhoods can be approximated through changes in the property value of the houses located in the neighborhood, or through changes in the quality of life of the neighborhood residents.

The price of a housing unit reflects a bundle of inherent attributes, including structural, locational,<sup>16</sup> and neighborhood attributes. Property values have been widely used as an outcome of interest when studying the effectiveness of neighborhood upgrading programs.<sup>17</sup> They provide information for understanding how private benefits (for households) are generated by a bundle of housing characteristics (e.g., dwelling materials), access to services (e.g., electricity, water, sanitation), and neighborhood infrastructure (e.g., paved roads, public spaces).

Neighborhood upgrading programs might be expected to increase property values because they improve public amenities and because owners might be more inclined to undertake private investments to upgrade their homes. However, detecting an increase in property values requires well-functioning and liquid property markets that price those improvements by increasing prices. A quasi-experimental impact evaluation examined the effect of upgrading municipal infrastructure on property values in the city of Campo Grande, Brazil ([IDB Project #BR-L1104](#)) (Acevedo, Hobbs, and Martinez 2017). The study analyzed the effect of the rehabilitation of

<sup>16</sup>\_ Such as proximity to employment centers.

<sup>17</sup>\_ To properly identify the effect of the neighborhood upgrading investments on this metric, structural and locational variables should be adequately controlled for.

roads and parks on property values using detailed administrative data of property characteristics and sales prices in beneficiary and nonbeneficiary neighborhoods. It found that the road improvement component had a significant effect on sales prices, but that there was no effect of the urban parks intervention.<sup>18</sup>

Benefits in property values, however, are not always a given. In the case of the second stage of the *Favela-Bairro* program, the impact evaluation found that despite positive impacts on neighborhood infrastructure and access to services, there was no effect on property values overall (Atuesta and Soares 2018). However, when analyzing heterogeneous effects within the favelas, the evaluation found an appreciation of property values in properties with poor accessibility to public transportation and low-value dwellings, reducing inequalities within neighborhoods. This study suggested that the lack of an overall effect on property values might have been related to the absence of formal property rights.<sup>19</sup> Guaranteeing property rights is usually a complementary intervention in the neighborhood upgrading programs financed by the IDB Group. However, there is no evidence available to allow for disentangling the effects on property values of the provision of urban infrastructure and access to services, on the one hand, and the presence of secure tenure, on the other.

The experimental evaluation of the Hábitat Program in Mexico (McIntosh et al. 2018) showed that it incentivized homeowner investments. In addition to its large effects on the quality of neighborhood infrastructure, the program had a positive impact on private investment in housing. For example, households in beneficiary neighborhoods were more likely than nonbeneficiary counterparts to install cement floors and flush toilets.

Recent evaluations of IDB Group programs in Argentina, Bolivia, Ecuador, and Uruguay looked at the effect of neighborhood upgrading programs on measures of the quality of life, including violence, health, education,

**18\_** Another experimental evaluation of a street pavement intervention in Mexico -which is usually used as a reference in the literature (Gonzalez-Navarro and Quintana-Domeque 2016)- found that pavement increased home values by 17% and 28%, based on professional appraisal measures and homeowners' valuations respectively.

**19\_** Although a property titling component was part of the original design of *Favela-Bairro*, it did not end up being implemented.

and socioeconomic status. In Argentina, the large-scale Neighborhood Improvement Program (*Programa Mejoramiento de Barrios* - PROMEBA) (IDB Project #AR-L1119) provided basic services (water, sewerage, gas, electricity), road and public space infrastructure (streets, sidewalks, parks, squares), and land and property titling to underserved neighborhoods. The program also included community participation strategies during design and execution aimed at increasing community involvement. An evaluation of the program, using matching techniques and data from multiple sources for 20,382 households in 22 provinces, found that PROMEBA increased beneficiaries' perceptions of safety and security in squares and streets, especially among women (Dorna, Goytia, and Romero 2019).

Looking at other outcomes of quality of life, the PROMEBA evaluation found that the program reduced school absences during flooding, and that it had a positive effect on the participation of women in community activities. This last result stands to some extent in contrast to the experimental evidence from Mexico's Hábitat, which showed that a pre-committed index of social capital did not improve as a result of that intervention,<sup>20</sup> although there was evidence of a reduction in the prevalence of personal assault.

Similar to the PROMEBA evaluation, an impact evaluation of the Neighborhood Improvement Program III (*Programa de Mejoramiento de Barrios* - PMB) (IDB Project #UR-L1146) in Uruguay analyzed the program's effects on schooling outcomes. The program financed investments in (1) urban infrastructure and basic urban services, (2) social and community development, and (3) formalization of property rights. The evaluation used a regression discontinuity technique that exploited the program eligibility rules.<sup>21</sup> It found that pre-school and elementary school students residing in the upgraded neighborhoods were between 23 and 63 percent less likely to be at the 90th percentile of the yearly count of school absences. That effect appeared to impact boys and girls similarly, irrespective of the

**20\_** The index was constructed using 14 questions on participation in groups, trust in institutions, neighbors and household members, levels of conflict, knowledge about community organizations, and social problems. To promote social participation, the program invested in community development centers, job training, and health and nutrition training for young mothers.

**21\_** PMB rules require neighborhoods to have at least 40 houses to be eligible for a program intervention.

age and time since the program started. This evaluation provides evidence of the relevance of neighborhood conditions for schooling outcomes of elementary-school-age children that could impact their future human capital accumulation (Zanoni, Acevedo, and Guerrero 2021).

To assess the impact of other urban interventions, big data have become instrumental in recent years. The urban experiment, *Panamá Camina*, is an example of the use of big data to evaluate these types of interventions (Box 1). It is expected that big data will continue to open more opportunities for impact evaluations in this sector.

### **Box 1. Using Big Data to Evaluate Local Urban Interventions**

The [IDB Cities Lab](#) designed an intervention framed within the Conservation and Management of Cultural and Natural Heritage Program (*Apoyo para la Conservación y Gestión del Patrimonio Cultural y Natura*) ([IDB Project #PN-L1146](#)) in Panama to increase pedestrian space around the Plaza de Mayo in Panama City. The intervention, *Panamá Camina*, restricted the use of cars in certain areas to allow pedestrians to take part in cultural activities from November 17 to December 16, 2018. The intervention was widely welcomed by the population, but one of the main concerns of the IDB Cities Lab was the potential negative spillovers on traffic in the surrounding area due to the traffic restrictions.

Using highly detailed data from Waze, an impact evaluation analyzed the effects on traffic speed during the weeks before and after the intervention to gauge its impact on traffic congestion (Blanco, Mitnik, and Salgado 2020). The evaluation considered Waze segments within 250 meters of the intervention to be the treatment zone and segments between 500 and 750 meters away to be the control zone. The study showed that concerns about negative spillovers were unwarranted, as it found that *Panamá Camina* did not change traffic congestion patterns in the treatment zone.

This is one example of the innovative prototypes implemented by the IDB Cities Lab, and the first one with a rigorous impact evaluation. The methodology and results of the *Panamá Camina* evaluation could be applied to other prototypes in order to understand the positive or negative effects of urban interventions on traffic. Moreover, these types of data allow for evaluating past interventions that did not include an impact evaluation in their design.

The evaluation of the Rural and Marginal Urban Electrification Program (*Programa de Electrificación Rural y Urbano Marginal - FERUM II*) in Ecuador ([IDB Project #EC-L1128](#)) also provides recent evidence of the impact of an energy infrastructure intervention on measures of quality of life. That program specifically focused on expanding access to and the quality of networked electricity services. Using household fixed-effects models and data from baseline and follow-up surveys in treated and nontreated rural communities and low-income urban neighborhoods, the evaluation showed that the program doubled household energy consumption and improved access to media and communications services (Jiménez Mori 2020). Moreover, the program resulted in increases in household income and expenditure, suggesting improvements in economic security. By contrast, there were no detectable effects on health outcomes for children or on perceived subjective well-being.

Similarly, an impact evaluation of a project in Suriname ([IDB Project #SU-L1009](#)) assessed the effect of connecting five communities in the Surinamese hinterland to the electricity grid, providing households with 24-hour-a-day electricity service. Using a difference-in-differences approach, Corral and Zane (2020) evaluated the effect of the program on household income, time use, energy consumption, and subjective welfare. They found that the program significantly increased household income as well as the number of businesses in the treated communities. However, no effect on time use was detected, and the effect on subjective welfare was positive but not statistically significant.



## Access to Adequate Housing

Evidence of the effectiveness of IDB Group operations that facilitate access to adequate housing is scarce. Four impact evaluations carried out by the IDB Group in Bolivia, Ecuador, Mexico, and Peru explored the effectiveness of different types of programs on the various dimensions of housing deficits. The impact evaluations of the programs in Ecuador and Peru evaluated the effectiveness of municipal spending and subsidies to buy new houses on both quantitative and qualitative housing deficits. The other impact evaluations conducted in Bolivia and Mexico analyzed the effectiveness of providing clean energy and energy-efficient dwelling upgrades on electricity use and measures of well-being.

*More evidence is needed to understand the mechanisms through which economic shocks and subsidies affect qualitative and quantitative housing deficits.*

On average, public expenditure on housing constitutes 1.5 percent of GDP in Latin America and the Caribbean (Libertun de Duren 2018). But what are the effects of a substantial increase in this type of public expenditure on housing deficits in municipalities with different natural endowments? An evaluation of public expenditure on housing between 2001 and 2013 in Peru exploited a unique setting provided by a tax arrangement known as the Mining Canon (Libertun de Duren and Osorio 2020b). Implemented in the early 2000s, the canon distributed taxes from mining companies to municipalities endowed with minerals. In 2007, there was a boom in international prices of minerals, which led to a fiscal windfall in these municipalities and a subsequent substantial increase in public expenditure on housing, specifically for subsidies to improve dwellings, build a new house on owned land, or purchase a new house. Using a difference-in-differences approach, the authors estimated the impact of the fiscal windfall on quantitative and qualitative housing deficits. Municipalities that benefited from the mineral boom and the subsequent increase in public expenditure on housing reduced their qualitative housing deficit by 15 percentage points in terms of the dimension of this deficit associated with poor materials, and by 4 percentage points in terms of the dimension associated with lack of public services (water, sanitation, and electricity).

However, there were no significant changes in other qualitative housing deficit dimensions such as overcrowding and lack of titling, or in quantitative housing deficits such as cohabitation.

A recent impact evaluation of the second stage of the National Social Housing Program (*Programa Nacional de Vivienda Social - Etapa 2*) in Ecuador ([IDB Project #EC-L1113](#)) analyzed the effects of the program on housing deficits and socioeconomic characteristics at the household level (Paredes 2019). The program awarded a US\$6,000 subsidy to eligible households to complement their household savings to buy a new home built by the private sector. The evaluation employed a difference-in-differences approach using panel data from the National Survey of Employment, Unemployment, and Underemployment (*Encuesta Nacional de Empleo, Desempleo y Subempleo - ENEMDU*), for two independent periods and groups of households: December 2013 and 2014 (first panel), and December 2015 and 2016 (second panel). The results showed that the program reduced the global housing deficit (which is usually split between qualitative and quantitative deficits) by 23 percent for the first panel of households (2013–2014). Although the results for the second panel of households (2015–2016) moved in the same direction, they were not statistically significant. The decline in the global housing deficit was driven by a statistically significant reduction in the quantitative deficit (19 percent for the first panel and 17 percent for the second panel), mainly explained by the reduction of overcrowding for the second panel of households (20 percent). No statistically significant effect was found in the short term on socioeconomic variables such as household income or disposable income. However, it should be noted that one year may not have been sufficient to detect any income gains.

***Innovative clean-energy and energy-efficiency interventions need to consider specific implementation conditions, including socioeconomic factors and human behavior.***

Another group of interventions have aimed to support the expansion of adequate housing by delivering specific improvements. Two impact evaluations by the IDB Group in Bolivia and Mexico explored the effectiveness of using green-energy and energy-efficient technology in



home improvement interventions. In Nuevo Leon, Mexico, an intervention that was not financed by the IDB Group provided homes with insulation and other energy-efficient upgrades (Davis, Martinez, and Taboada 2020). As part of a large housing development program, upgraded homes were built with additional thermal insulation in the walls and roof, in addition to window shading and a passive cooling system. Due to limited resources, not all new houses received the upgrades. Therefore, the construction firm decided to distribute upgrades across the housing development without a systematic pattern, facilitating the setting for a quasi-experimental evaluation. Despite the program having used technological solutions regarded as highly promising, the evaluation found no evidence of savings in electricity use or improvements in thermal comfort (as measured by levels of humidity and temperature) in upgraded households compared to non-upgraded households. Part of the explanation cited by the authors was that air conditioner ownership was lower than expected (limiting the potential for energy savings) and most households kept their windows open on hot days, neutralizing the potential thermal benefits of the intervention. This result highlights the importance of considering socioeconomic conditions and beneficiary behaviors in real implementation conditions.

An impact evaluation of the Rural Electrification with Renewable Energy Program (*Programa de Electrificación Rural con Energía Renovable*) ([IDB Project #BO-X1013](#)) in Santa Cruz, Bolivia, analyzed the implementation of photovoltaic peak systems in rural homes and found them to be very effective and efficient (Ballón et al. 2019). The program installed solar panels in houses without access to electricity in rural communities in nine municipalities. The panels generated enough energy to provide a minimum of five hours of lighting, with a mobile lighting point and an outlet to charge a cellular phone or radio. The impact evaluation used a cluster design in which half of the communities were assigned to the treatment group and the other half to the control group. The intervention reduced the use of traditional fossil sources of lighting (candles and battery/gas/oil lamps) and increased the use of lighting from renewable sources threefold in beneficiary households relative to nonbeneficiary ones. This substitution in lighting source produced savings in lighting expenditure that were larger than the operating costs of the system, making the intervention highly cost-effective. In addition, the program increased the use of mobile phones and reduced the probability of accidental burns.

## IDEAS FOR FUTURE WORK

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Rigorous evaluations supported by the IDB Group in the last decade have contributed to growing evidence about the multiple impacts of comprehensive neighborhood upgrading programs. One important lesson that has emerged is that despite the substantial positive effects of these programs on the quality of neighborhood infrastructure and access to services, long-term sustainability might be a challenge, so it is important to further study interventions that might foster it. The nuanced and often mixed results from recent evaluations also demonstrate that there is a need to better understand how upgrading informal neighborhood conditions can produce improvements in measures of well-being and quality of life. Also, there is an evidence gap on the differential effects that neighborhood upgrading programs and secure tenure interventions have on property values.

What little evidence is available on housing subsidy programs shows that they can reduce the quantitative housing deficit, but complementary programs that provide access to basic services might be needed to reduce the qualitative housing deficit. The future research agenda should go beyond housing deficits, assessing the effects of housing interventions on socioeconomic outcomes and well-being.

It is critical that programs that introduce clean-energy and energy-efficient technologies take into account real implementation conditions, as well as human behavior that does not always match prior assumptions. In certain circumstances, complementary interventions may be necessary to promote changes in people's behaviors and achieve efficient use of these technologies.

Finally, future research must take advantage of the opportunities that big data offer to evaluate urban interventions at different geographical levels.

## CONCLUSION

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Infrastructure investments in transport, water and sanitation, and housing and urban development are crucial to achieve sustainable development in Latin America and the Caribbean. During the recovery phase of the COVID-19 crisis, in particular, investments in sustainable and resilient infrastructure will be crucial to incentivize productive investment, create employment, and accelerate economic recovery. Despite significant progress in the region, access to basic services such as public transport, water and sanitation, basic infrastructure, and adequate housing remains a critical problem in many countries. This problem has been exacerbated by high urbanization rates that have resulted in rapid population growth in informal and often low-income urban areas around cities.

Over the last decade, the IDB Group has supported countries in their efforts to improve access to infrastructure services through a variety of interventions to extend transport, water and sanitation, housing, and neighborhood services to the most vulnerable populations. Overall, the evidence generated indicates that these programs have been successful in expanding the quality of infrastructure and services. However, the nuanced and often mixed results identified by some evaluations have also demonstrated a need to better understand how interventions can improve final outcomes of well-being and quality of life. In transport, the evidence base is still limited, both in terms of the types of interventions studied and the geographic coverage of the evidence. In addition, ongoing technological changes in the delivery of transport services imply that a robust research agenda will be necessary to evaluate the impact of these changes. Lessons from evaluations in the water and sanitation sector and housing and urban development sector indicate that more needs to be done to fully realize the benefits of investments in improving the quality of existing infrastructure and services and expanding them.

Despite the known challenges in designing and implementing evaluations of infrastructure interventions at scale, the success of the evaluations reviewed in this monograph demonstrates that accurate and valuable

evidence can be obtained using rigorous methods. In addition, evaluations, particularly in the transport sector, have shown how emerging technologies are opening up new and exciting opportunities to learn more from impact evaluations in the infrastructure sector by enabling rapid and in many cases real-time data generation, collection, and analysis. This monograph has provided examples of how digital technologies and big data can improve the potential for the analysis of development effectiveness in the sector.

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