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Why Cities Adopt Low-Carbon Infrastructure: Evidence from the Politics of Bus Rapid Transit

By

Nicholas E. Goedeking

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Environmental Science, Policy, and Management

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Jonas Meckling, Chair
Professor Alison Post
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Professor Dara O'Rourke

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Abstract

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Evidence from the Politics of Bus Rapid Transit

by

Nicholas E. Goedeking

Doctor of Philosophy in Environmental Science, Policy, and Management

University of California, Berkeley

Professor Jonas Meckling, Chair

This dissertation investigates the political economy of low-carbon infrastructure in cities in low- and middle-income countries. It focuses on the urban transportation sector, which is projected to emit alarming amounts of greenhouse gas (GHG) emissions by mid-century. Since most transportation emissions come from private automobiles, the more that urban transportation systems mitigate private vehicle dominance today, the more GHG emissions can be avoided tomorrow. Otherwise, the danger of carbon lock-in will loom large. Build-out of car-centered transportation infrastructure could trigger its continued expansion and set many cities on GHG-intensive pathways of urban development. The theoretical question at the heart of this dissertation therefore is: *When, how, and under what conditions do cities deploy and maintain low-carbon infrastructure systems?*

This research argues that Bus Rapid Transit (BRT) systems, a bus-based mass transit innovation, offer a unique empirical setting to investigate this question. For one, BRTs demonstrate an empirical track record of effective GHG mitigation. For another, they have proliferated in cities across the Global South since the mid-2000s and thus afford a data-rich starting point for analysis. The empirical question at the heart of this dissertation therefore is: *When, how, and under what conditions do cities deploy and maintain BRT systems?*

Current theoretical frameworks cannot yet explain the distribution of BRT systems across cities in low- and middle-income countries. This dissertation integrates insights from three broad academic literatures to examine the role of *political institutions*, *political interests*, and *public investment*. These three literatures, broadly defined, include works on *Cities and Climate Change*, the *Political Economy of Public Outlays and Infrastructure,* and *BRT Studies*.

In *When Do Cities Deploy Low-Carbon Infrastructure? Evidence from the Global South* (Chapter 2), this dissertation assesses which *macro-political institutions* are associated with the adoption of BRT systems. To this end it leverages a novel dataset of 92 BRT adoptions between 1970 and 2017, and examines whether political decentralization and democracy, alongside international non-governmental organizations, are associated with greater chances of BRT deployment. The results from three sets of survival regressions suggest they are: politically decentralized countries are significantly more likely to adopt BRTs when they are governed democratically. The analysis does not find the same association in autocratic government

contexts. Moreover, countries which host international non-governmental organizations advocating for BRT are indeed more likely to adopt domestic demonstration projects. This highlights that international civil society can serve as a driver of low-carbon urban innovation.

In *Governing Rapid Transit: Power Politics and Adaptability* (Chapter 3), this dissertation then further contextualizes the findings from the survival regressions by analyzing how *political interests,* together with *political institutions*, shape the deployment and durability of BRT systems. It develops two analytical frameworks for how to rethink transit planning and policy. First, the deployment of BRT systems can be understood as the result of *power politics*. BRT proposals tend to pitch *broad yet shallow support* against *narrow yet fierce opposition*. This renders them inherently contentious. Proposals move forward, however, when their implementation generates political benefits for powerful individuals. Second, the durability of BRT systems can be understood in terms of *adaptability* to adverse policy feedback. BRTs often suffer from cycles of adverse policy feedback: operational problems lead to backlash (e.g., from users, car owners, elites), which can exacerbate operational problems and lead to more backlash. Over time, such cycles result in financial instability, loss of social legitimacy, or even closure. BRTs do not necessarily endure because their operations perform well. Rather, contrary to the dominant view found in the literature, this research suggests that they survive when they successfully adapt to and mitigate adverse policy feedback. The chapter offers a novel analytical vantage point for understanding transit planning and policy, complementary to more conventional policy frameworks. It develops the two frameworks with evidence from 32 expert interviews conducted between April and June 2019.

In *Institutional Foundations of Rapid Transit Investment: Evidence from Mexico, Peru, and Colombia* (Chapter 4), this dissertation investigates how *political institutions* and *interests* affect *public investment* for mass transit development. It argues that there are four meso-political institutional enabling factors: an *institutional actor* who legitimizes and authorizes transfer of state capacity and resources to sub-national projects, a *framework* which facilitates the alignment of national and sub-national policy interests around shared policy goals, a *politically savvy funding mechanism* which disciplines public authority, and a *mechanism of equitable fiscal redistribution*. Taken together, these factors help accelerate rapid transit development, especially when there is a policy gap between sub-national regulatory responsibility over urban transport affairs and sub-national capacity to implement transport reform. This argument is examined with a comparative case study of public investment for BRT in two middle-income democracies in Latin America: Mexico and Peru. Mexico adopted 11 BRT systems between 2003 and 2017, whereas Peru deployed only a single BRT corridor within the same timeframe. The analysis shows how the four factors facilitated the creation of a national investment program in Mexico, and how the absence of the four factors in Peru has made mass transit development comparatively more difficult. To strengthen the external validity of the argument, the analysis also triangulates supplementary evidence from Colombia. Its methods combine process tracing, historical analysis, and 30 semi-structured interviews conducted between June and December 2021. The chapter offers a novel institutional explanation for why Mexico and Colombia, unlike Peru, have been able to scale up public investment for mass transit development.

This dissertation concludes with several avenues for future research and policy implications. Overarchingly, it contributes to scholarly debates on how to accelerate urban energy transitions, the politics of mass transit policy and planning, and the political economy of low-carbon infrastructure and investment.

To Elisabeth

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Acronyms and Abbreviations

BRT	Bus Rapid Transit
BRT+ CoE	BRT+ Centre of Excellence
CAF	Andean Development Corporation (*Corporación Andina de Fomento*)
CAPEX	Capital expenditure
CDM	Clean Development Mechanism
COFIDE	Development Finance Corporation of Peru (*Corporación Financiera de Desarrollo*)
CONPES	National Council of Economic and Social Policy of Colombia (*Consejo Nacional de Política Económica y Social*)
CTS	Center for Sustainable Transport (*Centro de Transporte Sostenible*)
ENGO	Environmental non-governmental organization
FARAC	Support Trust for the Rescue of Concessioned Highways of Mexico (*Fideicomiso de Apoyo para el Rescate de Autopistas Concesionadas*)
FONADIN	National Infrastructure Fund of Mexico (*Fondo Nacional de Infraestructura*)
GEF	Global Environment Facility
IDB	Inter-American Development Bank
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITDP	Institute for Transportation and Development Policy
LRT	Light Rail Transit (e.g., tram)
MDB	Multilateral development bank
MEF	Ministry of Economy and Finance of Peru (*Ministerio de Economía y Finanzas*)
MML	Metropolitan Municipality of Lima (*Municipalidad Metropolitana de Lima*)
MPA	Provincial Municipality of Arequipa (*Municipalidad Provincial de Arequipa*)
MRT	Mass Rapid Transit (e.g., heavy rail, metro, subway)
MTC	Ministry of Transport and Communications of Peru (*Ministerio de Transportes y Comunicaciones*)
NGO	Non-governmental organization
OPEX	Operating expenditure
PNTU	National Urban Transport Program of Colombia (*Programa Nacional de Transporte Urbano*)
PROTRAM	Federal Mass Transit Support Program of Mexico (*Programa de Apoyo Federal al Trasporte Masivo*)
SCT	Secretariat of Communications and Transportation of Mexico (*Secretaría de Comunicaciones y Transportes*)
SHCP	Secretariat of the Treasury and Public Credit of Mexico (*Secretaría de Hacienda y Crédito Público*)
UTTP	Urban Transport Transformation Program for Mexico (*Programa de Transformación del Transporte Urbano*)
WRI	World Resources Institute

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1. Introduction

1.1. The Policy Challenge and Research Question

Decarbonization requires widespread deployment of low-carbon infrastructure in cities (OECD et al. 2018; Seto et al. 2014; World Bank 2010a). The rise of a global middle class is generating unprecedented demand for electricity and mobility, alongside increases in greenhouse gas (GHG) emissions (Koo 2016; Kharas 2017). As incomes grow, motorization is expanding, resulting in larger absolute and relative shares of GHG emissions from transport. The most recent Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) warned with high confidence, "[w]ithout aggressive and sustained mitigation policies being implemented, transport emissions could increase at a faster rate than emissions from the other energy end-use sectors and reach around 12 Gt CO2eq/yr by 2050" (Creutzig et al. 2014). The Covid-19 pandemic is unlikely to change this trend in the medium- and long-run and could even accelerate it (Quéré et al. 2020; World Bank 2020a). This situation creates a special need for urban transport systems associated with lower GHG emissions compared to historical pathways of development. Since most transport emissions come from private automobiles, the better urban transport systems mitigate private vehicle dominance today, the more GHG emissions can be avoided tomorrow (cf. Ürge-Vorsatz et al. 2018; Unruh and Carrillo-Hermosilla 2006; Seto et al. 2016).

Time is of the essence (cf. Roberts et al. 2018). Transport infrastructures, such as roads, freeways and transit networks, are often very capital intensive and thus demonstrate multi-decadal lifecycles. Once in place, they only evolve gradually. Transport systems also shape urban form in profound ways, and thereby lock-in patterns of energy and fuel use well beyond their respective lifecycles (Creutzig et al. 2016). The danger of carbon lock-in therefore looms large (Unruh 2000). Build-out of car-centered transport systems could trigger perpetual build-out of these infrastructure systems, and thus set many cities on a nearly irreversible pathway of GHG-intensive urban development.

Electrification of private transportation alone will not be sufficient for deep decarbonization. While electric vehicles (EVs) undoubtedly have an important role to play, they are far from carbon free. Up to 90% of an EV's total GHG emissions are linked to the production of the vehicle and battery, not the driving (Girod, van Vuuren, and Hertwich 2014). Even more fundamentally though, EVs do not necessarily challenge the overarching car-centered transport architecture. Instead, there is a danger that EVs perpetuate, legitimize, and even greenwash the dominant GHG-intensive, car-based model of transportation.

On the flipside of the danger of carbon lock-in, however, there lurks an opportunity. Rapid urbanization can offer a platform for low-carbon policy change and development. Since modal shares of public transport use is still comparatively high in many cities in low- and

middle-income counties (BRT+ Centre of Excellence and EMBARQ 2021b), timely deployment of high quality, affordable public transport infrastructure instead of concentrated investment in car-centered systems could help protect and promote this low-carbon behavior (Creutzig et al. 2018; Spaargaren 2011). Governments therefore face a critical juncture over the next decades. Growing demand for urban mobility calls for policy choices regarding which kinds of transportation infrastructure to prioritize.

How to achieve timely, widespread deployment of mass transit systems, however, is not well understood. The urban chapter in the last IPCC Assessment Report found that the cities with the greatest potential to avoid future carbon emissions are often the least likely to realize this possibility (Seto et al. 2014). Local governments in low- and middle-income countries frequently lack the financial resources, institutional capacity, and formal authority to implement transformational policy change. Moreover, policymakers face a multitude of competing development needs. The mitigation of GHG emissions thus often ranks low on policy agendas. The IPCC concluded that there is an urgent research need to better understand how and under what conditions climate action in cities can be accelerated within these constraints (Seto et al. 2014). This dissertation follows this call. Its overarching research question, with a focus on urban transportation, is this: *When, how, and under what conditions do cities deploy and maintain low-carbon transportation infrastructure?*

1.2. Basic Definitions and Concepts

To approach the overarching question as rigorously as possible, the next sub-sections establish the conceptual groundwork. I clarify what I mean by 'cities' and 'low-carbon infrastructure', and offer an overview of different types of low-carbon systems which warrant investigation. This allows me to derive the empirical setting of this dissertation, Bus Rapid Transit systems, and lay the foundation for a review of key existing literatures.

1.2.1. *Cities as actors or places*

Broadly put, "cities are places where large numbers of people live and work; they are hubs of government, commerce and transportation" (UN 2016). Post (2018) argues there are two useful analytical definitions. One is to understand *cities as jurisdictions*: "a local jurisdiction possessing distinct powers and constraints" (*ibid*). It highlights *cities as actors*, enmeshed in a web of legal rules, roles, and responsibilities. Throughout the dissertation I qualify cities as jurisdictions by their respective governmental level (e.g., local, district, municipal, city, metropolitan). Post's second analytical definition views *cities as agglomerations*: "large, densely populated settlements characterized by social and economic heterogeneity" (*ibid*). This understanding emphasizes *cities as places*, characterized by a distinct flavor of politics. Whenever I am not explicitly referencing a governmental level or body, I draw on this second definition.

The link between cities and the climate crisis cannot be overstated (Bulkeley 2010; Bai et al. 2018; Dodman 2009; Satterthwaite 2010). Urban areas cover only 3% of the world's surface area, yet generate over 80% of global GDP and 70% of global GHG emissions (Liu et al. 2014; World Bank 2018). Without policy change, urban carbon emissions from energy use is projected to increase by 50% by 2050 (IEA 2016). Any effort to reconcile social and economic demands

with planetary boundaries requires particular attention to advancing more sustainable patterns of production and consumption in cities – in the Global North and South alike.

International policymakers recognize this. The Sustainable Development Goals (SDGs), for instance, explicitly call to "[m]ake cities and human settlements inclusive, safe, resilient and sustainable" (UN 2015). UN Habitat III has led to the New Urban Agenda, a global urban development strategy for the next 20 years, which heavily references both the SDGs and the Paris Climate Agreement of 2015. In March 2018, the IPCC held a *Cities and Climate Change Science Conference* as part of its 6th Assessment Report cycle, and announced that the 7th Assessment Report, scheduled for 2023-2028, will feature a *Special Report on Climate Change and Cities*. In short, cities, both as actors and as places, have become essential dimensions for understanding and addressing the climate crisis.

1.2.2. *Low-carbon infrastructure as a deductive or inductive concept*

There is no universal definition of low-carbon infrastructure (Ferrer et al. 2018). Popular synonyms for 'low-carbon' include, but are not necessarily limited to, 'climate friendly', 'climate compatible', 'green', 'sustainable', and the like – categories which are notoriously fuzzy. Instead, I posit that the concept can be defined either *deductively* or *inductively*.

Deductive definitions clarify 'infrastructure' and then merge the concept with a 'low-carbon' – or equivalent – qualifier. Infrastructure has, for instance, been defined as "the 'hidden hand' behind urban development and nation building, enabling the flow of people and critical resources such as water, energy, waste, information, agricultural produce, and manufactured goods" (Vojnovic 2010). Infrastructure is also frequently associated with the physical network itself that enables the flow of people and resources, materially embodied by freeways, roads, bridges, ports, pipes, electric power lines, fiber optic cables, and so forth. Low-carbon infrastructure could thus be deductively defined as *any kind of infrastructure which, looking backward in time, encodes less GHG-intensive flows of people and resources compared to historical pathways of development, or, looking forward in time, is associated with less GHG-intensive flows of people and resources compared to business-as-usual projections*.

Deductive definitions, however, can suffer from confirmation bias and regulatory capture. The devil lies in the details of how historical pathways of development and business-as-usual projections are theorized and operationalized. Underlying assumptions can reflect the influence of special interest groups and will remain contested. Moreover, our theoretical understanding of 'low-carbon', 'green', 'climate friendly', etc. will evolve over time in conjunction with changes in technology, social practices, and norms and values. An infrastructure system which is seen as 'green' in the present might be viewed as 'gray' in the future.

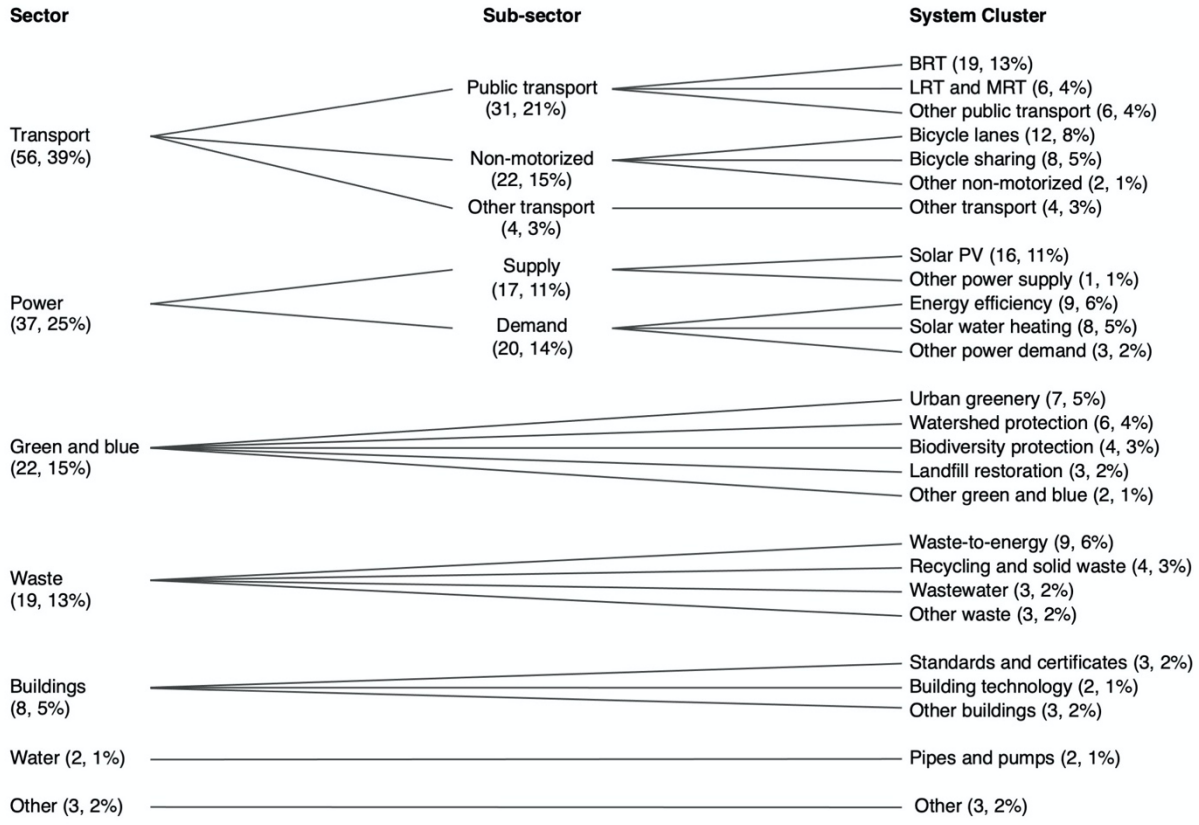
Inductive definitions, in comparison, do not rely on any single theoretical definition of either 'infrastructure' or 'low-carbon'. Instead, they assess which system types are commonly labelled as 'low-carbon', 'green', 'sustainable', and the like, and then review to what extent the label empirically holds for a particular system. I posit that inductive definitions are less likely to suffer from confirmation bias and regulatory capture because they are grounded in heterogeneous *ex-ante* impact assessments and *ex-post* impact evaluations. Given this advantage, for this dissertation I develop an inductive definition in the next two sections.

1.2.3. *Types of low-carbon infrastructure*

There is no single database which captures low-carbon infrastructure systems in cities in a representative way and would enable a straightforward review of different system types. Reporting platforms, such as the Carbon Disclosure Project (CDP 2022), the carbon*n* Climate Registry (ICLEI 2022), and the Non-State Actor Zone for Climate Action (UNFCCC 2022), focus on targets and timetables, and do not yet rigorously document policy outcomes. The actual population of systems therefore remains unknown. To determine which systems are commonly labelled as 'low-carbon', I conducted a content analysis of case studies published by C40 and ICLEI, two major transnational municipal networks.

To this end I combined a-priori codes and grounded theory to analyze 134 case studies from low- and middle-income countries which were published between 2009 and 2018. This exercise produced 148 projects across 50 cities in 18 countries. 89% of the projects are in Asia (49%) and Latin America (40%). Most projects fall under transport (39%) and power (25%). I uncovered eight clusters which invite further investigation: Bus Rapid Transit systems (13%), decentralized solar power (11%), bicycle lanes (8%), bicycle sharing (5%), energy efficiency (6%), solar water heating (5%), urban greenery (5%) and waste-to-energy (6%). An overview of the typology is offered in *Figure 1.*

Figure 1: Types of low-carbon urban infrastructure systems



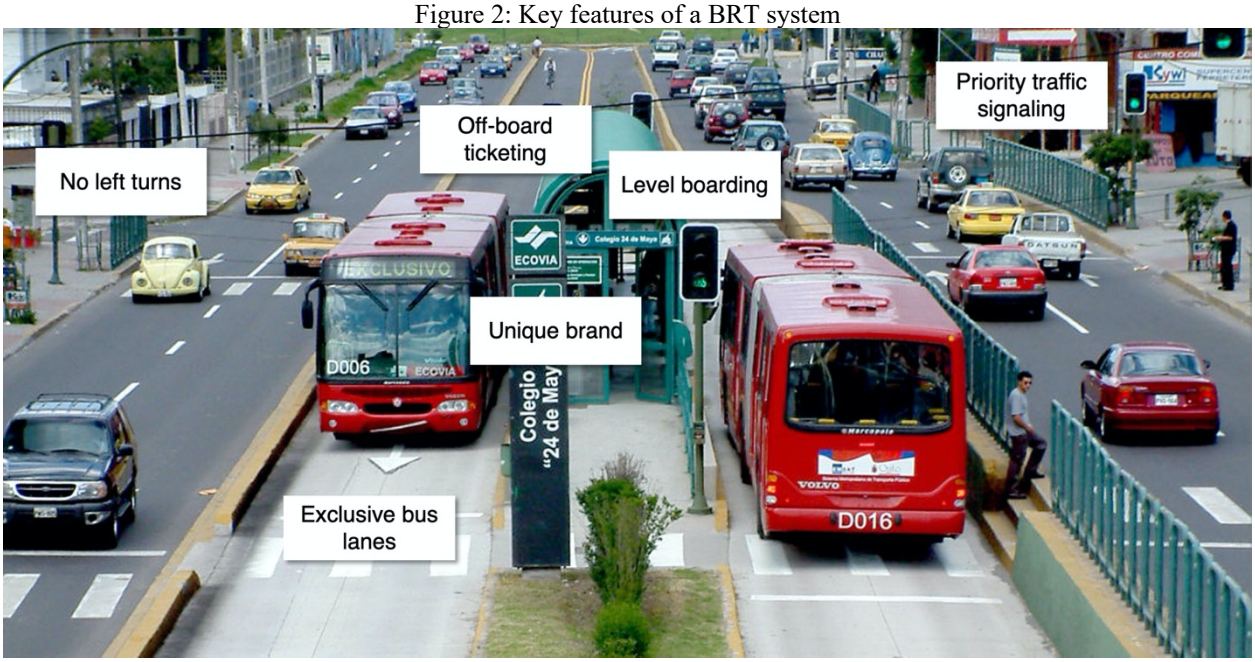
Note. Author's content analysis of 134 case studies published by C40 and ICLEI between 2009 and 2018. BRT – Bus Rapid Transit; LRT – Light Rail Transit (e.g., tram); MRT – Mass Rapid Transit (e.g., heavy rail, metro, subway).

Overall, the categories are not surprising, and generally capture what one might expect. Notably though, very few projects in the transport sector address electric vehicles. This could reflect the limited feasibility of transport electrification in cities in low- and middle-income countries. Interestingly too, the power supply side is almost exclusively characterized by decentralized solar power. This could capture the limited applicability of other renewable technologies in densely populated urban environments, such as utility-scale solar, wind, geo-thermal, and hydro power (cf. Kammen and Sunter 2016). Since this dissertation is mostly interested in the urban transportation sector, and given moreover that BRT systems constitute the largest technology cluster, to complete my inductive definition in the next section I review BRT systems.

1.2.4. *Bus Rapid Transit*

Bus Rapid Transit (BRT) systems are defined as a "flexible, rubber-tired form of rapid transit that combines stations, vehicles, services, running ways and information technologies into an integrated system with strong identity" (Levinson et al. 2003). In effect, BRTs can be thought of as surface-level, bus-based subway systems. Features such as dedicated bus lanes, level boarding, and pre-boarding fare collection, among others (*Figure 2*), enable them to service passenger capacities similar to subways, but often at a fraction of the capital costs.

Figure 2: Key features of a BRT system



Note. Replicated with modifications from ITDP (2022). The BRT system in Quito, Ecuador.

To assess whether BRTs qualify as a low-carbon infrastructure system, a research assistant and I implemented a systematic literature review of all available *ex-ante* impact assessments and *ex-post* impact evaluations for BRT systems indexed by the Transportation Research Board's TRID database. In total, we reviewed 38 academic papers. Each study was evaluated along two basic questions: first, does it offer supportive, mixed, or contradictory evidence to the assertion that BRT is a low-carbon innovation; and second, how, if at all, does it conceptualize the GHG impact of BRT? To structure the 'how', we applied the Avoid-Shift-Improve framework

(Dalkmann and Brannigan 2007; Nakamura and Hayashi 2013; Hidalgo and Huizenga 2013). This framework captures whether a system or technology *avoids* motorized trips, for instance by encouraging transit-oriented development; *shifts* travel behavior away from GHG-intensive modes to more GHG-efficient ones, such as from cars to public transport; or *improves* modal efficiencies, for example by improving traffic flow. The results of the systematic review are summarized in *Table 1.* Brief summaries of the key findings from all 38 papers are supplied in the annex.

Table 1: Literature review of BRT impact assessments and evaluations

	Avoid	**Shift**	**Improve**	**Other**	**Total**	**Total (%)**
Supportive	3	12	12	6	33	87%
Mixed	0	0	1	0	1	3%
Contradictory	1	0	0	0	1	3%
Other	0	0	0	3	3	8%
Total	4	12	13	9	38	100%
Total (%)	11%	32%	34%	24%	100%	

Note. The TRID database in total indexed 48 papers. 10 papers, however, were not accessible and consequently excluded from the review. The category 'Other' captures papers which develop arguments or test hypotheses beyond the Avoid-Shift-Improve framework.

Two patterns stand out. On the one hand, the great majority of papers support the assertion that BRT is a low-carbon system. 33 out of the 38 papers offer supportive evidence and/or arguments. Only two papers present mixed or contradictory evidence. On the other hand, most studies conceptualize the environmental impact of BRTs either as a *shift* in travel behavior or as an *improvement* in modal efficiency. A minority look at whether they avoid trips altogether. This skewed distribution could reflect methodological difficulties in assessing how changes in travel behavior result from changes in land use, or a general bias within the literature against studies with null results. A sample of illustrative *ex-post* impact evaluations is presented in (*Table 2*).

Needless to say, BRTs are no silver bullet for sustainable urban transport. They are neither GHG free, nor do they inevitably mitigate GHGs. *Summa summarum*, however, I posit that BRTs offer a unique empirical setting for analyzing the political economy of low-carbon infrastructure in cities in the Global South. They demonstrate an empirical track-record of GHG mitigation, have been adopted by over 90 cities in low- and middle-income countries (BRT+ CoE and EMBARQ 2020), and offer a rich empirical starting point for analysis. For this dissertation, based on the findings from the content analysis and literature review, I thus inductively define BRTs as one type of low-carbon urban infrastructure. It is also worth noting that major development institutions, like UN-Habitat (2013, 2020) and the World Bank (2014), have designated BRT as a critical low-carbon innovation, and that over half of all transport projects under the Clean Development Mechanism (CDM) were BRT projects (IPCC 2020).

Table 2: Sample of BRT impact evaluations

Authors	City	Findings
Bel and Holst (2018)	Mexico City, Mexico	An analysis based on field data finds that the Metrobus BRT helped reduce CO by 5.5-7.2%, NOx by 4.7-6.5%, and PM10 by 7.3-9.2%.
Hughes and Zhu (2011)	Guangzhou, China	Observational data shows that Guangzhou's BRT reduced CO2 emissions by an estimated 45,000 tons in its first year.
Hook *et al.* (2010)	Mexico City, Mexico; Jakarta, Indonesia; and Bogota, Colombia	CDM certified and/or observed emissions data show that CO2 reductions range from 26,816 tons in Mexico, to 60,000 tons in Jakarta and 68,813 tons in Bogota.
Deng and Nelson (2012)	Beijing, China	A passenger survey from Beijing's Southern Axis BRT (Line 1) shows that 12.4% of BRT users shifted from private cars.
Callaghan and Vincent (2007)	Los Angeles, USA	A ridership survey from Los Angeles' Orange Line BRT finds that 18% of BRT users previously drove private cars.
Rabinovitch and Hoehn (1995)	Curitiba, Brazil	An analysis based on passenger surveys and use statistics finds that 20-25% of BRT users shifted from private cars.

Note. Next to impact evaluations using backward looking empirical observations, there are countless impact assessments using forward looking projections and simulations that show how BRTs can help reduce GHG emissions (e.g., Kim *et al.*, 2019)

1.3. Three Existing Literatures

A comprehensive framework that could explain *when, how, and under what conditions cities deploy and maintain low-carbon infrastructure*, and by extension BRT systems, does not yet exist. Climate policy insights on how to advance urban decarbonization, for instance, mostly build on evidence from cities in high-income countries. It is unclear to what extent, if any, existing insights also apply to transition processes in cities in low- and middle-income countries. Likewise, while the energy transitions literature has taken an institutional turn, it has not yet systematically examined how *political institutions* condition *transition outcomes.* In this regard, transitions studies have not yet taken full advantage of lessons from comparative political economy. Transportation research, in turn, has mainly focused on the technical and managerial aspects of planning and implementation, but has not yet developed a nuanced understanding of how *political interests* fundamentally shape the deployment and durability of rapid transit systems. There are, however, three existing literatures which can serve as a theoretical starting point. I briefly review each in turn. The following reviews are not intended to be comprehensive. Rather, they offer a brief overview of major themes and debates upon which this dissertation can build. More detailed reviews are provided in each of the substantive chapters.

1.3.1. *Cities and Climate Change*

The first body of work examines the possibilities and limitations of *cities as actors* to reduce GHG emissions (Bulkeley 2010, 2021). Local governments are often framed as climate champions (Hoffman 2011; Bloomberg 2015; Barber 2017). Municipalities around the world have pledged ambitious GHG reduction targets (Bulkeley et al. 2014), joined transnational climate change networks (Andonova, Hale, and Roger 2017), and pioneered climate policy experiments (Evans, Karvonen, and Raven 2018; Bulkeley and Castán Broto 2013; Castán Broto and Bulkeley 2013). Municipalities might therefore be expected to drive the deployment of low-carbon infrastructure for the same reasons they implement climate policy: to advance regional economic competitiveness, pursue no-regret policies which produce local co-benefits, gain access to external resources, and adapt to foreseen climate related environmental impacts.

We also know, however, that cities are no panacea for sustainable development, neither as actors nor as places (Evans, Karvonen, and Raven 2018; Marvin and Guy 1997). Municipal governments are typically just one of many actors who shape policy outcomes in urban political arenas (Bulkeley and Betsill 2005, 2013). Policy change in cities does not unfold in isolation from regional, national, or even international interests. In fact, in certain policy areas, municipalities might not be an important actor group at all, such as in power grid policy, which tends to be governed at the national level.

Moreover, there is a gap between municipal GHG targets and actual reductions. While many local governments worldwide have pledged ambitious targets and timetables, it remains unclear to what extent, if any, these actions effectively mitigate emissions (Evans, Karvonen, and Raven 2018; Bulkeley 2010). This gap is often attributed to lack of financial resources, institutional capacity, and regulatory authority, alongside political fragmentation and general methodological difficulties in measuring the effectiveness of public policy (Romero Lankao 2007; Hardoy and Romero Lankao 2011). Many, if not all, of these factors are expected to shape the deployment of low-carbon urban infrastructure.

Nevertheless, local governments do appear to play a special role in climate policy. Mayors can possess significant agenda setting power (Acuto 2013; Davidson and Gleeson 2015). Municipal policymakers can be better attuned to local policy needs than their national counterparts (Barber 2017). Local governments can wield significant regulatory authority over certain urban affairs, such as public transportation, buildings, and waste management (Jonas, Gibbs, and While 2011; Rutland and Aylett 2008; Evans, Karvonen, and Raven 2018). The assertion that sub-national government actors behave as climate champions must therefore not be dismissed, and invites investigation into the possibilities and limitations of political decentralization to accelerate urban energy transitions.

A handful of papers have begun to investigate whether local climate policies substitute or complement national climate policies. While they are often presented as substitutes, recent studies challenge this framing. Hickmann (2017), for instance, finds strong complementarity between the two, and argues that city policies often rely on national policies to be effective. Similarly, Andonova, Hale and Roger (2017) present evidence that participation of municipal governments in transnational climate initiatives complements rather than substitutes national climate policy, especially in economies which are relatively closed.

1.3.2. *Political Economy of Public Outlays and Infrastructure*

The second body of literature, broadly defined, examines the distribution of public outlays and infrastructure. It highlights that infrastructure deployment is a process rather than an outcome. Infrastructure is not simply built. It needs to be envisioned, planned, approved, and financed, among other important steps (Dwarka and Feitelson 2013). Moreover, once built, systems must be operationalized, maintained, and updated. They are constantly renegotiated (Lindau, Hidalgo, and Facchini 2010; Bassett and Marpillero-Colomina 2013; Juma 2016). Deployment of low-carbon infrastructure will thus neither begin nor end with physical construction.

Studies, which largely focus on the public regulation of private investment in public infrastructure, show how investment for infrastructure is often very political (Dubash and Morgan 2012; Post 2018; Post and Murillo 2016). Henisz et al. (2005) find, for instance, that states in the Global South are frequently subject to powerful external pressures from international interests to adopt regulatory agencies, but that these agencies often lack local legitimacy and thus remain contested (Henisz and Zelner 2006; Henisz 2002; Henisz and Zelner 2005). Levy and Spiller (1994, 1996) present evidence that the absence of reliable legal checks and balances complicates the negotiation of anticipated costs and benefits, particularly when concessions for public utilities span long periods of time. The intensity of distributive politics in contexts characterized by poor utility services and weak state capacity is further fueled by privatization of public interests and economic volatility (Post and Murillo 2013, 2016; Dubash and Morgan 2012).

Institutional environments significantly determine the nature of distributive politics by setting 'the rules of the game' (North 1990a; Bergara, Henisz, and Spiller 1998). Spiller and Liao (2008) find, for example, that when legislators play an important role in policymaking, interest groups tend to use more transparent and direct lobbying strategies. When decision-making is confined to a governmental party, in comparison, interest groups seek access to individual politicians behind closed doors. Levy and Spiller (1994), in turn, draw on evidence from telecommunications regulation in Argentina, Chile, Jamaica, the Philippines and the United Kingdom to show how regulatory processes shape opportunities for administrative appropriation and manipulation. By extension, the distributive politics of public investment for low-carbon infrastructure is expected to vary significantly across national contexts.

Political systems, parties, and competition matter as well. Crain and Oakley (1995) find that term limits, citizen initiatives, and budgeting procedures significantly determined the distribution of public infrastructure investment across US states in the 1980s. Baskaran et al. (2015) show how in India public power utilities direct more electricity to constituencies which hold special elections, in an effort by the incumbent government to win swing voters. Studies also find evidence for an incumbency bias, whereby governments reward political strongholds (Kemmerling and Stephan 2015).

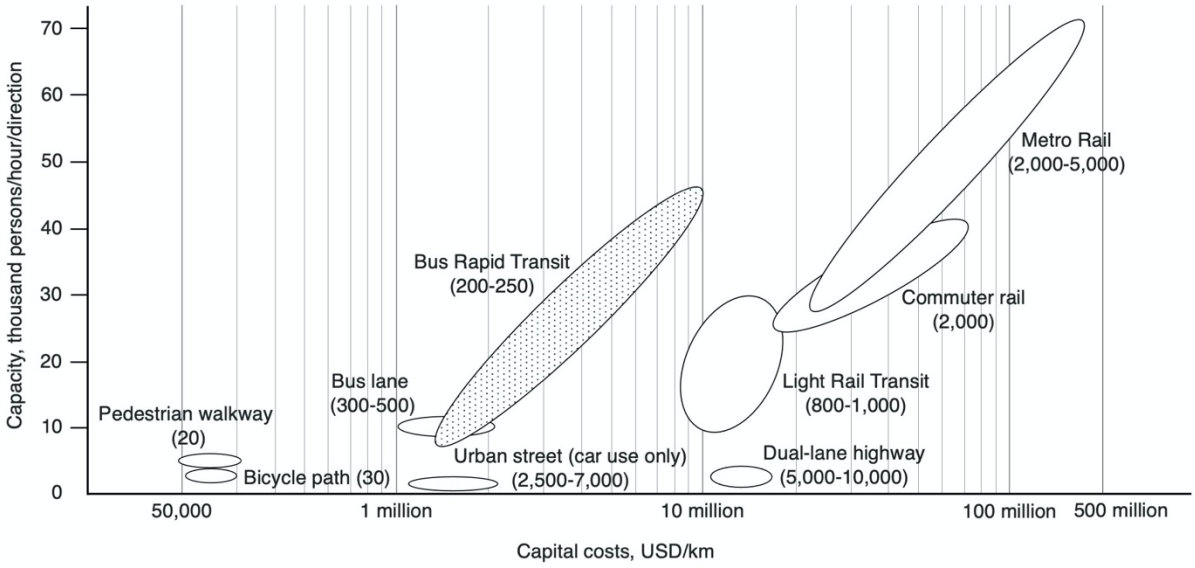
Finally, business interests play a special role. Lindblom (1977) calls attention to the "privileged position of business" in all politics because of its societal function of providing employment. Henisz and Zelner (2006) find that industrial consumers of electricity discipline political actors' incentives for constructing 'while elephants', large infrastructure projects which are prestigious but economically inefficient. Juma (2016) shows how incumbent industries will attempt to stifle or slow down new technological innovations. In other words, superior

technology does not deploy itself. Incumbents are expected to mobilize against innovations that threaten their business, regardless of whether these are seen as 'green' or 'gray.

1.3.3. *Bus Rapid Transit Studies*

The third body of literature specifically looks at BRT systems, the empirical setting of this dissertation. Very generally put, we know that BRT systems are deployed in response to *local demand* for mass transit (Mejía-Dugand et al. 2013; Lindau, Hidalgo, and Facchini 2010). They are critically enabled by *institutional capacity* and *access to financial capital* (Hidalgo and Carrigan 2010; Miller and Buckley 2001; Hidalgo and Graftieaux 2008). BRTs possess advantageous *technological properties*, most notably price and performance (Mejía-Dugand et al. 2013; Hidalgo and Carrigan 2010): BRTs can carry between 10 and 40 thousand passengers per hour per direction, which is comparable to rail-based systems, but are 10 to 100 times cheaper to build (*Figure 3*). From a cost perspective, this makes them attractive to governments with limited access to capital. BRTs are further enabled by *local co-benefits* associated with mass transit, most notably less air pollution, improved traffic safety, and employment (Mejía-Dugand et al. 2013; Venter et al. 2018; Hidalgo and Carrigan 2010; Hidalgo and Huizenga 2013).

Figure 3: Passenger capacity vs. capital costs of urban transport infrastructure



Note. Replicated with modifications from Tattini and Teter (2020). Bracketed figures capture capital cost to capacity ratios.

In short, if local demand and co-benefits shape the infrastructure demand-side, then capacity and access to capital characterize the supply-side. Technological properties act as moderating variables which condition the strength of the supply-side. From a transit planning and policy perspective, deployment unfolds when demand meets supply.

The BRT literature long recognizes that *politics* matters (Miller and Buckley 2001). Studies tend to emphasize three specific dynamics. First, the need for a local champion, such as a

mayor, who 'makes the case' and officially leads the initiative (Mejía-Dugand et al. 2013; Ponnaluri 2011; Ardila and Menckhoff 2002). Second, resistance from paratransit operators, who fear disruption and loss of livelihoods (Miller and Buckley 2001; C. Venter 2013; Asimeng and Heinrichs 2021). Third, opposition from private car owners, who reject a reduction in mixed roads space (Rizvi and Sclar 2014). Policy advice often focuses on ways to overcome resistance to projects, for instance how to formalize and incorporate paratransit operators into BRT operations.

Institutions tend to be approached in two ways. One approach understands institutions as the *organizational, financial, and legal design* of a BRT system, and examines which design features are more or less advantageous to BRT operations. Common topics include, but are not limited to, the tendering process, financial architecture, and fare collection system (ITDP 2017; Venter 2013). The other approach views institutions as political structures which shape deployment processes and project outcomes. Local elections, for instance, can either enable a BRT project by incentivizing incumbent politicians to implement it before the end of their term, or disable a project by destabilizing project leadership (Lindau, Hidalgo, and Lobo 2014; Mejía-Dugand et al. 2013).

The BRT literature speaks to several key themes highlighted by the works on cities and climate change. For instance, both tend to frame local actors, most notably mayors and municipalities, as local champions. Both see capacity and capital as critical enablers of policy change. Both also acknowledge that the main motivation for policy change, be it climate policy or transit reform, is not primarily the mitigation of GHG emissions. GHG abatement is mainly a co-benefit.

Likewise, the BRT literature addresses several topics raised by research on the distribution of public outlays and infrastructure. For example, both conceptualize deployment of infrastructure systems as a process rather than an outcome. Both highlight how political interests can shape policy outcomes. Opposition from paratransit operators, for instance, reflects the more general pattern of incumbent opposition to disruptive innovation. Finally, the BRT literature's understanding of institutions as *political structures*, such as local elections, captures the overarching idea that institutional environments condition the distributive politics of costs and benefits.

1.4. Dissertation Outline

This dissertation extends the above three bodies of literature to investigate the role of *political institutions, political interests,* and *public investment*. Its research goal is to contribute theoretical and empirical insights to the development of a more comprehensive political economic framework on low-carbon infrastructure in cities. Overall, this dissertation speaks to scholarly debates on how to accelerate urban energy transitions, the politics of mass transit policy and planning, and the political economy of low-carbon infrastructure and investment.

In *When Do Cities Deploy Low-Carbon Infrastructure? Evidence from the Global South* (Chapter 2), I investigate which *macro-political institutions* are associated with the deployment of BRT systems. I test whether cities in countries characterized by *political decentralization*, approximated by federalism, are generally more likely to adopt BRT systems. To this end I leverage a novel dataset of 92 BRT adoptions across 138 low- and middle-income countries

between 1970 and 2017. I triangulate evidence from three sets of survival regressions, two at the country-level and a third nested at the city-level. The results show how cities in countries characterized by political decentralization are indeed more likely to adopt BRTs, but only when they are governed by a democratic political system. I do not observe the same positive association in autocratic government contexts. The analysis is the first of its kind to empirically study how macro-political institutions condition urban energy transition outcomes across a large set of cities in the Global South.

In *Governing Rapid Transit: Power Politics and Adaptability* (Chapter 3), I examine how *political interests* alongside *political institutions* shape the deployment and durability of BRT systems. This inductive exercise contextualizes the survival regressions with evidence from 32 expert interviews which I conducted between April and June 2019. I develop two novel analytical frameworks. First, the deployment of BRT systems can be understood as the result of *power politics*. BRT proposals tend to pitch *broad yet shallow support* against *narrow yet fierce opposition*. This renders them inherently contentious. Proposals move forward, however, when implementation generates political benefits for powerful individuals. Second, the durability of BRT systems can be understood in terms of *adaptability* to adverse policy feedback. BRTs often suffer from cycles of adverse policy feedback: operational problems lead to backlash (e.g., from users, car owners, elites), which can exacerbate operational problems and lead to more backlash. Over time, such cycles result in financial instability, loss of social legitimacy, or even closure. This implies, contrary to dominant thinking, that BRTs do not necessarily endure because their operations perform well. Rather, BRTs survive because they successfully adapt to and mitigate adverse policy feedback. Overarchingly, this chapter offers a new analytical vantage point for understanding the politics of transit planning and policy, complementary to more conventional frameworks.

In *Institutional Foundations of Rapid Transit Investment: Evidence from Mexico, Peru, and Colombia* (Chapter 4), I assess how *political institutions* and *interests* interact to either enable or disable *public investment* for mass transit projects. I uncover four meso-political factors which enable accelerated mass transit development in secondary cities: an *institutional actor* who legitimizes and authorizes transfer of state capacity and resources to sub-national projects, a *framework* which facilitates the alignment of national and sub-national policy interests around shared policy goals, a *politically savvy funding mechanism* which disciplines public authority, and a *mechanism of equitable fiscal redistribution*. Taken together, these factors help scale up rapid transit development, especially when there is a policy gap between sub-national regulatory responsibility over urban transport affairs and sub-national capacity to implement transport reform. I examine this argument with a comparative case study of public investment for BRT in two middle-income democracies in Latin America: Mexico and Peru. Mexico adopted 11 BRT systems between 2003 and 2017, whereas Peru deployed only a single BRT corridor within the same timeframe. The chapter shows how the four factors facilitated the creation of a national investment program in Mexico, and how the absence of the four factors in Peru has made mass transit development comparatively more difficult. To strengthen the external validity of the argument, I also triangulate supplementary evidence from Colombia. My methods combine process tracing, historical analysis, and 30 semi-structured interviews which I conducted between June and December 2021. Overarchingly, the chapter offers a new institutional explanation for why Mexico and Colombia, unlike Peru, have been able to scale up

public investment for mass transit development. It thus contributes to the broader debates on how to accelerate into the rapid transit turn and the role of enabling political institutions.

In Chapter 5, I conclude with several avenues for future research and overarching policy implications. Complementary documentation and analyses are offered as supplementary materials at the end of each chapter and in the appendix.

2. When Do Cities Deploy Low-Carbon Infrastructure? Evidence from the Global South

2.1. Introduction

Decarbonization of urban energy systems will require significant deployment of low-carbon infrastructure over the next decades, especially in cities in low- and middle-income countries (Bai et al. 2018; Creutzig et al. 2016; OECD et al. 2018). Cities account for 70% of total energy-related carbon emissions (IEA 2016). Without policy change, urban emissions could increase 50% by 2050 compared to 2013 (*ibid*). Emissions from transport are particularly worrisome, which could nearly double globally from 7.0 Gt CO2eq in 2010 to 12 Gt CO2eq per year by 2050 (Creutzig et al. 2014).[1] The vast majority of this growth is projected to come from cities in non-OECD countries (IEA 2016). Tackling urban carbon emissions in emerging economies is therefore an urgent energy policy objective.

Scholarship on urban energy governance and climate change long recognizes this policy challenge. Keirstead and Schulz (2010) were amongst the first to call attention to the importance of urban energy policy for widespread decarbonization (cf. Lazarus, Chandler, and Erickson 2013; Jaccard et al. 2019). Likewise, Rutter and Keirstead (2012) warned that cities in the Global South will most likely undergo rapid carbonization. More recently, Castán Broto (2017) introduced the concept of energy landscapes to assess how the spatial organization of urban energy systems shapes transition pathways (cf. Castán Broto 2017a).

The institutional and political contexts that could enable or even accelerate widespread adoption of cleaner urban energy systems, however, remain ill understood (Seto et al. 2014; Roberts et al. 2018). While the politics of low-carbon transitions is now widely recognized as a critical research frontier (e.g., Meadowcroft 2011; Hess 2014; Köhler et al. 2019), explanations of urban transition processes continue to heavily rely on case-based evidence from industrialized countries (Grandin et al. 2018). It remains unclear to what extent, if any, urban energy transitions unfold along similar pathways across different levels of economic development in the Global South (Luque-Ayala, Marvin, and Bulkeley 2018; Bai et al. 2018). Moreover, while the transitions literature has taken an institutional turn (Lockwood et al. 2017; cf. Kern 2011), this research has tended to study either how institutional logics shape transition processes (e.g., Fuenfschilling and Truffer 2014) or the institutionalization of transition processes (e.g., Barnes et al. 2018; Strambach and Pflitsch 2020). Less work has assessed how formal political institutions condition cleaner energy system outcomes (Ehnert et al. 2018). In this regard, scholarship on urban energy governance has not yet taken full advantage of the comparative political economy

[1] Covid-19 is unlikely to change this trend and could accelerate it (Quéré et al. 2020; World Bank 2020a).

literature (Lockwood et al. 2017). To advance the debate on how institutional and political contexts condition cleaner energy system outcomes in cities, I combine transition theory with insights from comparative political economy to address the following question: when do cities in low- and middle-income economies deploy low-carbon infrastructure?

I develop and test three expectations. First, I hypothesize countries characterized by political decentralization to be generally more likely to deploy low-carbon urban infrastructure. Political decentralization, understood in terms of the transfer of political authority from national to subnational government (cf. World Bank 2001), will bring decision-makers closer to urban constituents and thereby facilitate known mechanisms of urban carbon mitigation. Second, I theorize that the positive association between political decentralization and greater likelihood of low-carbon infrastructure adoption depends on whether a country is governed democratically. In the absence of stable and effective accountability mechanisms, political decentralization could worsen the prospects of cleaner energy system outcomes. Finally, I expect local offices of international non-governmental organizations advocating for low-carbon energy systems to play an enabling role. This would call attention to international civil society as an important actor for accelerating the deployment of low-carbon urban innovation.

For empirics, I leverage a novel dataset with 92 Bus Rapid Transit (BRT) system deployments across 138 low- and middle-income economies between 1970 and 2017. BRT systems can be defined as a "flexible, rubber-tired form of rapid transit that combines stations, vehicles, services, running ways and information technologies into an integrated system with strong identity" (Levinson et al. 2003). They are an ideal case for studying low-carbon urban infrastructures because they evidence an empirical track record of urban carbon mitigation (Hidalgo and Huizenga 2013; Wirasinghe et al. 2013), have been designated a critical low-carbon innovation by major development institutions (UN-Habitat 2013, 2020b; World Bank 2014), and are relatively well-documented, which helps overcome city-level data scarcity. All BRT adoption dates were manually verified to ensure the empirical assessment builds on the most accurate data possible. Focusing on one type of infrastructure allows to control for cross-system variation. As my methodology I employ three survival regression analyses: two at the country-level and a third nested at the city-level. To my knowledge, this is the first research project to systematically extend theoretical insights on urban energy governance to hypotheses on enabling institutional and political contexts, and to quantitatively test these with evidence from a large set of low- and middle-income economies. The results from the empirical assessment generally support my argument.

The remainder of this chapter is structured as follows: Section 2.2 reviews known mechanisms of urban responses to climate change and develops the hypotheses. Section 2.3 outlines the research design, including the methodology. Section 2.4 documents the data collection, and Section 2.5 presents the empirical results. Finally, Section 2.6 summarizes the main conclusions and derives several policy implications. Supplementary materials are offered in Section 2.7.

2.2. Deployment of Low-Carbon Infrastructure in Cities

2.2.1. *Three Mechanisms from the Literature: Local Co-benefits, Urban Experimentation and Niche Culmination*

Inspired by classical works on clean technology (e.g., Clift 1995) and carbon lock-in (e.g., Unruh, 2000), *low-carbon urban infrastructure* can be defined as any kind of infrastructure that primarily serves constituents in a given urban agglomeration, and evidences fewer greenhouse gas (GHG) emissions over the course of its lifetime compared to either, looking backward in time, historical systems at similar levels of economic development or, looking forward in time, business-as-usual projections. In the context of low- and middle-income economies, low-carbon infrastructure could be labelled *cleaner* innovation, to acknowledge that systems labelled as such can be quite dirty (e.g., GHG-intensive) and that decarbonization in the Global South generally connotes relative rather than absolute decoupling (Loo and Banister 2016; Vadén et al. 2020). I thus use the terms *cleaner* and *low-carbon* interchangeably.

Three major mechanisms from the existing literature on urban responses to climate change serve as a starting point for explaining the deployment of cleaner urban infrastructure systems. The first focuses on *local co-benefits*. Environmental concerns tend to rank low on urban policy agendas, especially in emerging economies, where policymakers often face more immediate development needs (Bulkeley 2010; Hardoy and Romero Lankao 2011). GHG mitigation is therefore an unlikely driver. However, urban climate mitigation often produces significant local co-benefits, such as employment opportunities, better air quality, increases in economic competitiveness, and negative energy costs (Keirstead and Schulz 2010; Bulkeley 2010). Scholars have drawn on co-benefits to solve the mitigation-adaptation paradox (Bulkeley 2011).[2] Co-benefits could also help explain the deployment of low-carbon infrastructure: policymakers will supply cleaner infrastructure systems if these are associated with significant co-benefits for urban constituents.

The second mechanism draws on *urban experimentation.* Deployment of urban innovation requires policy entrepreneurship and social learning. Policymakers face significant policy uncertainties. They need to test how new technologies can cater to urban infrastructure demands (Bulkeley and Castán Broto 2013; Evans, Karvonen, and Raven 2018). Policymakers will shop around for infrastructure solutions and launch pilot projects to assess how infrastructure packages work under real-life conditions and gauge interest group reactions (Castán Broto and Bulkeley 2013). Scholars find that policymakers pursue urban experimentation to realize co-benefits, gain access to external resources, and engage in strategically symbolic and visible governance (Hoffman 2011). By extension, deployment of low-carbon urban infrastructure could be explained as one type of urban experimentation.

The third mechanism looks at *niche culmination*. Classical socio-technical transitions theory (e.g., Geels 2002) posits that low-carbon innovations face entrenched socio-technical systems, which are perpetuated by co-dependent technological and institutional path dependencies (Lachman 2013; Pearson and Foxon 2012). Powerful incumbent interests, which have co-evolved with governing institutions, will stifle or curtail innovations that challenge their

[2] The mitigation-adaptation paradox refers to the counter-intuitive tendency of local governments to pursue mitigation over adaptation policies (Granberg and Elander 2007).

dominant socio-technical position (Unruh 2002; Juma 2016). Low-carbon innovations need to grow from 'cracks' within dominant regimes, to survive incumbent opposition or regulatory capture long enough to culminate (Unruh 2002). Culmination occurs either through *hybridization*, whereby niche innovations gradually merge with dominant systems, or *niche market growth*, whereby innovations grow alongside market expansion (Unruh 2002; Unruh and Carrillo-Hermosilla 2006). Scholars have used niche culmination to conceptualize deployment of renewable energy technology (e.g., Geels et al. 2017), and it could equally help explain deployment of low-carbon urban infrastructure.

Scholars have repeatedly pointed out, however, that our understanding of these mechanisms largely rests on case studies from industrialized economies (e.g., Bai *et al.*, 2018; Grandin *et al.*, 2018). The extent to which they explain variation in *urban* responses generally, and variation in adoption of low-carbon infrastructure in the Global South more specifically, remains understudied (Luque-Ayala, Marvin, and Bulkeley 2018). We still lack basic knowledge of the *institutional and political contexts* that enable the pursuit of local co-benefits, urban experimentation and niche culmination (Seto et al. 2014; Roberts et al. 2018; Bai et al. 2018; Romero-Lankao et al. 2018). To advance this research frontier, in the next section I combine insights from transition theory with lessons from comparative political economy to formulate three hypotheses.

2.2.2. *Hypotheses*

2.2.2.1. *Political Institutions*

Political institutions shape the 'rules of the game' (Crain and Oakley 1995; Levy and Spiller 1994, 1996; Bergara, Henisz, and Spiller 1998).[3] 'The game' refers to the distributive politics of infrastructure deployment (Dubash and Morgan 2012): policymakers, who control the allocation of public outlays, and interest groups, who formulate infrastructure demands, negotiate deployment formally and informally based on the expected distribution of costs and benefits (Levitt and Snyder 1995; Henisz and Zelner 2006; Juma 2016). Such politics will be particularly intense in contexts characterized by lack of public services, weak state capacity, privatized public interests, economic volatility, elite rent seeking and widespread mistrust in public policy (Dubash and Morgan 2012; Post and Murillo 2013). Political institutions such as electoral rules, constitutional checks and balances, and regulatory responsibilities will reward and punish certain types of behavior and thereby structure the distributive politics of deployment. In the context of *urban* infrastructures, this politics will unfold in urban political arenas (Bulkeley 2010; Post 2018). This begs the question which political institutions are associated with greater chances of low-carbon infrastructure deployment, and leads to my first hypothesis:

> *Hypothesis 1: Countries/cities characterized by political decentralization are more likely to deploy low-carbon urban infrastructure.*

At least three theoretical arguments point towards this expectation. First, political decentralization brings policymakers closer to urban constituents (Bardhan and Mookherjee

[3] This is an *interest-based historical institutionalist* theoretical framing (Roberts et al. 2018).

2006; Faguet 2014). The closer policymakers are to constituents, the better they can identify public preferences and, by extension, local co-benefits. Policymakers will thus be more capable of allocating public outlays to infrastructures tailored to identified urban needs. Second, decentralization can provide more opportunities for small-scale experimentation in cities across a country (Arends 2020). Smaller experiments, on the one hand, reduce the cost of policy failure. Policymakers might therefore be more willing to pursue unproven innovations. More experiments, on the other, can help more niche innovations evade unwanted attention by incumbent regimes and increase the likelihood of successful niche culmination. Third, decentralization can increase political competition between local governments and amongst candidates for political office (Faguet 2014; Arends 2020). Competition can incentivize urban experimentation and better governance vis-à-vis the realization of local co-benefits, and simultaneously curtail the power of incumbent socio-technical regimes.

Scholars and policymakers who contend that city governments ought to be empowered with additional legal authority and financial resources to address urban GHG emissions often build on these and related arguments. For example, the latest *Renewables in Cities 2021 Global Status Report* (REN21 2021) frames local governments as champions of renewable innovation and simultaneously highlights how "[o]ne decisive variable in a city's ability to advance the deployment and use of renewable energy is the degree of regulatory and financial power that national governments grant to city governments" (p. 16). The report thus implies that city governments ought to be empowered. Similarly, Bulkeley, Mcfarlane and Macleod (2016) formulate a case for "enhanced urban autonomy". Barber (2017) even goes so far to argue that realization of the Paris Agreement demands a "devolution revolution" (p. 37).

However, there are reasons to be skeptical of such generalized cases for local empowerment. Treisman (2007) shows how theoretical intuitions in support of decentralization can often be reversed. For instance, while decentralization might bring decision-makers closer to constituents, multiple levels of government can equally make it easier to divert responsibility, erode transparency and fuel rent seeking. Decentralization might disincentivize experimentation at the city-level because local decision-makers have more to lose by 'putting all their eggs in one basket'. Decentralization may not spark competition amongst local governments, and even if it does, it can lead to perverse incentives. Atop such theoretical reservations, an expansive literature on decentralization and development offers empirical evidence that decentralization can sometimes *worsen* policy outcomes. Reviews of this scholarship find over a dozen mechanisms whereby decentralization leads to less efficient, equal and accountable public services (Arends 2020; Speer 2012).

Whether or not decentralization is associated with low-carbon infrastructure outcomes is ultimately an empirical question, which justifies the first hypothesis. Furthermore, scholarship that calls for decentralization is often highly empirical but appears to mainly draw on findings from democracies. Bulkeley, Mcfarlane and Macleod (2016), for instance, base their case on the United Kingdom, Brazil, India, and South Africa. Likewise, Barber (2017) cites evidence from cities like London, Oslo, New York and Seoul, all of which are located in democracies. This empirical focus points to regime type (democracy vs. anocracy and autocracy) as an important conditionality for the decentralization argument, and leads to my second hypothesis:

> *Hypothesis 2: The positive association between decentralization and greater likelihood of low-carbon urban infrastructure deployment is more likely to be observed in democracies.*

The main argument here is that political decentralization will only enable the pursuit of *local co-benefits*, *urban experimentation,* and *niche culmination* when it interacts with effective and stable accountability mechanisms. I posit that such mechanisms are more likely to be found in democracies. Competitive elections provide strong electoral incentives to respond to constituents (Faguet 2014; Fiszbein 1997). In competitive democracies political decentralization directs electoral incentives downward to constituents and thereby enfranchises more citizens, public officials, and information into decision-making. By contrast, decentralization in anocracies and autocracies can generate incentives to undermine accountability and transparency.

Importantly, the argument does not preclude policy experimentation in the absence of either decentralization *or* democracy (e.g., Heilmann 2008). Rather, the net effect of decentralization is hypothesized to increase the chances of experimentation when decentralization interacts with democracy. I therefore expect political decentralization and democracy to evidence a positive interaction effect.

2.2.2.2. *International Actors*

Alongside *political institutions*, we know that deployment decisions are significantly shaped by *international actors* (e.g., Dubash and Morgan, 2012). Infrastructure packages are offered and promoted by powerful international interests, such as multinational corporations , multilateral development banks, and international organization (Unruh and Carrillo-Hermosilla, 2006; Murillo and Martínez-Gallardo, 2007). Their influence is particularly strong in weak institutional environments (Dubash and Morgan 2012). The 'urban' politics of urban infrastructure is never solely urban, and instead encompasses multiple complex sets of actors, of which domestic interests, including local governments, are often only one of many (Bulkeley and Betsill 2005). A comparatively new international actor might be associated with cleaner infrastructure outcomes, which leads to the third hypothesis:

> *Hypothesis 3: Countries/cities that host international environmental non-profits advocating for low-carbon urban innovation are more likely to deploy low-carbon urban infrastructure.*

Scholarship shows how environmental non-profits can facilitate *urban experimentation* (e.g., Bulkeley and Castán Broto, 2013; Castán Broto and Bulkeley, 2013). Non-profits can offer technical capacity and expertise to local governments to plan and implement niche innovations (e.g., Welie and Romijn, 2018). Moreover, findings from studies on *urban policy mobilities* (e.g., McCann, 2011; Kennedy and Kennedy, 2016; Levenda, 2019) suggest that international non-state actors can mobilize local political platforms around co-benefits associated with urban sustainability; place climate mitigation as a co-benefit onto urban policy agendas; diffuse and advocate for low-carbon best practices; facilitate social learning; and help local decision-makers gain access to external resources. Through these mechanisms, international ENGOs could be understood as *enabling international actors*.

2.3. Research Design

2.3.1. *Empirical Setting: Bus Rapid Transit*

To test the hypotheses, I look at the deployment of Bus Rapid Transit (BRT) systems across 138 low- and middle-income economies between 1970 and 2017. BRTs are bus-based mass transit systems (Lindau, Hidalgo, and Lobo 2014). Key features like designated lanes, off-board fare collection and station-level boarding allow BRTs to reach passenger capacities similar to subways, but often at a fraction of the capital cost (Deng and Nelson 2013; Mejía-Dugand et al. 2013; Dario Hidalgo and Graftieaux 2008). 1970 is chosen as the starting year of the study period to allow for some time to pass *before* the very first BRT deployment in 1974. 2017 is chosen as the end year because that is the final year on record in the 2018 Rapid Transit Database (ITDP 2018).

Focusing on BRT offers at least four major advantages, which together make the system an ideal case for studying cleaner urban infrastructure. First, BRTs evidence a track record of environmental benefits (Hidalgo and Huizenga 2013; Wirasinghe et al. 2013). Impact evaluations show that BRTs can reduce GHG emissions from urban transport. BRTs can help *avoid* travel through transit-oriented development, *shift* travel to more efficient modes, and *improve* the efficiency of mass transit, for instance through higher average speeds and less idling (Hidalgo and Huizenga 2013). Notably, over half of all transport projects under the Clean Development Mechanisms were BRT projects (IPCC 2020), and major development institutions have designated BRTs a key low-carbon transit system (e.g., UN-Habitat 2013, 2020b; World Bank 2014).

Second, BRTs are well-documented. It has been difficult to systematically study the deployment of cleaner urban innovation across emerging economies because instances of their adoption have either been rare or inconsistently documented. BRTs have not suffered from data scarcity in the same way. Their features and deployments have been documented for over a decade by two international non-profits: EMBARQ, a non-governmental organization (NGO) affiliated with the World Resources Institute (WRI) which was recently re-branded as the WRI Ross Center for Sustainable Cities (BRT+ Centre of Excellence and EMBARQ 2020a), and the Institute for Transportation and Development Policy (ITDP 2018). Their datasets offer a unique empirical starting point for studying cleaner urban innovation.

Third, BRTs have been around for over 45 years. The first deployment can be dated to 1974 in Curitiba, Brazil (Lindau, Hidalgo, and Facchini 2010). From Curitiba, the system diffused to other emerging economies, first to cities in Latin America, then to metro areas in Asia, and most recently to urban agglomerations in Africa (Hidalgo and Gutiérrez 2013). This relatively long history allows for a relatively long study period.

Finally, focusing on one type of system allows to control for cross-system variation. The distributional effects of deployment will differ by infrastructure type. Focusing on BRT makes deployments more comparable across countries and cities. Evidence from case studies on the deployment of BRTs suggests that BRTs have similar distributional effects across different political economic contexts (Lindau, Hidalgo, and Lobo 2014). It is well-documented, for instance, that paratransit operators often organize strong opposition to BRT projects. This dynamic has been observed in Colombia (e.g., Bassett and Marpillero-Colomina, 2013), India

(e.g., Rizvi and Sclar, 2014), South Africa (e.g., Venter, 2013) and Tanzania (e.g., Rizzo, 2015), only to mention a handful of examples.

The deployment of a BRT system is a complex and dynamic process. For the analysis, I narrow deployment down to the adoption stage, defined as the point in time when a system commences public operations. Additional information on why I focus on adoption is provided in the supplementary materials.

2.3.2. *Methodology*

BRT adoption is analyzed with Cox proportional-hazard survival regressions. Survival analysis is a method widely used by studies in Public Health to assess 'time to death' associated with a set of risk factors. Hence the term 'survival'. In this chapter the method captures 'time to BRT adoption' associated with a set of political economic factors. Unlike ordinary least squares regressions, survival analysis allows for censoring: just because a jurisdiction did not adopt a BRT by the end of 2017, the cutoff point of this study, does not preclude subsequent adoption. Survival analyses with time dependent covariates employ a counting process that can be thought of as a lottery system (Therneau, Crowson, and Atkinson 2020): the likelihood of an event happening (e.g., winning the lottery) depends first on whether subjects participate in the lottery, and second on certain characteristics associated with each subject (e.g., how many lottery tickets they bought). For an in-depth explanation of the method I refer to Therneau and Grambsch (2000).

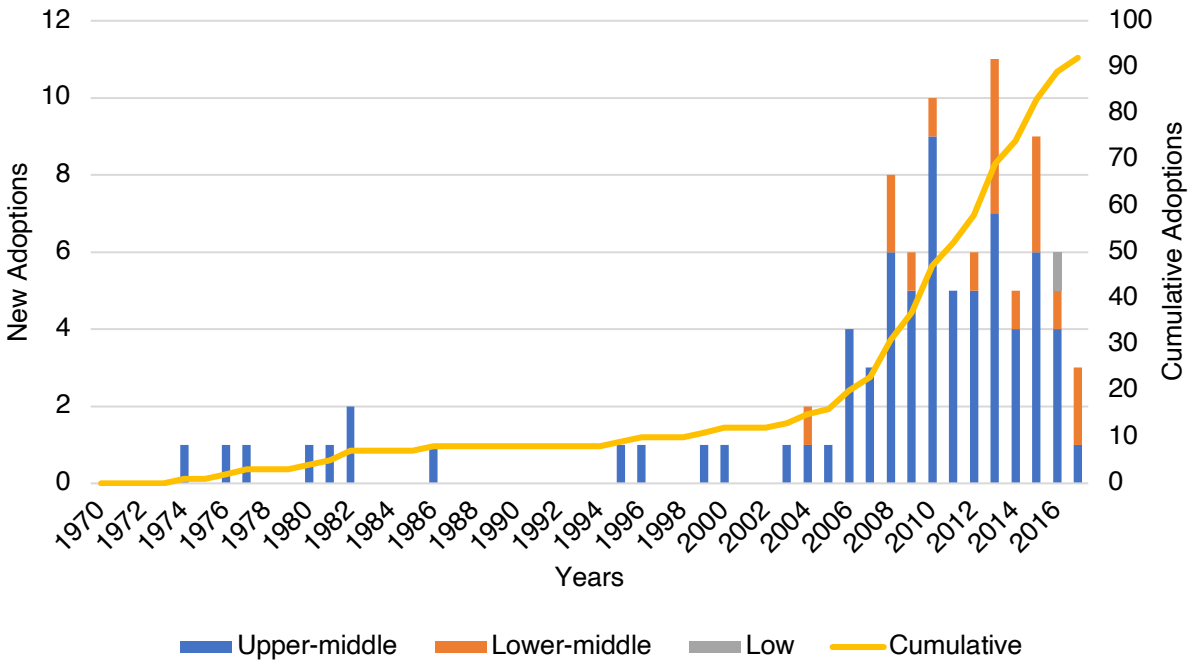
Survival analysis offers further analytical advantages. The method accounts for the temporality of an event. It thus caters to calls from scholars who argue transition research must more explicitly account for and analyze the temporality of transition processes (e.g., Grandin et al. 2018; Roberts et al. 2018). Moreover, the method is well-suited to help explain the occurrence of *rare* events. While BRTs have been deployed across a relatively wide range of countries over a relatively long period of time, their adoption is not the norm. Most cities in the Global South do not have BRTs. Any method that analyzes BRT adoption needs to be sensitive to this pattern.

The study triangulates evidence from three separate analyses at two different scales: the first two are at the country-level, while the third is nested at the city-level. The first employs 'time to first event' models to regress country-level factors onto 'time to first BRT adoption per country'. It assesses how political institutions at a national level, notably political decentralization and democracy, shape deployment patterns. The second analysis repeats the exercise from the first, but with 'multiple events' models, to regress country-level factors onto 'times to multiple BRT adoptions per country'. This reduces data wastage and increases robustness. The third analysis extends the exercise to the subnational level. Just like in the first analysis, the third employs 'time to first event' models, but this time regresses a combination of *national and sub-national factors* onto 'time to first BRT adoption *per city*'. Whereas the first two analyses capture variance across as many emerging economies as possible, the third leverages a stratified global sample of cities from the Atlas of Urban Expansion (Angel, Blei, et al. 2016).

2.4. Data and Coding

BRT adoption dates were collected and verified in four consecutive steps between January and June 2020. First, all BRT systems documented by BRTData.org (BRT+ Centre of Excellence and EMBARQ 2020) and the Rapid Transit Database (ITDP 2018), and located in countries classified by the World Bank between 2008 and 2017 as either low or middle income, were merged into a single spreadsheet. Second, adoption years were cross-referenced. Years that were the same in both databases were considered verified. Adoptions that either differed or were listed in one but not the other dataset were marked for additional cross-referencing. Third, unclear dates were manually cross-referenced through desktop research with assistance from three undergraduate researchers. For robustness, each adoption date was double-cross referenced blindly. Finally, to ensure data quality, I reviewed all manual entries and sources. When necessary, I conducted further research. These four steps resulted in 92 BRT adoptions in 21 economies between 1974 and 2017 (*Figure 4*). Additional documentation of the data collection and coding process is provided in the supplementary materials.

Figure 4: BRT Adoptions by Country Income Group, 1970-2017



Note. Data from author extension of ITDP (2018) and BRT+ Centre of Excellence and EMBARQ (2020). Figure design inspired by BRT+ Centre of Excellence and EMBARQ (2020b).

For the analyses, adoption years are translated into a dichotomous variable (1, 0) reflecting whether or not a country (analysis 1 and 2) or a city (analysis 3) adopts a BRT system in a given year. An overview of all cross-referenced dates, together with their respective justification and sources, is listed in the appendix.

Political decentralization is approximated by *federalism*. Here I follow Andonova, Hale, and Roger (2017) who assert that federalism is the best available proxy for political decentralization that covers a sufficiently large set of countries. They suggest that federalism

serves as a conversative proxy because it measures political decentralization quite narrowly. To enable temporal analysis, the country classifications reported by the Forum of Federations (2020) were extended to capture the year in which a country became federal.

Three further proxies are used to capture different types of decentralization. The first two measure *political decentralization* by whether or not a country held *state-* or *municipal-level elections* in any given year, based on codes from the 2017 Database on Political Institutions (Scartascini, Cruz, and Keefer 2018). To facilitate interpretability, the original categorical codes, which differentiate between two types of elections, were collapsed into dichotomous ones. The third proxy measures *fiscal decentralization* at a *city-level* by the percentage of *own source revenue* raised by local government, as reported by the Global Municipal Finance Database (UN-Habitat 2020a). This data was scraped from the database website. Unlike the first two proxies, the third is not time varying. However, it is the best available standardized data on own source revenue for a relatively large set of cities that corresponds to the stratified global sample of cities from the Atlas of Urban Expansion.[4]

Regime type, that is, whether a country is classified as a democracy, anocracy or autocracy in any given year, is based on the Polity scores reported in the Polity5 dataset (Center for Systemic Peace 2020). *Environmental NGO office* locations and operation dates were collected manually between June and August 2020. I focused on EMBARQ and ITDP field offices, which serve as proxies for regional operations of international non-profits advocating for BRTs. Locations and dates were first collected through desktop research. Wherever necessary, field offices were contacted by email to gather missing data.

The analyses control for competing explanatory factors as best as possible. At the country-level, time-series *GDP per capita* data from the World Development Indicators is used to control for income effects (World Bank 2020c). *CO2 emissions per capita from road transport* from the International Energy Agency's (IEA) CO2 Emissions from Fuel Combustion Statistics database (IEA 2020) are used to control for GHG emissions. While this seems unlikely, for reasons mentioned in Section 2.2, it is worth testing. *Regional effects* are accounted for by a categorical variable that captures a country's geographic region (World Bank 2020b).

At the city-level, standardized panel data on GDP and CO2 emissions are limited.[5] However, other explanatory factors are included. I use a dichotomous variable to account for whether a city is located in a country that has adopted at least one *other BRT*. Deployment of a BRT system in one part of the country could increase the likelihood of deployment elsewhere in the same jurisdiction. Moreover, I use data from the Atlas of Urban Expansion to calculate the average annual change in urban extent, build-up and population between the early 1990s and early 2000s, to account for urban growth. Greater urban sprawl could increase pressures to deploy mass transit. Finally, I account for the historical *road width* of a city, approximated by the share of roads wider than 16 meters before 1990 with data from Volume II of the Atlas of Urban Expansion (Angel, Lamson-Hall, et al. 2016). Designated mass transit corridors need land, which can be scarce in cities. Land appropriation for transport infrastructure is often controversial. All things considered I would therefore expect cities with wide roads to be more likely to adopt BRTs than cities with comparatively narrower road space.

[4] The IMF's (2020) *Fiscal Decentralization Dataset* almost exclusively covers industrialized economies. The *Fiscally Standardized Cities* (FiSC) database only covers US cities (Lincoln Institute of Land Policy 2020).
[5] The World Cities Reports (UN-Habitat 2020b) include city-level GDP data mostly for OECD cities.

Ideally, the analyses would include panel data on urban air pollution, road safety and congestion (UN-Habitat, 2013; World Bank, 2014; ITDP, 2017). Unfortunately, data of this kind does not yet currently exist for a sufficiently large set of countries or cities. The main regressions therefore cannot account for these factors. However, in the supplementary materials I purse several strategies to overcome this data scarcity and mitigate the risk of omitted variable bias. For instance, I present supplementary evidence with time-invariant data from the World Health Organization (WHO): *air pollution* is measured in terms of fine particular matter (PM 2.5) in urban areas as a country average (WHO 2020a), *road safety* is captured by the road traffic death rate (per 100,000 population) (WHO 2020b), and *congestion* is estimated by *vehicle registrations per capita* (WHO 2020c). An overview of all variables is listed in the supplementary materials.

2.5. Empirical Analysis and Findings

2.5.1. *Analysis 1: Time to Adopting First BRT by Country*

The first analysis looks at time to first BRT adoption by country across 138 low- and middle-income economies between 1970 and 2017. By definition, each country can at most evidence one first adoption. Of the 92 verified adoptions 21 are first adoptions. The maximum number of events per model in the first analysis is therefore 21.

Models leverage as much panel data as possible. Variables are time varying, unless specified otherwise. When necessary, I test for reverse causality. The number of observations (*N*) and events vary across models since not all variables were available for all 138 economies for all years between 1970 and 2017. Positive coefficients indicate higher risk of a first event occurring and can be interpreted as greater likelihood of a first BRT adoption associated with a particular variable. Negative coefficients indicate lower risk of a first event occurring and thus capture less likelihood of a first BRT adoption. The results are presented in *Table 3*. Robust standard errors are clustered by country and shown in parentheses.

Model 1 serves as the core model for the first analysis. It supports the first and third hypotheses and shows that both federalism and the presence of ENGO offices are positively associated with the adoption of a first BRT at 99% confidence, after controlling for per capita income. Model 2 extends Model 1 by controlling for region and per capita CO2 emissions from road transport. Sub-Saharan Africa serves as the reference category for the regional variable. The results from Model 1 remain unchanged. Model 2 also picks up on a regional effect in East Asia and Pacific and supports the expectation that GHG emissions are an unlikely driver: the effect of per capita CO2 emissions from road transport is insignificant and close to zero.

Because of the relatively small number of events per model, Models 1 and 2 cannot be freely extended with additional predictors without the analyses running out of iterations. This renders the regional variable relatively costly. Given this trade-off, Models 3-8 control for income but not region. Regional effects are reintroduced in the second analysis, where the larger number of events enables the inclusion of more predictors.

Models 3 and 4 extend the analysis to the second hypothesis. Model 3 suggests that neither democracies nor anocracies are more likely to adopt a first BRT system compared to autocracies, after controlling for federalism, ENGO offices and per capita income. In fact, both coefficients are negative, even though they are not significant. In Model 4 the effect of regime

type remains insignificant, but there is a significant positive interact between federalism and regime type: the likelihood of a first adoption is much higher where federalism interacts with democracy or anocracy compared to autocracy. Notably, the effect of federalism turns negative yet remains significant. This supports the argument that jurisdictions characterized by political decentralization are significantly more likely to adopt BRT systems when they are democratic.

Models 5-8 test hypotheses two again, but instead of controlling for regime type they include proxies for subnational elections. This accounts for the possibility that federalism can, but may not, entail subnational elections. Model 5 shows that national jurisdictions characterized by state-level elections are not necessarily more likely to adopt a first BRT. Model 6, however, reveals a highly significant positive interaction between federalism and state-level elections, and a negative coefficient for federalism. Considering the similar results from Model 4, state-level elections can be interpreted as an alternative proxy for democracy.

Models 7 and 8 replicate Models 5 and 6 but for municipal elections. Similar to Model 5, Model 7 does not find an effect for municipal elections. The results from Model 8, however, are surprising: here the effect of federalism stays positive, but the interaction between federalism and subnational elections turns negative. The likelihood of a first adoption decreases where federalism interacts with municipal elections. These results need to be interpreted with caution, however, since they might be driven by the restricted sample of economies for which data on municipal elections are available.

Further statistical analyses are offered in the supplementary materials to assess the robustness of these results. They show that the results do not significantly change after testing the ENGO predictor for reverse causality and adding additional controls, including proxies for urban congestion, air pollution and road safety.

Table 3: Analysis 1 – Time to Adopting First BRT by Country

	Core Model	Core + Region + CO2	Core + Regime		Core + Political Decentralization			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Federalism (H1)	1.81***	1.45**	1.72***	-14.19***	1.66***	-16.05***	1.68***	3.78***
	(0.42)	(0.59)	(0.42)	(0.90)	(0.52)	(0.93)	(0.56)	(1.14)
ENGO country office (H3)	3.92***	3.39***	3.84***	3.85***	3.57***	3.48***	3.29***	3.36***
	(0.56)	(0.59)	(0.57)	(0.55)	(0.59)	(0.62)	(0.52)	(0.52)
Log GDP per capita	0.63***	0.57	0.67***	0.62***	0.67***	0.61***	0.71***	0.71***
	(0.18)	(0.36)	(0.19)	(0.17)	(0.17)	(0.17)	(0.21)	(0.21)
Region East Asia & Pacific		1.31*						
		(0.78)						
Region Europe & Central Asia		-1.48						
		(0.95)						
Region Latin America & the Caribbean		0.74						
		(0.71)						
Region Middle East & North Africa		-0.58						
		(1.02)						
Region South Asia		-0.17						
		(1.00)						
Road CO2 per capita		0.00						
		(0.00)						
Regime Democracy			-0.50	-0.49				
			(0.78)	(0.78)				
Regime Anocracy			-0.49	-0.87				
			(0.82)	(0.96)				
Regime Democracy * Federalism (H2)				15.72***				
				(1.05)				
Regime Anocracy * Federalism (H2)				16.43***				
				(1.39)				
State elections					-0.13	-0.39		
					(0.51)	(0.65)		
State elections * Federalism (H2)						18.00***		
						(1.25)		
Municipal elections							0.01	0.65
							(0.80)	(1.09)
Municipal elections * Federalism (H2)								-2.35**
								(1.15)
N (Number of events)	5175 (21)	3116 (21)	4449 (21)	4449 (21)	3042 (20)	3042 (20)	2351 (17)	2351 (17)
Log likelihood ratio test	49 on 3 df, p=1e-10	49.66 on 9 df, p=1e-07	48.1 on 5 df, p=3e-09	49.08 on 7 df, p=2e-08	42.37 on 4 df, p=1e-08	43.89 on 5 df, p=2e-08	37.27 on 4 df, p=2e-07	39.33 on 5 df, p=2e-07
AIC	157.57	147.33	156.02	159.04	140.40	140.88	115.05	114.99

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. Models 4, 5, 6 and 8 evidence minor violations of the proportional hazard assumption and therefore need to be interpreted with caution. Wald test scores for Models 4 and 6 need to be ignored because 'loglik' converged before some of their variables. Their likelihood ratio test scores, however, still hold (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

2.5.2. *Analysis 2: Time to Adopting Multiple BRTs by Country*

The second analysis repeats all steps from the first, but with two major distinctions that reduce data wastage and increases robustness: it accounts for multiple BRT adoptions per country and controls for regional effects in all models. Although the second analysis leverages significantly more events than the first, it too cannot leverage all 92 adoptions. The maximum number of events per model is 72. The reason for this limitation is that multiple event models can at most account for one event per period, yet a handful of jurisdictions experienced multiple adoptions per period. The analysis therefore tends to underestimate the effect of countries with multiple events per year.

Multiple event survival regressions come in different variations (Therneau and Grambsch 2000). The model specifications were determined in two steps. First, different BRT adoptions were assumed to constitute a same type of event. Multiple adoptions by country are understood as *ordered* events. Second, the *ordered events models* are further specified as *conditional*. Here the assumption is that subjects cannot be at risk of an *n*th event until event $n - 1$ has occurred (Therneau and Grambsch 2000, p. 187).[6] Time could be captured either through 'time since entry' or 'conditional gap time'. To facilitate the transferability of the dataset from the first analysis, the second analysis employs 'time since entry'. All results are shown in *Table 4.*

As in the first analysis, Model 1 serves as the core model. Federalism stays positive and highly significant at 99% confidence, but there is no longer an effect associated with ENGO offices. In fact, the presence of an ENGO office loses its significance in all subsequent models. This suggests that ENGOs are helpful to get deployment started but are less important once a domestic demonstration project exists. Model 2 adds per capita carbon emissions from road transport and shows that the results from Model 1 remain unchanged.

Models 3 and 4 extend the analysis to the second hypothesis and include regime type. Model 3 reflects the findings from the preceding two, but additionally finds a significant negative effect for democracy and anocracy. Model 4 adds an interaction between federalism and regime type, which is positive and highly significant at 99% confidence for both democracy and anocracy. Federalism stays highly significant but turns negative. The findings from Model 4 thus further support the argument that political decentralization must interact with democracy to increase the likelihood of cleaner infrastructure deployment, and otherwise has a negative effect.

Models 5-8 test the second hypothesis again, but instead of controlling for regime type add proxies for subnational elections. Models 5 and 7 show that subnational elections on their own are not significant. Model 6 finds a positive and highly significant interaction between federalism and state elections, and thus mirrors the findings from Model 4. The interaction between federalism and municipal elections in Model 8 is insignificant. Additional model specifications and robustness checks are documented in the supplementary materials.

[6] Multiple adoptions within the same jurisdiction can neither be assumed to be mutually independent nor to constitute a renewal process, which preclude the Anderson-Gill variation. The models could be conceptualized as a competing risk problem. However, because adoptions within a single jurisdiction are not mutually exclusive, evidenced by jurisdictions with multiple events per period, I posit that the conditionality variation is the more appropriate specification.

Table 4: Analysis 2 – Time to Adopting Multiple BRTs by Country

	Core	Core + CO2	Core + Regime Type		Core + Political Decentralization			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Federalism (H1)	1.44***	1.15***	1.45***	-15.35***	1.04**	-15.52***	1.27**	3.11***
	(0.43)	(0.40)	(0.48)	(0.94)	(0.53)	(0.83)	(0.52)	(1.13)
ENGO country office (H3)	0.92	0.78	0.82	1.03	0.81	0.79	0.63	0.68
	(0.83)	(0.60)	(0.90)	(0.81)	(0.66)	(0.68)	(0.62)	(0.61)
Log GDP per capita	0.45**	0.79**	0.61***	0.60***	0.45**	0.43**	0.67***	0.71***
	(0.22)	(0.34)	(0.21)	(0.23)	(0.22)	(0.21)	(0.23)	(0.25)
Region East Asia & Pacific	0.75	0.99	0.88	0.74	0.93	0.91	1.11*	1.31*
	(0.66)	(0.72)	(0.55)	(0.58)	(0.63)	(0.63)	(0.59)	(0.67)
Region Europe & Central Asia	-1.27	-1.77*	-1.63*	-1.82*	-0.97	-1.00	-1.07	-0.88
	(0.90)	(0.91)	(0.96)	(0.99)	(0.89)	(0.89)	(0.82)	(0.90)
Region Latin America & the Caribbean	0.63	0.52	0.72	0.72	0.68	0.64	0.39	0.59
	(0.54)	(0.53)	(0.49)	(0.59)	(0.57)	(0.57)	(0.46)	(0.60)
Region Middle East & North Africa	0.44	0.13	-0.07	-0.12	0.36	0.37	0.30	0.46
	(0.85)	(0.77)	(0.77)	(0.87)	(0.83)	(0.83)	(0.84)	(0.91)
Region South Asia	1.40***	1.54***	1.67***	1.77***	1.37***	1.32**	1.61***	1.90***
	(0.47)	(0.52)	(0.52)	(0.55)	(0.50)	(0.51)	(0.48)	(0.62)
Road CO2 per capita		0.00						
		(0.00)						
Regime Democracy			-1.06*	-0.93				
			(0.61)	(0.64)				
Regime Anocracy			-1.39**	-2.19***				
			(0.56)	(0.84)				
Regime Democracy * Federalism (H2)				16.36***				
				(1.06)				
Regime Anocracy * Federalism (H2)				18.14***				
				(1.27)				
State elections					0.51	0.42		
					(0.50)	(0.56)		
State elections * Federalism (H2)						16.66***		
						(1.12)		
Municipal elections							0.64	1.16
							(0.67)	(1.01)
Municipal elections * Federalism (H2)								-1.95
								(1.23)
N (Number of events)	5393 (72)	3334 (72)	4667 (72)	4667 (72)	3260 (71)	3260 (71)	2546 (61)	2546 (61)
Log likelihood ratio test	40.21 on 8 df, p=3e-06	38.98 on 9 df, p=1e-05	49.79 on 10 df, p=3e-07	54.15 on 12 df, p=3e-07	36.25 on 9 df, p=4e-05	37.08 on 10 df, p=5e-05	34.11 on 9 df, p=9e-05	35.48 on 10 df, p=1e-04
AIC	238.35	219.98	226.32	225.96	218.50	219.67	184.96	185.59

Note. Time to multiple event Cox proportional hazard regressions (ordered event conditional variation): positive coefficients indicate higher likelihood of adoption whereas negative coefficients indicate lower likelihood of adoption. Robust standard errors are clustered by country and shown in parentheses. All models are stratified by event number. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. All models except 2 and 7 evidence minor violations of the proportional hazard assumption, and therefore need to be interpreted with caution. Wald test scores for Models 4 and 6 need to be ignored because 'loglik' converged before some of their variables. Their likelihood ratio test scores, however, still hold (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

2.5.3. *Analysis 3: Time to Adopting First BRT by City*

The third analysis is nested at the subnational level. Like the first, it looks at time to first adoption, but this time by city instead of by country. To this end it draws on the globally representative sample of cities developed for the Atlas of Urban Expansion (Angel, Blei, et al. 2016; Angel, Lamson-Hall, et al. 2016). The sample is stratified by world region, the number of cities in any given country, and the population size of any given city. The analysis looks at the 147 cities that fall into countries classified by the World Bank as either low- or middle-income. These 147 cities come from 55 countries and evidence 29 first BRT adoptions between 1970 and 2017. For detailed documentation on the sampling methodology I refer to Angel, Blei, et al. (2016).

Data limitations remain pervasive at a city-level. Compared to the first two analyses, the third therefore includes more time-invariant predictors. To increase the robustness of these predictors, the analysis employs shorter time periods: the models start either in 1990 or 2000 instead of 1970. None of the models capture all 29 first adoptions, either because predictors do not cover all cities or periods, or because of the shorter time periods. The results are shown in *Table 5.*

The analysis itself falls into two parts. The first (Models 1-3) starts in 1990 and tests whether *fiscal decentralization*, approximated by own source revenue, is associated with greater likelihood of a first BRT adoption. Model 1 suggests that, unlike own source revenue, both the presence of a city-level ENGO office and country-level per capita income are positively and significantly associated with the adoption of a first BRT system. Model 2 shows that regime type on its own does not have an effect. However, as predicted by theory, Model 3 evidences a positive and significant interaction between own source revenue and democracy: cities that report comparatively high levels of own source revenue are indeed more likely to adopt a first BRT system when located in a democracy. In the supplementary materials I show how these results remain robust when one replaces own-source revenue with federalism.

The second part of the analysis (Models 4-6) starts in 2000 and tests the robustness of the ENGO city office predictor. Although the models use a shorter time period than those in the first part, they capture up to 26 first BRT adoptions. Because all predictors are at the city-level, the models are stratified by country. Model 4 finds that the presence of an ENGO office at a city-level has a positive and significant effect, after accounting for the presence of at least one other BRT in the same country and the average annual change in urban population between the early 1990s and early 2000s. The presence of another BRT is highly significant but negative. In fact, the coefficient is strikingly large and serves as a reminder that BRT adoptions are rare events: most countries possess at most one BRT system, which is why the likelihood of a second system will decrease if one stratifies by country. Model 5 adds road width as an additional control variable. Here, the presence of an ENGO office loses significance, whereas road width is shown to be significant and positive. Model 6 further adds own-source revenue and shows that the ENGO city office predictor regains significance, but must be discounted due to the much smaller number of observations and events. Several additional robustness checks are documented in the supplementary materials.

Table 5: Analysis 3 – Time to Adopting First BRT by City

	Part I			Part II		
	Core	Core + Regime Type		ENGO + Additional Controls		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Own source revenue (time-invariant) (H1)	0.39	0.44	0.13			0.27
	(0.27)	(0.29)	(0.30)			(2.23)
ENGO city office (H3)	2.70***	2.80***	2.51***	1.52***	1.07	1.54***
	(0.48)	(0.58)	(0.65)	(0.47)	(0.71)	(0.53)
Log GDP per capita	0.62**	0.65**	0.71*			
	(0.31)	(0.32)	(0.37)			
Regime Democracy		0.09	-1.44			
		(0.65)	(1.07)			
Regime Anocracy		0.37	-0.07			
		(1.02)	(1.17)			
Regime Democracy * Own source revenue (H2)			2.24**			
			(0.98)			
Regime Anocracy * Own source revenue (H2)			0.48			
			(1.52)			
Other BRT				-20.85***	-20.59***	-20.78***
				(0.31)	(0.34)	(0.54)
Change in urban population (time-invariant)				3.41	4.08	4.22
				(3.74)	(3.31)	(4.26)
Road width (time-invariant)					10.77***	12.20
					(3.64)	(9.42)
N (Number of events)	1464 (13)	1451 (13)	1451 (13)	2399 (26)	2399 (26)	992 (14)
Log likelihood ratio test	12.24 on 3 df, p=0.007	12.43 on 5 df, p=0.03	15.17 on 7 df, p=0.03	17.6 on 3 df, p=5e-04	21.63 on 4 df, p=2e-04	12.46 on 5 df, p=0.03
AIC	95.88	99.62	100.88	81.09	79.06	28.11

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. Models 4-6 are stratified by country. All models fulfil the proportional hazard assumption. Wald test scores for Models 4-6 need to be ignored because 'loglik' converged before 'ENGO city office'. Their likelihood ratio test scores, however, still hold (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

2.5.4. *Summary of results*

The results from all three analyses are summarized in *Table 6.* The first hypothesis posited that countries and cities characterized by political decentralization ought to be more likely to deploy cleaner urban infrastructure. The findings from analyses one and two support this expectation. Countries that are politically decentralized are indeed more likely to adopt both a first BRT system and multiple BRT systems. Several robustness checks support this finding (see the supplementary materials). The third analysis, which extends the exercise to fiscal decentralization at the city-level, however, does not find a significant effect associated with own source revenue. That being said, own-source revenue is amongst the weakest variables in the analysis. Its non-supportive evidence could therefore reflect data limitations.

The second hypothesis theorized that the positive effect of decentralization depends on democratic government. The results from all three analyses support this expectation. Politically decentralized countries, when they are governed democratically, are significantly more likely to adopt both a first BRT and multiple BRTs. Similarly, cities that control larger shares of their municipal budget are indeed more likely to adopt a BRT system when they are located in a democracy. The overall effect of decentralization is driven by adoption in democracies. I do not observe the same relationship in autocratic contexts.

Table 6: Summary of results

Hypothesis	*Political Decentralization*		*Fiscal Decentralization*	
	Analysis 1: First event by country	Analysis 2: Multiple events by country	Analysis 3: First event by city	
			Part I	Part II
1. Countries/cities characterized by decentralization are more likely to deploy low-carbon urban infrastructure.	*Supportive*	*Supportive*	*Not supportive*	*Not supportive*
2. The positive association between decentralization and greater likelihood of low-carbon urban infrastructure deployment is more likely to be observed in democracies.	*Supportive*	*Supportive*	*Supportive*	*NA*
3. Countries/cities that host international environmental non-profits advocating for low-carbon urban innovation are more likely to deploy low-carbon urban infrastructure.	*Supportive*	*Not supportive*	*Supportive*	*Mixed*

Note. Including all robustness checks in the supplementary materials, the analyses encompass 61 different models.

The third hypothesis proposed that countries or cities hosting an international ENGO advocating for cleaner urban energy systems ought to be more likely to deploy cleaner innovation. Here the results are mixed. At a country-level, the first analysis is supportive. Countries that host an ENGO are indeed more likely to adopt a first BRT system. However, this effect does not hold for multiple adoptions. This suggests that ENGOs play an important role for enabling a country's first domestic demonstration project but are less critical for subsequent deployments.

Nonetheless, a country ENGO office is a very narrow proxy for non-profit activity. Since ENGO engagement will extend to countries without a permanent local presence, this result does not preclude ENGOs as an important enabling actor.

Beyond these main results, two additional findings stand out. First, several country-level models that account for regime type show that coefficients associated with democracy and anocracy tend to be negative. In the second analyses several of these predictors gain significance. This raises questions about which regime types are conductive to the deployment of cleaner urban energy systems in the absence of political decentralization. Second, the effect of per capita CO2 emissions is practically zero in all models. This strengthens the assertion that GHG emissions are an unlikely enabling factor for cleaner infrastructure deployment.

2.6. Conclusion and Policy Implications

This chapter explains variation in the deployment of low-carbon infrastructure across cities in low- and middle-income countries. It is the first research project to systematically extend theoretical insights on local co-benefits, urban experimentation, and niche culmination to hypotheses on enabling institutional and political contexts, and to test these with evidence from a large set of emerging economies. It finds that countries characterized by political decentralization are generally more likely to adopt cleaner urban infrastructure. The positive effect of decentralization, however, critically depends on the presence of democratic governance. This is consistent with the chapter's argument that political decentralization incentivizes the pursuit of local co-benefits, urban experimentation, and niche culmination only when accompanied by effective and stable accountability mechanisms. Alongside political institutions, international civil society can play an enabling role. The results show that the local presence of an international ENGO advocating for cleaner urban energy systems significantly increases the chances of a domestic demonstration project.

The empirical assessment leveraged a novel dataset of 92 BRT system deployments across 138 low- and middle-income economies between 1970 and 2017. All adoption dates were manually cross-referenced to ensure that the assessment builds on the most accurate data possible. The research design is novel in how it overcomes data scarcity, controls for cross-system variation, and employs a methodology that accounts for censoring, temporality, and rare events. The assessment tested both country- and city-level predictors, and triangulated evidence from 61 statistical models.

The study offers three major policy implications. First, the results show how formal political institutions critically condition the deployment of low-carbon urban infrastructure. Policy interventions that advance the decarbonization of urban energy systems are enabled by political decentralization, but only in institutional context that are governed democratically. This finding contributes to the recent institutional turn in energy transition scholarship (Lockwood et al. 2017; Strambach and Pflitsch 2020).

Second, calls by scholars and policymakers for 'enhanced urban autonomy' (Bulkeley, Mcfarlane, and Macleod 2016; cf. REN21 2021), or even a 'devolution revolution' (Barber 2017), must be qualified by political regime type. The link between political decentralization and deployment of low-carbon innovation appears to depend on accountable decision-making, which

cannot be assumed to exist across all political economic contexts. In the absence of credible accountability mechanisms, subnational empowerment might impair urban decarbonization.

Third, international civil society can help drive decarbonization of urban energy systems. Alongside local capacity building and international climate finance, international civil society offers another promising pathway to enable widespread deployment of low-carbon innovation. The assessment finds no evidence that urban GHG emissions explain the deployment of low-carbon infrastructure. To be effective, policies to reduce urban GHG emissions will have to deliberately leverage drivers other than GHG mitigation.

The results point towards several future research needs. For one, the hypotheses will have to be extended to different types of low-carbon urban infrastructure, complemented by nested comparative case studies that strengthen our understanding of their causal mechanisms, and re-tested as better standardized panel data on urban congestion, air pollution and road safety become available. For another, future research will have to assess how, why and under what conditions non-profits facilitate urban energy transition processes. It could be invaluable to better understand the historical origins and behavior of international non-profits that enable low-carbon innovation. Finally, there is a need to study the *durability* of cleaner urban energy systems. Deployment of cleaner infrastructure alone will not suffice to reduce urban GHG emissions. Cleaner infrastructure must 'survive' over decades to reduce environmental impacts. A handful of BRT systems, however, have been closed or even fully dismantled (Nguyen and Pojani 2018). The reasons for their demise are not yet sufficiently understood.

The literature on urban energy governance and climate change is just beginning to leverage insights from comparative political economy to better understand the institutional and political contexts that could enable or even accelerate widespread deployment of low-carbon infrastructure in cities in the Global South. Both the possibilities and limitations of urban low-carbon transitions in low- and middle-income cities remain understudied, although it is precisely these cities that evidence the greatest potential to avoid future GHG emissions. As urban GHG emissions continue to grow, the need to uncover more effective pathways for urban decarbonization will only become more urgent.

2.7. Supplementary Materials

2.7.1. *Overview of variables*

All variables used in the regressions are listed in Tables 7-9.

Table 7: Variables

Variable	Definition	Sources	Unit	Panel	Min.	Max.	Mean	S.D.
Dependent Variables								
Analysis 1: First BRT adoption by country	Dichotomous variable reflecting whether or not a country adopts a first BRT system in a given year	Author extension of BRT+ Centre of Excellence and EMBARQ (2020) and ITDP (2018) [(a)]	Country	1970 - 2017	0	1	0.003	0.057
Analysis 2: Multiple BRT adoptions by country	Dichotomous variable reflecting whether or not a country adopts a BRT system in a given year	Author extension of BRT+ Centre of Excellence and EMBARQ (2020) and ITDP (2018) [(a)]	Country	1970 - 2017	0	1	0.011	0.104
Analysis 3: First BRT adoption by city	Dichotomous variable reflecting whether or not a city adopts a first BRT system in a given year	Author extension of BRT+ Centre of Excellence and EMBARQ (2020) and ITDP (2018) [(a)]	City	1970 - 2017	0	1	0.004	0.065
Institutional Variables								
Federalism	Dichotomous variable reflecting whether a country is federal	Author extension of Forum of Federations (2020) [(a)]	Country	1970 - 2017	0	1	0.063	0.243
Democracy, Anocracy or Autocracy	Categorical variable capturing a country's regime type	Author extension of Center for Systemic Peace (2020) [(a)]	Country	1970 - 2017	NA	NA	NA	NA
State elections	Dichotomous variable reflecting whether a country holds political elections at the state level	Author extension of Scartascini, Cruz, and Keefer (2018) [(a)]	Country	1975 - 2017	0	1	0.486	0.500
Municipal elections	Dichotomous variable reflecting whether a country holds political elections at the municipal level	Author extension of Scartascini, Cruz, and Keefer (2018) [(a)]	Country	1975 - 2017	0	1	0.724	0.447
Own source revenue	Percentage of revenue raised by local government, excluding intergovernmental transfers	UN-Habitat (2020)	City	NA	0	4.498	0.574	0.607

Note. Minimums, maximums, means and standard deviations (S.D.) are calculated using all available observations for a given variable. Summary statistics of variables used by several analyses (e.g., federalism) reflect the values associated with the first analysis.
(a) Further documentation in the supplementary materials.

Table 8: Variables (Continued)

Variable	Definition	Sources	Unit	Panel	Min.	Max.	Mean	S.D.
Country-level Variables								
NGO country office	Dichotomous variable reflecting whether a country hosts at least one NGO office	Coded by author [(a)]	Country	1970 - 2017	0	1	0.002	0.043
GDP per capita	GDP per capita (current US$)	World Bank (2020)	Country	1970 - 2017	58	16932	1832	2203
Road CO2 per capita	CO2 emissions per capita (kg CO2/capita) attributed to road transport	International Energy Agency (2020)	Country	1971 - 2017	0	3140	383	375
East Asia & Pacific, Europe & Central Asia, Latin America & the Caribbean, Middle East & North Africa, South Asia, or Sub-Saharan Africa	Categorical variable reflecting the geographical region of a country	World Bank (2020a)	Country	NA	NA	NA	NA	NA
City-level Variables								
NGO city office	Dichotomous variable reflecting whether a city hosts at least one NGO office	Coded by author [(a)]	City	1970 - 2017	0	1	0.005	0.068
Other BRTs	Dichotomous variable reflecting whether at least one other city has adopted a BRT system in the same country	Coded by author [(a)]	City	1970 - 2017	0	1	0.185	0.388
Change in urban extent	Average annual change in urban extent (ha) between late 1980s/early 1990s and late 1990s/early 2000s	Author extension of Angel *et al.* (2016) [(a)]	City	NA	0.009	0.404	0.070	0.068
Road width	Share of roads wider than 16 meters before 1990	Angel, Lamson-Hall, *et al.* (2016)	City	NA	0.000	0.319	0.109	0.061

Note. Minimums, maximums, means and standard deviations (S.D.) are calculated using all available observations for a given variable. Summary statistics of variables used by several analyses (e.g., federalism) reflect the values associated with the first analysis.
(a) Further documentation in the supplementary materials.

Table 9: Variables (Continued)

Variable	Definition	Sources	Unit	Panel	Min.	Max.	Mean	S.D.
Additional Variables								
Road safety	Estimated road traffic death rate (per 100 000 population)	World Health Organization (2020b)	Country	NA	0.900	35.90	20.416	8.261
Urban air pollution	Concentrations of fine particulate matter (PM2.5) in urban areas, as a country average	World Health Organization (2020a)	Country	NA	7.700	99.500	28.269	15.316
Vehicle registrations per capita	Number of registered vehicles per capita	Author extension of World Health Organization (2020c) [(a)]	Country	NA	0.004	0.900	0.175	0.160
Change in urban build-up	Average annual change in urban build-up (ha) between late 1980s/early 1990s and late 1990s/early 2000s	Author extension of Angel *et al.* (2016) [(a)]	City	NA	0.013	0.845	0.119	0.152
Change in urban population	Average annual change in urban population between late 1980s/early 1990s and late 1990s/early 2000s	Author extension of Angel *et al.* (2016) [(a)]	City	NA	-0.022	0.512	0.054	0.064

Note. Minimums, maximums, means and standard deviations (S.D.) are calculated using all available observations for a given variable. Summary statistics of variables used by several analyses (e.g., federalism) reflect the values associated with the first analysis.
(a) Further documentation in the supplementary materials.

2.7.2. *Additional notes on the sample: country income classifications*

The World Bank updates country income classifications on an annual basis (World Bank 2020d). To increase the robustness of the analyses, my sample includes all countries which between 2008 and 2017 were classified as either low income, lower middle-income and/or upper middle-income at least seven out of ten times. For example, Argentina was classified as upper-middle income eight times (2008-2013, 2015, and 2016) and high-income two times (2014 and 2017). For the purpose of the study, Argentina is therefore treated as an upper middle-income economy. Chile, in comparison, was classified as upper-middle income four times (2008-2011) and high income six times (2012-2017). Chile is therefore treated as a high-income economy and excluded from the analysis.

2.7.3. *Additional notes on selected variables*

2.7.3.1. *BRT adoption dates*

To ensure that the empirical assessment builds on the best available data, each unclear BRT adoption date was manually cross-referenced as rigorously as possible and on average for over an hour. Multiple sources sometimes listed conflicting dates. In such instances, sources were weighted against each other to determine the date used by the analysis. When there was clear evidence of an adoption, yet there were two credible conflicting dates, I used the later date as a more conservative proxy. When there was evidence of a BRT project, but if it remained unclear if the system had commenced operations as of 2017, I erred on the side of caution and excluded the system from the analysis. A comprehensive list of all cross-referenced dates, together with their respective justifications and sources, is provided in section 4.1. of this appendix.

Despite these efforts to determine dates as carefully and accurately as possible, there are four reasons why BRT adoption years must be interpreted as approximations. First, the definition of what constitutes a BRT remains contested. While the term Bus Rapid Transit can be traced back to the 1960s, the label has only been widely used since the early 2000s. Sources that predate the 2000s therefore rarely explicitly label bus priority systems as BRTs, even if many systems have been labeled as such retrospectively. This makes it difficult to cross-reference BRT adoptions in the 1970s, 80s and 90s with historical documents. Moreover, although the BRT Standard (ITDP 2016) was developed to clarify definitional issues, the definition of what constitutes a full BRT has evolved over time alongside technological advancements. A system that could have been classified as a full BRT in the past, might no longer fulfill all definitional criteria today. Additionally, systems are sometimes described as “lesser” or “light” BRT systems, raising the question to what extent, if any, these systems qualify as BRTs. In short, the line between BRTs and bus priority systems can be fuzzy. In general, when sources labelled a system as a BRT, and if no source contradicted this classification, I assumed that the label was accurate. Systems labelled “lesser” or “light” BRT systems were classified as BRTs.

Second, there is no set definition of adoption. Constituting a major urban infrastructure project, the deployment of a BRT system is a complex and dynamic process. The project first

needs to be envisioned and proposed; then the system needs to be planned, financed, and constructed; and finally, it needs to be tested, inaugurated, and operationalized, only to mention the key steps. What complicates matters further is that these steps do not necessarily follow a set sequence. Sometimes systems are opened before the construction is completed (Hidalgo and Carrigan, 2010). Sometimes BRTs are re-launched after inauguration (e.g., Amritsar, India). Some BRTs are officially opened, although they are technically merely modernized or expanded (e.g., several systems in Brazil in the run-up to the 2014 World Cup). Official planning documents, policy briefings and press articles rarely address such definitional issues, and often conflate intended dates with actual dates. For the analysis, I narrow deployment down to the adoption stage, defined as the point in time when operations begin, *regardless* of whether the construction has been completed and the system has reached its intended size.

Third, the dataset may suffer from false positives. Some BRT systems are officially inaugurated and begin operations, but never reach their intended size (e.g., Bangkok, Thailand). Some systems are fully implemented but not serviced as originally planned (e.g., San Salvador, El Salvador). Some systems are fully implemented but subsequently closed or even dismantled (e.g., Delhi, India). Moreover, the adoption of a BRT system does not necessarily mean that the city in question did not have a formalized public transport system beforehand. In Porto Alegre, for example, the BRT appears to have replaced electric trolley buses.

Fourth, BRTData.org (BRT+ Centre of Excellence and EMBARQ 2020a) and the Rapid Transit Database (ITDP 2018), the two datasets used to identify and verify the majority of adoptions, are not guarded against inconsistencies related to definitional issues and the danger of false positives. The manual cross-referencing revealed, for example, that several BRTData entries document intended rather than realized BRT projects, as well as conventional bus systems rather than BRTs. Additionally, the two datasets might neither be comprehensive, nor independent from each other. Since the World Resources Institute and ITDP often collaborate on issues related to BRTs, it is possible that entries in one dataset were used by the other dataset, and vice versa. That being said, the ITDP's Rapid Transit Database can be assumed to suffer less from definitional issues and false positives because it more heavily relies on the BRT Standard and is therefore grounded in a technical typology. This is why I treat adoption dates that are the same in both datasets as verified.

2.7.3.2. *Regime type*

The Polity5 dataset uses Correlates of War (cowc) country codes (Center for Systemic Peace 2020). The dataset used in the analysis, however, uses World Bank country codes. Before merging the Polity5 variables with the main data frame, I therefore used the R package 'countrycode' to standardize Polity5's country codes. One set of country years had to be manually re-coded: Vietnam. Polity5 reports entries for Vietnam North (1970-1975), South Vietnam (1970-1975), and Vietnam (1976-2017). To facilitate the analysis, I collapsed the three entries into a single country, Vietnam, and coded the entries for 1970-1975 as NA.

When implementing the empirical assessment, I followed standard coding practice: Polity5 scores between 6 and 10 were recoded as democracy, scores between -5 and 5 as

anocracy, and scores between -6 and -10 as autocracy. Entries classified as -88, -77 and -66 were recoded as anocracy.

2.7.3.3. *Registered vehicles per capita*

The World Health Organization data on registered vehicles per country (WHO 2020) captures two figures: first, the total number of registered vehicles, and second, the year the total was documented. To calculate the per capita figures, I divided the total number of registered vehicles by the population of the respective country in the year that the registrations were counted (UN 2019).

2.7.3.4. *Average annual change in urban extent, build-up, and population*

The Atlas of Urban Expansion documents land cover metrics (incl. urban extent, build-up, and population) for three different land cover dates, labeled T1, T2 and T3 respectively (Angel, Blei, et al. 2016). Land cover dates differ for each city. Generally, however, T1 captures the late 1980s/early 1990s, T2 the late 1990s/early 2000s and T3 the mid-2010s. The Atlas of Urban Expansion only provides entries on average annual changes for the period between T2 and T3. Average annual changes for the period between T1 and T2 had to therefore be calculated manually. To this end I first calculated the number of years between T1 and T2 in decimals (T2-T1). In a second step I then calculated the average annual change for each land cover metric for each city as the compound annual growth rate.

2.7.4. *Supplementary tables and analyses*

2.7.4.1. *Analysis 1: Time to adopting first BRT by country*

It is possible that the ENGO office variable suffers from reverse causality: international ENGOs might open offices in countries where a first BRT adoption is already underway. To test for this eventuality, I add a two-year lag to the predictor's effect and re-run all models. As shown in *Table 10*, the results do not change. The ENGO predictor remains highly significant.

Ideally, I would have added a longer lag. Unfortunately, however, the distribution of my data does not allow for lags greater than two years. If one adds a three-year lag, for instance, then all first BRT adoption dates predate all lagged ENGO country office opening dates. In effect, the ENGO office predictor turns to zero and loses its explanatory power. That being said, the additional findings from *Table 10* increase my confidence that the results from the first analysis are robust.

Additional robustness checks are shown in *Table 11*. If per capita income and emissions are excluded, there is a positive regional effect not only in East Asia & Pacific but also in Latin America & the Caribbean (*Table 11*, Model 1). This makes intuitive sense given that BRTs originated in Latin America in the 1970s and 80s, and that per capita income and emissions are corelated and unevenly distributed geographically. The effect of per capita emissions remains

zero even if one only controls for income (*Table 11*, Model 2). The two main predictors, federalism and ENGO offices, stay significant after controlling for rough proxies for road safety, urban air pollution and congestion (Models 3-6). Neither state nor municipal elections are statistically significant if one excludes federalism (Models 7 and 8). This strengthens the assumption made by Models 5-8 that state or municipal elections capture an effect that is distinct from federalism and serve as alternative proxies for democracy.

Table 10: Testing ENGO country office for reverse causality

	Core Model	Core + Region + CO2	Core + Regime		Core + Political Decentralization			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Federalism (H1)	2.24***	1.72***	2.24***	-5.53***	1.96***	-15.30***	2.13***	3.58***
	(0.45)	(0.57)	(0.46)	(0.85)	(0.49)	(0.90)	(0.53)	(1.09)
ENGO country office w/ 2-year delay (H3)	4.96***	5.27***	4.65***	4.71***	4.37***	4.33***	4.01***	3.94***
	(0.74)	(1.43)	(0.77)	(0.83)	(0.90)	(0.86)	(0.70)	(0.68)
Log GDP per capita	0.40**	0.61*	0.39**	0.37**	0.49***	0.41**	0.53***	0.54***
	(0.17)	(0.35)	(0.18)	(0.19)	(0.18)	(0.17)	(0.18)	(0.19)
Region East Asia & Pacific		1.50*						
		(0.83)						
Region Europe & Central Asia		-1.97**						
		(0.79)						
Region Latin America & the Caribbean		0.99						
		(0.63)						
Region Middle East & North Africa		-0.46						
		(1.04)						
Region South Asia		0.90						
		(0.69)						
Road CO2 per capita		0.00						
		(0.00)						
Regime Democracy			-0.31	-0.43				
			(0.76)	(0.81)				
Regime Anocracy			-0.81	-1.03				
			(0.85)	(0.96)				
Regime Democracy * Federalism (H2)				7.83***				
				(1.09)				
Regime Anocracy * Federalism (H2)				7.96***				
				(1.35)				
State elections					0.03	-0.34		
					(0.54)	(0.67)		
State elections * Federalism (H2)						17.65***		
						(1.18)		
Municipal elections							0.27	0.82
							(0.71)	(1.09)
Municipal elections * Federalism (H2)								-1.64
								(1.17)
N (Number of events)	5175 (21)	3116 (21)	4449 (21)	4449 (21)	3042 (20)	3042 (20)	2351 (17)	2351 (17)
Log likelihood ratio test	38.56 on 3 df, p=2e-08	44.78 on 9 df, p=1e-06	38.51 on 5 df, p=3e-07	39.35 on 7 df, p=2e-06	32.43 on 4 df, p=2e-06	34.87 on 5 df, p=2e-06	29.34 on 4 df, p=7e-06	30.41 on 5 df, p=1e-05
AIC	168.01	152.21	165.62	168.77	150.34	149.90	122.99	123.92

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. All models fulfill the proportional hazard assumption. Model 4 needs to be interpreted with caution because it ran out of interactions. The Wald test score for Model 6 needs to be ignored because 'loglik' converged before two of its variables. The model's likelihood ratio test score still holds (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

Table 11: Additional robustness checks

	Region	CO2	Core + Additional Controls				Political Decentralization	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Federalism (H1)	2.50***	1.37***	1.66***	1.99***	1.25**	1.21*		
	(0.43)	(0.44)	(0.47)	(0.50)	(0.58)	(0.65)		
ENGO country office (H3)	3.97***	3.62***	4.10***	4.07***	4.01***	4.25***	3.85***	3.54***
	(0.73)	(0.53)	(0.58)	(0.65)	(0.57)	(0.66)	(0.50)	(0.53)
Log GDP per capita		0.49**	0.82***	0.57**	0.32	0.46	0.65***	0.56***
		(0.25)	(0.24)	(0.26)	(0.28)	(0.29)	(0.20)	(0.19)
Region East Asia & Pacific	1.39**							
	(0.67)							
Region Europe & Central Asia	-0.54							
	(1.13)							
Region Latin America & the Caribbean	1.62**							
	(0.66)							
Region Middle East & North Africa	0.22							
	(1.24)							
Region South Asia	-0.85							
	(1.20)							
Road CO2 per capita		0.00						
		(0.00)						
Road safety (time-invariant)			0.06*			0.05		
			(0.03)			(0.03)		
Urban air pollution (time-invariant)				-0.01		-0.01		
				(0.02)		(0.02)		
Registered vehicles per capita (time-invariant)					2.31*	1.91		
					(1.40)	(1.45)		
State elections							0.54	
							(0.46)	
Municipal elections								0.29
								(0.80)
N (Number of events)	6403 (21)	3116 (21)	1954 (18)	2134 (18)	1728 (17)	1710 (17)	3042 (20)	2351 (17)
Log likelihood ratio test	57.7 on 7 df,	37.8 on 4 df,	47.72 on 4 df,	47.14 on 4 df,	42.81 on 4 df,	44.22 on 6 df,	34.55 on 3 df,	30.24 on 3 df,
	p=4e-10	p=1e-07	p=1e-09	p=1e-09	p=1e-08	p=7e-08	p=2e-07	p=1e-06
AIC	160.04	149.18	128.77	132.54	120.11	122.35	146.22	120.08

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. All models fulfill the proportional hazard assumption.

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

2.7.4.2. *Analysis 2: Time to adopting multiple BRTs by country*

Additional robustness checks are shown in *Table 12*. There are multiple significant regional effects if one does not control for per capita income (*Table 12*, Model 1). Per capita emissions stay insignificant even after excluding regional effects (*Table 12*, Model 2). I posit that these two findings justify controlling for regional effects while excluding per capita emissions in the remaining multiple event models. Moreover, I test the robustness of the core model by adding rough controls for road safety, urban air pollution and congestion (*Table 12*, Models 3-6): three out of four robustness checks support the findings from the core model. If one replicates Models 5 and 7 but excludes federalism, state elections gain significance whereas municipal elections stay insignificant (*Table 12*, Models 7 and 8). This suggests that for multiple events, federalism captures some of the effect of state elections.

Table 12: Additional robustness checks

	Region	CO2	Core + Additional Controls				Political Decentralization	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Federalism (H1)	1.70***	1.34***	1.23***	1.29***	1.06**	0.88		
	(0.47)	(0.39)	(0.47)	(0.44)	(0.52)	(0.55)		
ENGO country office (H3)	0.85	0.93	1.24	0.83	1.00	1.20*	1.10**	1.10**
	(0.85)	(0.69)	(0.82)	(0.78)	(0.75)	(0.73)	(0.47)	(0.46)
Log GDP per capita		0.37	0.63***	0.78***	0.29	0.47*	0.58**	0.83***
		(0.38)	(0.23)	(0.24)	(0.25)	(0.24)	(0.23)	(0.25)
Region East Asia & Pacific	1.16**		0.86	0.69	1.02	1.30	0.50	0.36
	(0.58)		(0.60)	(0.58)	(0.78)	(0.81)	(0.71)	(0.73)
Region Europe & Central Asia	-0.70		-0.99	-1.44*	-0.78	-0.30	-1.29	-1.65*
	(0.97)		(0.93)	(0.81)	(0.97)	(0.95)	(0.92)	(0.85)
Region Latin America & the Caribbean	1.28***		0.60	0.60	1.09	1.61*	0.64	0.17
	(0.49)		(0.63)	(0.59)	(0.75)	(0.82)	(0.65)	(0.66)
Region Middle East & North Africa	0.92		0.62	-0.10	0.98	0.79	-0.11	-0.22
	(0.91)		(0.90)	(0.97)	(0.94)	(1.02)	(0.87)	(0.92)
Region South Asia	1.24**		1.69***	0.94*	1.77**	1.46*	1.58***	1.91***
	(0.51)		(0.53)	(0.53)	(0.70)	(0.81)	(0.56)	(0.63)
Road CO2 per capita		0.00						
		(0.00)						
Road safety (time-invariant)			0.05***			0.05**		
			(0.02)			(0.02)		
Urban air pollution (time-invariant)				0.03**		0.03**		
				(0.01)		(0.01)		
Registered vehicles per capita (time-invariant)					0.77	1.09		
					(1.10)	(1.14)		
State elections							0.96***	
							(0.36)	
Municipal elections								0.67
								(0.69)
N (Number of events)	6624 (72)	3334 (72)	2143 (62)	2323 (62)	1909 (59)	1891 (59)	3260 (71)	2546 (61)
Log likelihood ratio test	38.7 on 7 df, p=2e-06	23.16 on 4 df, p=1e-04	41.09 on 9 df, p=5e-06	40.44 on 9 df, p=6e-06	32.72 on 9 df, p=1e-04	38.81 on 11 df, p=6e-05	30.85 on 8 df, p=1e-04	27.21 on 8 df, p=6e-04
AIC	241.02	225.81	207.38	211.23	195.83	193.38	221.90	189.85

Note. Time to multiple event Cox proportional hazard regressions (ordered event conditional variation): positive coefficients indicate higher likelihood of adoption whereas negative coefficients indicate lower likelihood of adoption. All models are stratified by event number. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. The proportional hazard assumption holds across all models, except for 'ENGO country office', which needs to be interpreted with caution.

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

2.7.4.3. *Analysis 3: Time to adopting first BRT by city*

I re-run Models 1-3 but employ federalism as my proxy for decentralization rather than own source revenue (*Table 13*). As expected, the results reflect those of the original three models. In fact, Model 3 also closely resembles Model 4 from Analysis 1 and Model 4 from Analysis 2. This not only supports my assertion that own source revenue can serve as a sub-national proxy for decentralization, but also strengthens my confidence in the overall results of the empirical assessment.

Like in the first analysis, it is possible that the ENGO office variable suffers from reverse causality: international ENGOs might open offices in cities where a BRT adoption is already underway. To test for this eventuality, I add a three-year lag to the ENGO office variable: even with such a lag the results stay the same (*Table 14*, Models 1-6). The positive effect of an ENGO office stays significant at 99% confidence, and the presence of an ENGO city office even regains significance after accounting for road width (*Table 14*, Models 4-6). In fact, the ENGO office predictor stays significant with a time lag of up to five years, after which the models run into technical issues.

For additional robustness, I re-run the original Models 4-6 with change in urban extent and change in urban buildup as alternative proxies for change in urban population (*Table 15,* Models 1-6). Here the results remain largely unchanged, except that the presence of an ENGO city office loses its significance when one includes own source revenue (*Table 15,* Models 5 and 6).

Table 13: Replicating the results with federalism instead of own source revenue

	Core	Core + Regime Type		ENGO + Additional Controls		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Federalism (H1)	0.61	0.49	-14.49***			
	(0.38)	(0.46)	(0.81)			
ENGO city office (H3)	2.51***	2.51***	2.52***			
	(0.47)	(0.48)	(0.47)			
Log GDP per capita	0.65***	0.65***	0.63***			
	(0.19)	(0.20)	(0.20)			
Regime Democracy		0.22	0.34			
		(0.54)	(0.55)			
Regime Anocracy		0.19	-0.47			
		(0.63)	(1.06)			
Regime Democracy * Federalism (H2)			14.77***			
			(0.97)			
Regime Anocracy * Federalism (H2)			15.97***			
			(1.49)			
Other BRT						
Change in urban population (time-invariant)						
Road width (time-invariant)						
N (Number of events)	5588 (27)	5499 (27)	5499 (27)			
Log likelihood ratio test	22.54 on 3 df, p=5e-05	22.57 on 5 df, p=4e-04	23.93 on 7 df, p=0.001			
AIC	239.43	243.02	245.66			

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. The models are not stratified by country. Otherwise, country-level predictors would lose their explanatory power. Model 3 evidences minor violations of the proportional hazard assumption and therefore needs to be interpreted with caution. The Wald test score for Model 3 needs to be ignored because 'loglik' converged before three of its variables. The model's likelihood ratio test score, however, still holds (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

Table 14: Testing ENGO city office for reverse causality

	Core	Core + Regime Type		ENGO + Additional Controls		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Own source revenue (time-invariant) (H1)	0.37	0.43	0.06			0.34
	(0.26)	(0.30)	(0.29)			(2.25)
ENGO city office w/ 3-year delay (H3)	2.85***	3.00***	2.54***	1.95***	1.56**	2.34**
	(0.62)	(0.76)	(0.61)	(0.53)	(0.73)	(1.00)
Log GDP per capita	0.61*	0.63*	0.60*			
	(0.32)	(0.32)	(0.33)			
Regime Democracy		0.22	-1.42			
		(0.79)	(1.16)			
Regime Anocracy		0.34	-0.23			
		(1.08)	(1.18)			
Regime Democracy * Own source revenue (H2)			2.35**			
			(1.09)			
Regime Anocracy * Own source revenue (H2)			0.60			
			(1.49)			
Other BRT				-21.13***	-20.87***	-21.42***
				(0.29)	(0.34)	(0.53)
Change in urban population (time-invariant)				3.30	4.01	3.51
				(3.59)	(3.24)	(3.80)
Road width (time-invariant)					10.40**	11.84
					(3.53)	(9.40)
N (Number of events)	1464 (13)	1451 (13)	1451 (13)	2399 (26)	2399 (26)	992 (14)
Log likelihood ratio test	9.72 on 3 df,	9.9 on 5 df,	12.8 on 7 df,	19.13 on 3 df,	22.95 on 4 df,	13.52 on 5 df,
	p=0.02	p=0.08	p=0.08	p=3e-04	p=1e-04	p=0.02
AIC	98.40	102.15	103.25	79.55	77.74	27.05

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and are shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. Models 4-6 are stratified by country. Models 1 and 2 evidence minor violations of the proportional hazard assumption and therefore need to be interpreted with caution. Wald test scores for Models 4-6 need to be ignored because 'loglik' converged before 'ENGO city office'. Their likelihood ratio test scores, however, still hold (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

Table 15: Additional robustness checks

	ENGO + Additional Controls					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Own source revenue (time-invariant) (H1)					1.92	3.88
					(1.82)	(2.98)
ENGO city office (H3)	1.51**	1.69***	0.90	1.12	2.11	4.26
	(0.59)	(0.59)	(0.67)	(0.88)	(1.94)	(4.40)
Other BRT	-20.85***	-20.77***	-20.70***	-20.53***	-20.53***	-20.01***
	(0.32)	(0.31)	(0.45)	(0.34)	(0.77)	(0.94)
Change in urban extent	1.33		3.77		-1.47	
	(3.30)		(3.63)		(8.99)	
Change in urban build-up		-1.57		-0.75		-8.80
		(1.61)		(1.59)		(14.28)
Road width			11.46***	9.71**	6.39	4.61
			(3.72)	(3.81)	(7.59)	(8.00)
N (Number of events)	2399 (26)	2399 (26)	2399 (26)	2399 (26)	992 (14)	992 (14)
Log likelihood ratio test	16.78 on 3 df,	17.19 on 3 df,	21.18 on 4 df,	20.42 on 4 df,	11.66 on 5 df,	12.53 on 5 df,
	p=8e-04	p=6e-04	p=3e-04	p=4e-04	p=0.04	p=0.03
AIC	81.90	81.50	79.51	80.27	28.91	28.04

Note. Time to first event Cox proportional hazard regressions: positive coefficients indicate higher likelihood of first adoption whereas negative coefficients indicate lower likelihood of first adoption. Robust standard errors are clustered by country and are shown in parentheses. All variables are time-varying, unless specified otherwise. Varying observations (N) and number of events reflect data limitations. All models are stratified by country. Model 6 evidences minor violations of the proportional hazard assumption, and therefore needs to be interpreted with particular caution. Wald test scores need to be ignored because 'loglik' converged before 'Other BRT', but likelihood ratio test scores still hold (Therneau 2008).

**** Significant at the 1% level. ** Significant at the 5% level. * Significant at the 10% level.*

3. Governing Rapid Transit: Power Politics and Adaptability

3.1. Introduction

Accelerating widespread usage of mass transit in cities in low- and middle-income countries presents a critical policy strategy to avoid future greenhouse gas (GHG) emissions (World Bank 2014; UN-Habitat 2020b, 2013; Seto et al. 2014). Mass transit helps mitigate private vehicle motorization and urban form associated with automobiles (Hidalgo and Huizenga 2013; Dalkmann and Brannigan 2007). Since urban form significantly conditions urban GHG emissions, transit infrastructure offers a unique policy lever to lock-out future GHGs over decades, if not centuries (cf. Ürge-Vorsatz et al. 2018; Mattauch, Creutzig, and Edenhofer 2015). If this policy lever is left unpulled, urban emissions could otherwise escalate by 50% by 2050 compared to 2013 (IEA 2016).

Comparatively little mass transit research has drawn on insight from political science to systematically examine political and institutional factors which can drive rapid transit interventions. From a governance perspective this is problematic given the widespread recognition that many drivers and barriers associated with rapid transit development are political in nature (e.g., Miller and Buckley 2001; Ardila and Menckhoff 2002; ITDP 2017). Existing theoretical frameworks still struggle to explain how distributive politics ('who gets what, when, how') and political institutions ('the rules of the game') can help scale-up mass transit initiatives. In this chapter I therefore ask: how do politics and institutions shape the deployment and durability of mass transit systems in cities in low- and middle-income countries? My main objective is to offer a new analytical perspective for how to understand transit planning and policy, complementary to more conventional policy frameworks, and highlight avenues for future research.

I employ an inductive, exploratory research design. Specifically, I leverage evidence from an expert elicitation with 32 mass transit specialists on the political economy of Bus Rapid Transit (BRT) systems. BRTs are commonly defined as a "flexible, rubber-tired form of rapid transit that combines stations, vehicles, services, running ways and information technologies into an integrated system with strong identity" (Levinson et al. 2003). They can be thought of as bus-based, surface-level subway systems. Key design features, such as physically segregated bus lanes, off-board ticketing and station-level boarding, allow them to service passenger capacities similar to subway systems, but often at a fraction of the capital costs associated with rail-based transit infrastructure. BRT systems present an ideal case for assessing the role of politics and institutions. They have been widely implemented in cities across low- and middle-income countries, and therefore offer a rich empirical starting point for inductive analysis. Since 1974,

over 90 BRT systems have been built across 21 low- and middle-income countries (BRT+ Centre of Excellence and EMBARQ 2020a).

I develop two analytical frameworks for how to rethink transit planning and policy. First, the deployment of BRT systems can be understood as the result of *power politics*. BRT projects tend to pitch *broad, shallow political support* against *narrow, fierce political opposition*. 'The cards thus tend to be stacked against BRT proposals.' However, evidence from the elicitation suggests that proposals can move forward when they generate private political benefits to powerful individuals. Political institutions thereby condition the rules governing political benefits: they determine who can reap political benefits (e.g., mayors, governors, bureaucrats), the form of political benefits (e.g., winning elections, ascending the ranks of the civil service), and important conditionalities on how to realize them (e.g., the formal rules of the political systems). While it is well known that *local champions* are frequently associated with successful BRT projects (e.g., UN-Habitat 2013; ITDP 2017; Nguyen and Pojani 2018), the framework around *broad, shallow support* vs. *narrow, fierce opposition* presents a new explanation for *why* this is the case: interests associated with political benefits are more capable than interests linked to public benefits to politically compete with interests associated with private costs.

Second, the durability of BRT systems can be understood as the result of operational *adaptability* to cycles of adverse policy feedback. Evidence from the elicitation indicates that BRT operations often suffer from adverse policy feedback: operational problems lead to some form of backlash (e.g., from users, car owners, local elites), which can worsen operational problems and result in even more backlash. Such cycles over time can 'cannibalize' systems and lead to financial instability or closure. This framework around *adaptability* challenges the literature's dominant view that BRT systems endure when they perform well. Instead, it proposes that BRT systems endure when they adapt to or mitigate adverse policy feedback. Factors which could turn *adverse* feedback into *beneficial* feedback include resilient financial architectures, aggressive adaptive management practices, and a critical mass of users.

The remainder of the chapter is structured as follows. Section 3.2 reviews the existing literature. Section 3.3 documents the methodology, including the expert elicitation process and analysis. Section 3.4 presents the main findings on the role of politics and institutions. Finally, Section 3.5 summarizes the main conclusions and outlines several avenues for future research. Supplementary materials are provided in Section 3.6.

3.2. The Existing Literature

3.2.1. *What explains the deployment of BRT systems?*

The existing literature suggests that BRT projects are driven and enabled by *urban transport needs*, *technical capacity, access to financing, technological properties,* and *co-benefits*. It highlights how BRT initiatives often trigger fierce political resistance by special interest groups, most notably *paratransit operators* and *car owners*. Systems are implemented when projects overcome political barriers, for instance with the help of a *local champion*. Existing frameworks, however, cannot yet explain the origins and mechanisms of political support. Institutions such as *political elections* are recognized to condition project cycles, yet their workings and limitations are undertheorized.

Studies document five overarching sets of factors, the 'big five', which generally explain the deployment of BRT systems. The first and most important set captures growing *urban transport needs.* As a mass transit system, BRTs are first and foremost deployed as a mass transit solution (Mejía-Dugand et al. 2013; Lindau, Hidalgo, and Facchini 2010). They can enable significant travel time savings, alleviate traffic congestion, and ease commuting (Venter et al. 2018). BRTs are therefore often planned and implemented as part of urban transport reforms.

A second set of factors, broadly defined, encompasses *planning and implementation capacity*. The deployment of a BRT system is an extremely complex undertaking, requiring extensive technical planning, financial modelling, engineering, regulatory coordination, contract tendering, public relations management, community participation, and the like (Hidalgo and Carrigan 2010; ITDP 2017; Miller and Buckley 2001). Planning and implementation capacity cannot be taken for granted. Lack of capacity can seriously jeopardize any BRT project, regardless of transport needs.

A third set focuses on *access to financing*. Like most large-scale transport projects, BRTs require public investment to help cover capital costs (Miller and Buckley 2001; Hidalgo and Graftieaux 2008). Public financing can come in many different forms, but often involves a combination of multilateral assistance, intergovernmental transfers, national investment programs, and municipal own-source revenues (Lindau et al. 2008; cf. Granoff, Hogarth, and Miller 2016; Ingram, Liu, and Brandt 2013). More recently, efforts have been made to unlock financing through land-value capture (Zhang and Yen 2020). The verdict on the effectiveness of this new instrument, however, remains unresolved (Guzman, Enríquez, and Hessel 2021; Zhang and Yen 2020).

A fourth set encompasses favorable *technological properties*. Two properties appear particularly salient: price and performance. BRTs are often framed as a low-cost, high-capacity mass transit innovation (Mejía-Dugand et al. 2013; Hidalgo and Carrigan 2010): they can achieve passenger capacities similar to subways, but often at a fraction of the capital cost (Hidalgo and Gutiérrez 2013; Mejía-Dugand et al. 2013). This makes them attractive to governments that must reconcile growing urban transport needs with limited access to financing.

A final set of factors covers *co-benefits* associated with the deployment of mass transit systems (Mejía-Dugand et al. 2013; Flores Dewey 2013). While growing urban transport needs undoubtedly remain the main driver, co-benefits can factor into decision-making. Prominent co-benefits linked to BRTs include reductions in urban air pollution, improved traffic safety, better job accessibility, higher labor standards, urban economic development, and the mitigation of GHG emissions (Mejía-Dugand et al. 2013; Venter et al. 2018; Hidalgo and Carrigan 2010; Hidalgo and Huizenga 2013).

These 'big five' factors provide a basic theoretical framework for explaining the adoption of BRT. Transport needs and co-benefits characterize the transit demand-side, while capacity and financing shape the supply-side. Technological properties like price and performance serve as moderating variables which condition the strength of capacity and financing. The process of deployment unfolds when infrastructure demand meets infrastructure supply.

Alongside techno-economic factors, distributive politics ('who get what, when, how') is recognized as an important dimension of mass transit planning and implementation. It is no secret that "[t]ransportation projects are often very political" (Miller and Buckley 2001; cf. ITDP 2017). The BRT literature tends to highlight three specific political dynamics: the need for a *local champion* to 'fight the fight' and chaperone a project from beginning to end (e.g., Mejía-

Dugand et al. 2013; Ponnaluri 2011; Ardila and Menckhoff 2002), resistance from incumbent *paratransit operators* who fear loss of their livelihood (e.g., Miller and Buckley 2001; Venter 2013), and backlash from *private vehicle owners* who foresee reductions in mixed-traffic road space (e.g., Rizvi and Sclar 2014).

These political dynamics are often framed as critical dimensions of effective stakeholder management during the planning and implementation process. As a result, research has mostly examined how to overcome political resistance to ongoing projects, for instance by incorporating paratransit operators into BRT services (e.g., Venter 2013). By extension, scholarship has manly tried to explain the deployment of BRT systems in terms of overcoming political barriers (e.g., Wu and Pojani 2016; Lindau, Hidalgo, and Lobo 2014). Comparatively less research has analyzed where political support comes from in the first place, or *why* local champions play such an important role.

A handful of studies have begun to assess the politics of BRT in more structural political economic terms, beyond politics as effective stakeholder management. Rizzo (2015), for instance, unpacks the political economy of the BRT project in Dar Es Salaam, Tanzania. He shows how the lack of domestic support for the project can be explained by how the Tanzanian government has sought to reconcile conflicting international and domestic interests, notably between the World Bank and local bus operators. Wu and Pojani (2016), in turn, try to explain why the BRT project in Bangkok, Thailand, was downsized. They find that lack of financing was not an obstacle. Rather, the project suffered from regulatory fragmentation among local transport agencies, a change in governorship, and adverse Japanese automotive industry interests. Even though both papers primarily explain project outcomes in terms of political barriers rather than drivers, their assessments show how BRT projects are shaped by powerful domestic and international interests, and thus highlight the limits of purely techno-economic explanations.

Institutions ('the rules of the game') are approached by the BRT literature in two distinct ways. The first assesses institutions in terms of the *organizational design* of systems. Major topics include the arrangement of special regulatory agencies (e.g., ITDP 2017), formalization of paratransit operators (e.g., Venter 2013), fare collection methods and processes (e.g., ITDP 2017), and administrative and financial architectures (e.g., Lindau et al. 2008; Ponnaluri 2011; Rizvi and Sclar 2014). Studies and policy papers have collected best practices on these and related issues, based on the recognition that the organization design of a system critically conditions its overall performance (ITDP 2017).

The second approach assesses institutions in terms of larger *governance structures.* Papers sometimes note, for example, that electoral cycles can drive BRT projects (Lindau, Hidalgo, and Lobo 2014; Mejía-Dugand et al. 2013; Hidalgo and Carrigan 2010; Hidalgo and Gutiérrez 2013). One frequently cited 'selling point' of BRTs is that they can in principle be deployed within three to four years, which corresponds to a typical municipal electoral cycle. A mayor who commits to a BRT project can face strong political incentives to inaugurate the system before running for re-election.

Compared to our understanding of *organizational designs,* however, our understanding of *governance structures* is undertheorized. For example, the mechanism linked to electoral cycles assumes, first, an institutional context characterized by elections; second, the local champion in question is elected (e.g., as opposed to appointed); and third, elections are competitive. Yet in many political economic contexts such an institutional configuration cannot be assumed.

Moreover, studies that address governance structures sometimes prescribe institutional arrangements without disclosing important caveats. For instance, local governments are often framed as BRT champions facing limited access to financial, technical, and regulatory resources (e.g., Hidalgo and Graftieaux 2008; Lindau, Hidalgo, and Facchini 2010; Mejía-Dugand et al. 2013). To enable BRT projects, so the common prescription, local governments ought to therefore be empowered with additional resources and power (e.g., Dalkmann 2013). The framing thus invokes a need for decentralization.

Lessons from comparative political economy, however, warn against such universal calls for decentralization (Arends 2020; Fan, Lin, and Treisman 2009; Bardhan and Mookherjee 2006). While it is true that decentralization can, under certain conditions, improve public policy outcomes (Gadenne and Singhal 2014; Faguet 2014), decentralization can also worsen outcomes. While political decentralization can bring decision-makers closer to constituents, additional layers of government can just as well reduce transparency, erode accountability, and feed rent seeking (e.g., Treisman 2007).

In summary, the existing literature suggests that the deployment of BRTs can be first and foremost explained by 'the big five': *urban transport needs, technical capacity, access to financing, technological properties,* and *co-benefits*. Projects often spark fierce political opposition from special interest groups, yet move forward when they overcome political barriers. The origins and mechanisms of political support are less well understood. The literature recognizes the influence of political institutions, such as elections, but their enabling or disabling features remain undertheorized.

3.2.2. *What explains the durability of BRT systems?*

The literature indicates that operations are at the heart of the durability question. On the one hand, it asserts that BRTs 'survive' if they perform well and 'die' if they perform poorly. On the other hand, it acknowledges that BRTs do not simply 'perform well'. Major factors associated with operational difficulties include *low-quality technical designs*, *insufficient capacity expansions* alongside passenger growth, *political legacies*, *transit fare dynamics,* and multi-decadal *regulatory cycles*. It remains unclear, however, to what extent these factors contribute to a larger shared phenomenon, and why operational problems so often correlate with political problems.

Compared to scholarship on deployment, the durability of BRT systems has been somewhat neglected. This neglect is surprising given just how critical it is for BRTs to survive over decades in order to generate environmental benefits. Examples of BRT systems which have encountered major difficulties include the system in Chongqing, China, which was partially dismantled in 2012; the corridor in New Delhi, India, which was fully dismantled in 2016; and the system in San Salvador, El Salvador, which was forced to open its dedicated bus lanes to mixed traffic in 2017. Anecdotal evidence suggests that many more BRTs have started to face serious operational, financial, and political difficulties, including the systems in Vietnam, Pakistan, South Africa, and Colombia.

One exception to this neglect is Nguyen and Pojani (2018), who ask "why do some BRT systems in the Global South fail to perform or expand?". They conduct a comparative case study of the BRT systems in Bangkok, Delhi, Hanoi, Lagos, and Lima. While each system has suffered from idiosyncratic circumstances, shared explanatory factors for their problems include faulty

organizational designs, regulatory fragmentation, and unstable political leadership. Nguyen and Pojani conclude that factors which shape deployment also tend to affect durability.

I posit, however, that the broader BRT literature offers at least five additional political-institutional mechanisms which can threaten a BRT system's survival. One captures the political effects of *low-quality system design*. News articles indicate that the New Delhi BRT suffered this fate (e.g., Mohan 2015). Lack of integration with other transport modes, poor station design, on-board ticketing and unsafe passenger access, among other factors, resulted in poor service quality and, in combination with persistent criticism of private vehicle interests, eventually culminated in full political fallout. While Rizvi and Sclar's (2014) comparison of the planning processes in New Delhi and Ahmedabad pre-date the closure of the New Delhi corridor in 2016, their paper foreshadows many of the issues that resulted in the system's closure.

A second mechanism addresses how *insufficient capacity expansion* alongside growth in passenger demand can lead to overcrowding. Bassett and Marpillero-Colomina (2013) suggest that this mechanism helps explain the changing urban politics around the *TransMilenio* system in Bogotá, Colombia. While the system's overcrowded conditions evidence its success in catering to growing urban transport needs, Bassett and Marpillero-Colomina show how capacity issues have fueled user backlash, creating political incentives to divert public resources away from improving and expanding the system.

A third mechanism captures an effect associated with the *political legacy* of a local BRT champion (ITDP 2017). Political leadership by a local elected champion can backfire over the medium- to long-term if a system becomes too strongly associated with the champion. Once the champion has left office, political contenders might seek to challenge the BRT as a means to challenge the champion's legacy, especially if contenders are from a competing political party and the BRT system already faces operational problems. This mechanism appears to have unfolded in Guadalajara, Mexico (*ibid*).

A fourth mechanisms looks at the adverse effects of *fleet rationalization*. Gómez-Lobo (2020) presents evidence that the financial architecture of BRT systems in secondary cities in Colombia has contributed to a *reduction* in aggregate formal transit ridership. Because operating expenses typically increase with increased system formalization, this creates pressure to increase fares. An increase in fares, however, is often politically and socially unfeasible. To reconcile the higher operating expenses with fixed transit fares, operators are forced to rationalize the BRT fleet by reducing the fleet size, transit routes, and frequencies, which can lead to capacity issues.

A fifth mechanism captures the effects of a *regulatory cycle* associated with public transport in low- and middle-income countries (e.g., Gwilliam 2008; Paget-Seekins, Flores Dewey, and Muñoz 2015). The cycle can be summarized as follows. Initially, public transport is offered by a regulated public transport company. The public company struggles to compete with semi-formal, unregulated private operators. To cut costs and increase service quality the public transport company is privatized, though transit fares remain regulated. Eventually, the private company cannot sustain operations and goes bankrupt, leaving the entire market solely serviced by semi-formal operators. Fierce competition, collusion and low labor standards, amongst other factors, contribute to a further deterioration of the urban transport situation. The government eventually intervenes by offering a regulated public monopoly through forced consolidation. The cycle then repeats.

In short, the existing literature suggests that BRTs endure when their operations perform well. We know, however, that there are many dynamics which jeopardize operational

performance, some of which are technical in nature (e.g., technical design features), while others are more financial or political (e.g., fleet rationalization or political legacies). Operations therefore never 'simply perform well', which begs the question to what extent, if any, these various dynamics are interrelated and contribute to a larger shared phenomenon.

3.3. Methodology

Expert elicitations are now commonly used to assess large-scale socio-technical trends and patterns in transport policy research, and identify major outstanding issues, especially when phenomena are difficult to measure or model (e.g., Colson and Cooke 2018). The method is a version of elite interviewing which leverages semi-structured, in-depth exchanges with technical experts. Experts are identified and recruited based on formal qualifications and professional experience. Compared to ordinary elite interviewing, expert elicitations synthesize qualified specialist knowledge to generate more generalizable research insights. They have been used, for instance, to assess the intrinsic vulnerability of traffic networks (Nogal, Morales Nápoles, and O'Connor 2019), the effectiveness of electric vehicle policies (Santos and Davies 2020), and barriers to the adoption of autonomous vehicles (Raj, Kumar, and Bansal 2020). In this chapter I follow this research approach.

The interview process followed three steps. First, I developed an interview guide structured around core themes from the existing literature. It began with open-ended questions, and later addressed specific dynamics and explanatory factors. This design allowed the guide to combine inductive discovery with deductive testing. The language of the guide was kept as neutral as possible to avoid biasing responses. Halfway through the interview process the guide was updated to help further delve into specific examples and cases. Both versions of the guide are provided as supplementary materials.

Second, I assembled an initial sampling frame of prospective expert participants. To this end, I systematically reviewed the authors of recent BRT publications, as well as the websites of multilateral development banks (MDBs), non-governmental organizations (NGOs), and research networks. This resulted in 89 prospective experts with extensive specialist knowledge and experience across BRT systems around the world. I then prioritized prospects using a scoring scheme that accounted for position, seniority, and organization affiliation. This initially produced 15 experts classified as either 'good' or 'excellent' leads.

Finally, I commenced the interview process by reaching out to the leads. Each interview started with a brief conversation about the participant's background and professional career. This allowed me to tailor the questions to their specific expertise. For example, if a participant had previously worked as operations manager of a major BRT system in Latin America, I framed the questions in terms of the history and context of that specific system. Towards the end of each conversation I triangulated the results by sharing my preliminary findings. I also asked for additional contacts, which allowed me to snowball the sampling frame.

In total I conducted 32 semi-structured interviews between April and June 2019, either in person in Washington, DC or remotely by phone or online video call. The interviews lasted between 20 and 120 minutes, and on average took 55 minutes. I interviewed experts at the World Bank (7), Inter-American Development Bank (IDB) (7), World Resources Institute (WRI) (9), and Institute for Transport and Development Policy (ITDP) (3), amongst consultants affiliated

with the BRT+ Center of Excellence (BRT+ CoE) (3) and other transit professionals (3). 23 interviews were recorded. The remaining 9, which were mainly phone-based and difficult to capture on audio for technical reasons, were documented with detailed notes. An overview of all participants is provided in the supplementary materials. Many experts served as senior executives and/or managers of BRT systems on the ground before joining a development bank (14) or NGO (12), which explains the expert cluster at WRI. The pool of expertise covered BRTs in Colombia, India, Mexico, Peru, the Philippines, Tanzania, and Vietnam, among others.

The analysis then followed three steps. First, I transcribed the 23 audio recordings using language recognition software (Temi). Second, I systematically coded all interviews using qualitative coding software (MAXQDA). I combined a-priori codes with grounded theory (Glaser and Strauss 1967), which allowed new themes to emerge from the transcripts alongside pre-determined ones (cf. Gibbs and Taylor 2010; Miles and Huberman 1994; Willms et al. 1990). This entailed coding all transcripts using the a-priori-codes and adding new codes as unexpected themes came up. The a-priori-codes mirrored the themes from the interview guides (see supplementary materials). This exercise produced a scheme with over 400 codes and over 1,500 coded segments. Finally, I clustered the codes and segments by overarching, standardized themes (Gibbs and Taylor 2010; Mason 2002), which yielded the main results.

3.4. Results

3.4.1. *Deployment of BRT Systems*

In the next two sections, I step by step develop my first analytical framework for how politics and institutions shape the *deployment* of BRT systems. On the role of politics, I first show how distributive politics interacts with each of the 'big five' explanatory factors from the existing literature (transit needs, co-benefits, capacity, financing, and technological properties), and then highlight how political benefits can help overcome the collective action problem associated with mass transit interventions. On the role of political institutions, I parse out the different ways in which institutions determine the rules governing political benefits, and emphasize the institutional diversity which can enable mass transit projects. I support my framework with illustrative examples and quotes from the interviews. Extensive evidence is also provided in footnotes. An overview of the main analytical contributions is provided in *Table 17.*

3.4.1.1. *Politics*

The interviewees suggested that *urban transport needs* are highly contested. Cities in low- and middle-income countries face multiple dynamic, inter-dependent transport challenges, most notably urban sprawl, private vehicle motorization, traffic congestion, and regulatory fragmentation. None of these automatically point to mass transit as an obvious solution or might be addressed through mass transit alone. This leads to two basic distributional political conflicts among decision-makers: first, to what extent public outlays should be allocated to transport

investments[7], and second, how different types of transport investments should be prioritized.[8] Unlike political support for more road infrastructure, political support for transit infrastructure is not self-perpetuating. "If you think the car is the way to go and you see congestion", one expert posited, "the solution that naturally comes to mind is you build bigger roads, you build a highway, you build more parking, you build all of these things that support the car mode which generates more people wanting more car mode and then you end up getting a system which is very expensive and not particularly good at moving people around the city" (J. Mason, interview, April 10, 2019). The distributional politics of mass transit planning therefore begins well before any local champion is willing to publicly announce a commitment to a mass transit project: it begins with the mobilization and consolidation of a transit coalition which makes the case for public investment in public transport, challenges the car-centric model of development, and shows how mass transit can be a viable, effective solution.

The interviewees moreover indicated that *co-benefits* are just as contested as transport needs, but play a critical role for the mobilization and consolidation of a transit coalition. Different kinds of co-benefits cater to different kinds of interests (*Table 16*). Immediate co-benefits are particularly salient for sub-national interests (e.g., residents, municipal decision-makers, local interest groups). The more concentrated they are, the stronger their salience. Delayed yet concentrated co-benefits, in turn, can serve national interests (e.g., finance ministries). The more delayed and diffused co-benefits become, the more they cater to international interests (e.g., MDBs, NGOs).[9] Illustrative evidence from Mexico demonstrates this pattern. An important motivation for Mexico City's first BRT line was to reduce urban air pollution.[10] A comparatively stronger motivation behind Mexico's *Federal Mass Transit Support Program* (PROTRAM), which was led by the country's finance ministry, was to foster urban economic development (cf. Mier y Teran 2013). Mexico's *Urban Transport Transformation Program* (UTTP), in turn, was set up by the World Bank alongside PROTRAM as a climate finance instrument (cf. World Bank 2010). While the pattern here is stylized, I expect it has also played out in other political economic contexts, such as in Colombia, Brazil, India, and South Africa.

[7] "There's challenges of spending a lot of money. Big projects bring up questions of priority. What should you be spending money on? Is this big infrastructure project more important than crime? Is it more important than education? There are trade-offs. What's the priority?" (J. Mason, interview, April 10, 2019).
[8] "At the end, it's politics of money" (G. Menckhoff, interview, 5 June 2019).
[9] "We [at the development bank] are committed to reducing our greenhouse gases, and that's why we now go for a BRT and not for another program [in Douala, Cameroon]. But the main concern is congestion […]. Obviously, the greenhouse gases are an additional benefit (Anonymous, interview, 17 April 2019).
[10] "It was on air quality. The whole project was about air quality. Climate was not a big issue yet. It was to make Mexico City more 'air quality friendly'" (A. Lobo, interview, 20 June 2019).

Table 16: Types of co-benefits

	Immediate	Delayed
Concentrated	Strong primary co-benefits, e.g., air quality, traffic safety → Subnational interests	Secondary co-benefits, e.g., economic development → National interests
Diffused	Weak primary co-benefits, e.g., branding/image → Subnational interests	Tertiary co-benefits, e.g., GHG mitigation → International interests

Note. Different types of co-benefits cater to different types of interests.

Several experts challenged the salience of GHG mitigation as a subnational co-benefit altogether.[11] In most cities in low- and middle-income economies there are no legal requirements to mitigate GHGs. If BRTs mitigate GHGs, they do so coincidentally.[12] If cities frame BRT as a climate solution, they often do so as a strategy to access international climate finance. One expert explained, "[environmental concerns] indirectly played a role. They played a role for funding. A lot of BRT projects, the technical work, was financed through grants from the Global Environmental Facility or from environmental foundations or from environmental programs at bilateral donor agencies. So, in terms of money, the environmental money played a key role in getting BRT moving. At the ground level, whether the environment was the kind of concerns that governments had, I would say it wasn't as big a thing, except from a kind of political branding perspective. Governments want to be seen as green" (W. Hook, interview, 7 July 2019). This suggests that GHG mitigation could more accurately be characterized as an indirect sub-national co-benefit vis-a-vis access to external resources and the policy preference of international interests.

Politics often determines *access to financing*, and by extension *access to capacity*. Although urban transport is often regulated at a subnational level, municipal governments frequently do not have sufficient own-source revenue to fully self-finance BRT projects – either because of insufficient levels of subnational taxation, significant dependencies on intergovernmental transfers, lack of access to debt financing, or a combination thereof. In such cases, central governments act as a gatekeeper to external financial resources. Political alignment

[11] "Everybody likes to talk about greenhouse emissions. But to be honest, nobody cares. There's no rule in [most cities in Mexico] that actually forces you to take a decision on how many tons [of emissions] you have to have in your fuel, in your energy. So, it is more a topic that everybody likes to talk about, but actually it is not a thing. In Mexico we have a Law for Climate Change, a Law for Energy Industry and recently a carbon market in pilot stage. However, the transport sector is not included in the carbon market regulation, and most cities in Mexico do not regulate emissions or are very flexible to it" (M. Priego, interview, 19 June 2019).

[12] "NGOs promoting BRT are going to tell you BRT is about climate change. But [BRT] is not designed to be good for the environment. Basically, this is designed to help as many people to move as by as fast as possible through the city. If it helps the environment, that's great. But that's not by design. This happens because the transport agency or secretary leading the project mainly cares about mobility (D. Martinez, interview, 25 April 2019).

of key national and subnational policy interests therefore often presents an important condition for the implementation of a BRT project.[13] [14]

Politics can also directly shape *technological outcomes*. Politics can factor into the location of transit corridors, the design of traffic intersections, and even specific technological features such as fuel type. Here, the *Metropolitano* BRT corridor in Lima, Peru, which was opened in 2010, serves as a good example. The system was the first in Latin America to be serviced by buses running on liquefied natural gas (LNG), not for environmental reasons however, but rather because of financial obligations faced by the central government associated with a domestic gas pipeline (cf. Scholl and Quintanilla 2015). Peru's national development bank, COFIDE, linked the BRT concessions to LNG buses, which then had to be newly produced for the system.[15] National policy preferences in this case determined subnational transit technology outcomes.

Beyond the 'big five', I find that the politics of BRT is more fundamentally determined by anticipated distributional effects of transit interventions. Although BRTs, if implemented, can generate significant public (co-)benefits, these are often fairly distributed among urban residents. New BRT projects therefore tend to generate political support which is relatively *broad but shallow*. At the same time, BRTs can cause significant private costs, such as loss of livelihoods, displacement, traffic disruption, less load capacity, loss of access to retail, and the like, which are far more focused on a handful of interest groups, such as paratransit operators, car owners, residents, etc. Concentrated private costs translate to political opposition which is typically *deep and fierce*. This leads to a collective action problem: when broad and shallow support faces off with deep and fierce opposition, support has a structural disadvantage.[16] [17]

This structural disadvantage can be overcome, however, when BRT projects offer concentrated political benefits to powerful individuals.[18] [19] This seems to have been one major

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[13] "Every successful BRT project, Bogotá, Jakarta, Ahmedabad, usually is strong at the city level, usually the mayor. They argue for the BRT. Political will backed by funding. Countries where there is a split between the city and the national government, politics comes into play. In the Philippines, politics drives everything. The best thing you can hope for is the mayor to be from the same party as the president. The national government only gives money to the city when, at the end of the project, it also looks good for the national government" (C. Brader, interview, 14 May 2019).

[14] "The other [political issue] is when the mayor of the city if of a different political party than the president. [T]hat was the case of Honduras, for example, now that it changed. So, that even complicated things more" (C. Bouillon Buendia, interview, 24 April 2019 – *personal opinion only, not necessarily the view of the IDB*).

[15] "In Lima, […] many [bus operators, including their Colombian partners] contacted us, [saying] 'we don't want gas buses and articulate gas bus, forget it. It can't be done. It's not possible'. I even saw letters from the three major bus manufacturers to the city of Lima, that they would not be interested to make gas buses. […] But the mayor said, 'I want the gas buses. It's up to you how to figure it out.' […] The bus operators, they were businessmen and found a way of doing it in China" (G. Menckhoff, interview, 22 May 2019).

[16] "When you build a BRT, you create a big mess in your city. Because you block the roads, you create more congestions, you do some heavy work, so you create a lot of dust and pollution. Because you take a golf course from the rich people, so they don't like you. Because you take, I don't know, something from the poor and so they don't like you. So, nobody likes you when you build something" (B. Lefevre, interview, 30 April 2019).

[17] "The first line […], you need to do it quickly. So, you must do good preparation so that that first line just goes in quickly, doesn't disrupt people too much. And when it's running, it creates a constituency that will back for that system. And you have a set of people that will support it" (M. Pai, interview, 18 June 2019).

[18] "[The political question is] how do I improve the quality of life of the people who will re-elect me in the next election cycle? The transportation question is how do I prevent these people that will eventually get to an income level of X to buy a car?" (Anonymous, interview, 26 April 2019).

[19] "Politicians want to cut a ribbon" (H. Allen, interview, 22 May 2019).

reason, for instance, why so many urban decisionmakers around the world took note of Mayor Enrique Peñalosa's *TransMilenio* success in Bogotá. Peñalosa demonstrated how implementing a BRT could generate political gains.[20] While the importance of local champions is not new, the framework around '*broad but shallow* support vs. *deep and fierce* opposition' offers a new explanation for *why* local champions play such a critical role. Compared to shallow public benefits, concentrated political benefits appear more able to politically compete with – and win out – against concentrated private costs.

What complicates this mechanism is that not all mass transit projects offer the same political benefits. Subways, for instance, offer greater political rewards than BRTs. "If you're a politician, you get points for inaugurating a brand-new metro system or a tram, which looks great, it's sexy, you can cut a ribbon", one interviewee asserted. "But if you're trying to sell people on BRT buses, [the response is] 'We already have buses. How is this any better? Why are we wasting money on this?'" (V. John, interview, 17 May 2019). Subways are idealized as clean, fast, and quiet, while buses are stigmatized as dirty, slow, and loud. In medium-sized cities with 500,000 to 1 million residents, this difference in political prestige does not typically lead to policy gridlock. Capital cost concerns and passenger capacity limitations along key transit corridors tend to point to BRT as the only feasible option. In large cities with several million habitants, however, this perception can seriously jeopardize deployment.

In large cities, two complicating mechanisms can be at play. First, competing policy preferences for either BRT or subway can split the mass transit coalition.[21] In the face of contested urban transport needs and co-benefits, this split can weaken the mass transit coalition and contribute to policy gridlock. Second, competing policy preferences can trigger an adverse policy cycle. Contenders for political office compete by promising prestigious subway projects. Once in office, however, they cannot deliver because of lack of resources and capacity. Such policy failure increases the political gains associated with realizing a subway, and incentivizes contenders for political office to further outcompete each other with prestigious subway projects. Such cycles appear to have characterized transit policymaking in several major cities in Latin America.[22] [23]

Both mechanisms offer a novel explanation for why branding of BRTs as clean, modern, and prestigious is an integral component of effective planning and implementation. Such branding is crucial not only to cater to the modal preferences of middle-class users[24], but also to

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[20] "[Peñalosa] kicked started a bunch of BRT projects in a lot of countries. […]", one expert notes. "The fact that he had implemented a system in a democratically elected government and that this helped his political popularity […]. I think, this is what made [BRT] projects very attractive to other political leaders because they realized that they could have a ribbon cutting ceremony within their term of administration. That was a big pitch, that was a big selling point" (W. Hook, interview, 7 June 2019).

[21] "You want to change the world. And then there's two ways of changing the world: [BRT and subway]. And then the proponents of both are competing. And then they're saying yours is bad. Like they both change. They both improve. [The shared goal is transit.] Just stop fighting and see which you do first" (C. Pardo, interview, 11 June 2019).

[22] "Everyone, all [major cities] have tried to start with Metros. Lima tried. Bogotá tried but couldn't do it. El Salvador, no." (D. Martinez, interview, 25 April 2019).

[23] "But the political interference has been a problem in Bogotá for 30 years. It's been a struggle. Really, it's been a struggle" (Anonymous, interview, 26 April 2019).

[24] "BRT gives consumers a similar feeling as travelling on a metro or rail: the stations are easy to identify, the regular frequency, a more intuitive system. All of this helps amplify the image of the system with the promise of higher quality for riders" (H. Allen, interview, 22 May 2019).

diminish the 'prestige gap' between subways and BRTs and thereby mitigate an adverse political cycle. This suggests that branding during the planning phase targeted at decisionmakers is just as important as branding during the operations phase aimed at users. This would also explain why rail interests sometimes undermine BRT projects: unsolicited subway proposals by multinational rail corporations can initially exploit the prestige gap and cater to politicians' policy preference for subway projects, but subsequently trigger an adverse policy cycle and lead to policy gridlock. This appears to have happened in Arequipa, Peru, where a local BRT initiative fell apart after extensive planning when a multilateral rail consortium proposed a monorail.

Alongside *domestic interests*, the assessment finds that *international interests* also often play a role. Major international actors, such as development banks (e.g., the World Bank, IDB, CAF), multinational corporations (e.g., Volvo), development agencies (e.g., GIZ), climate finance interests (e.g., CDM, GEF), and an army of consultants, shape the infrastructure supply-side by offering financing, capacity, and technology. Interviewees moreover asserted that the global diffusion of BRTs since the early 2000s has been facilitated by the advocacy of two international non-profits: the World Resources Institute (WRI) and the Institute for Transportation and Development Policy (ITDP).[25] [26] [27]

Both WRI and ITDP engage in global agenda-setting around low-carbon urban mass transit. They track global trends (e.g., BRT+ Centre of Excellence and EMBARQ 2020), benchmark and compare technical systems (e.g., ITDP 2016), publish flagship reports (e.g., Hidalgo and Carrigan 2010), and host international conferences (e.g., WRI 2021). They also foster open-access technical capacity by collecting and spreading best practices, and developing freely accessible technical planning documents (e.g., ITDP 2017). Moreover, both non-profits run an extensive network of international offices.WRI has offices in Brazil, China, Ethiopia, India, Indonesia, and Mexico. ITDP manages operations in Brazil, China, India, Indonesia, Mexico, Kenya, Uganda, Tanzania, Ethiopia, Rwanda, and Egypt. These regional operations engage in regional agenda setting, offer local technical capacity, and sometimes actively lobby for BRT projects.[28] International interests thus not only shape the infrastructure supply-side, but also the demand-side. While development banks work through the 'front door' by formally offering financing and capacity, non-profits can work through the 'side door' by informally engaging in local politics.[29]

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[25] "EMBARQ is worldwide. It was created for BRT. EMBARQ was created to promote BRT. Then it became much bigger" (B. Lefevre, interview, 30 April 2019).

[26] "In the early 2000s, ITDP and EMBARQ's advocacy agendas in pro of sustainable mobility and BRT was quite similar. Both organizations provided technical support and advisory – on conceptual designs, feasibility studies, study tours – to several developing world cities that were considering implementing BRT corridors to improve public transport" (L. Canon Rubiano, interview, 30 April 2019).

[27] "Peñalosa [the former mayor of Bogotá] is hired by many governments and NGOs to go around the world and preach the gospel. And many, many mayors, governors, presidents [start] undertaking BRT. And then there are some very good NGOs. One of them is ITDP. The other one is WRI" (Anonymous, interview, June 2019).

[28] "Our approach [at ITDP], our theory of change is to get projects on the ground and then spread them. And so, getting them on the ground involves dealing with the politics of actual implementation, which can be really challenging, especially in a lot of low- and middle-income countries" (J. Mason, interview, 10 April 2019).

[29] "The [development] banks were very happy with us [ITDP] because we can do things that they couldn't do. We started building field office operations, so we had permanent staff on the ground in nine countries. And WRI followed our administrative model, and they also created ground troops because then they could have those NGOs be flexible and they can intervene at the political level in a way the development banks cannot" (W. Hook, interview, 7 July 2019).

The interviews moreover revealed that both WRI and ITDP have received financial contributions from foundations associated with fossil fuel interests. WRI's first office in Mexico was funded by the Shell Foundation in 2002.[30] Further investigation suggests that WRI has received substantial financial contributions from the Shell Foundation at least until 2020 (e.g., WRI 2002, 2020; Shell Foundation 2019). ITDP's initial BRT campaign, in turn, was jump-started by a grant from the W. Alton Foundation, a philanthropic organization which used to be associated with the Cities Service Company, now named the Citgo Petroleum Corporation.[31] While the influence of fossil fuel interests over WRI and ITDP remains unclear, this funding history certainly begs the question to what extent, if any, the BRT agenda has suffered from regulatory capture.

In comparison to fossil fuel interests, I found no evidence of *overt* political meddling by automobile interests. Multinational car manufacturers do not appear to perceive urban mass transit as a direct regulatory threat.[32] Their adverse influence tends to be less direct.[33] Urban decisionmakers, for instance, are often members of the car-driving elite. Urban elites therefore sometimes appear biased against public transport.[34]

3.4.1.2. *Institutions*

In line with previous studies, the assessment shows how *election cycles* critically shape BRT deployment processes. A contender for political office can promise a BRT and, in principle, deliver in three to four years. Election cycles thereby generate strong political incentives to inaugurate the system within one term. The interviews also reveal, however, that the exact workings of this mechanism are not yet fully understood. For example, quick deployment appears to serve as a driver only under certain conditions. Depending on the size and complexity of a BRT project, budgeting three to four years for the implementation phase is ambitious. One expert commented, "[t]here's something which is a bit misleading, which you often can read in the technical press: 'Oh BRT can be done so fast. We did it in three years.' The busway [in Bogotá] was already under construction when the decision was made to implement the BRT

[30] "EMBARQ was started with a grant from the Shell Foundation, to support the BRT in Mexico City" (B. Lefevre, interview, 30 April 2019).

[31] "We were aware of what Curitiba did in the late seventies, early eighties, from the earliest days of ITDP. But it became a kind of big program focus starting around the year 2001, or so, when we got a grant from the W. Alton Jones Foundation and we hired a guy named Lloyd Wright to set up a BRT program" (W. Hook, interview, 7 June 2019).

[32] "It's pretty rare for us to see automobile manufacturers involved at the municipal level. Maybe in the old days, the automobile manufacturers maybe had more money to throw around and more bandwidth and maybe know they were more active players in the political discussions. But they're not that threatened by BRT, and they are more threatened by like changes in air quality tailpipe regulations and this kind of a thing" (W. Hook, interview, 7 June 2019).

[33] "There may not be evidence of car companies specifically interfering to impede public transport, but there is certainly a lot of money being spent by government interests (e.g., export banks, bilateral development banks) to subsidize the construction of car-centric infrastructure (highways and flyovers) in other countries, and we've specifically seen this a lot recently in Africa. Often, the wealthier countries subsidizing this car infrastructure (via below-market loans and grants) have large automobile manufacturing sectors which could then benefit from the increased demand for cars in these new markets. I'm not aware of this as an explicit policy, but it's certainly worth exploring or noting" (J. Mason, personal correspondence, 17 February 2022).

[34] "Politician themselves often tend to be wealthier and tend to drive. So, they view the world from the car and so that can be a very influential component of how these decisions get made. They are car divers themselves" (J. Mason, interview, 10 April 2019).

concept. So, the construction drawings were modified, just in the nick of time to complete the BRT busway. But the long period of the bidding process – drafting the bidding documents, organizing the bidding process, awarding the contract – had already been achieved; that's where you lose time" (G. Menckhoff, interview, 5 June 2019). Systems that have been deployed quickly are either relatively small, have been extensively prepared beforehand, or are enabled by existing road infrastructure.[35]

Likewise, political incentives seem to differ depending on whether a mayor is running for re-election at a city-level or competing for higher office at a country-level. Running for re-election appears to strengthen a policy preference for BRT, while competing for higher office seems to amplify a policy preference for subway. In Lima, for instance, Mayor Luis Castañeda initially favored an underfinanced subway project over a fully financed BRT initiative in the run up to his 2011 presidential bid.[36] While this hypothesis requires further testing, it could reveal a new policy dilemma: mass transit projects in medium-sized cities are enabled by clear policy preferences, but disabled by lack of capacity and resources. Mass transit projects in large cities, which can serve as a jumping board into national politics, are enabled by capacity and resources, but disabled by competing policy preferences.

Additionally, the election cycle mechanisms pre-suppose three institutional features: an institutional context characterized by a democratic political system; that the local champion is elected (e.g., versus appointed); and that the elections are competitive. These features, however, cannot be assumed to exist across all political economic contexts. While it is true that many BRTs have been deployed in middle-income democracies, many have also been adopted by cities in autocratic regimes. This suggests that election cycles are just one institutional form which can harness private political benefits towards mass transit deployment.

At a deeper level, the interviewees suggested that domestic political institutions shape politics in three important ways. First, institutions determine who can reap the political benefits of addressing urban transport. Winners might include mayors, administrators, governors, ministers, or even presidents. Second, institutions determine the form of the political benefit. Examples include winning re-election, winning a bid for higher office, or ascending the ranks of the civil service. Finally, institutions shape the relationship between the local and central government and thereby enable or disable mass transit projects. For example, if implementing a BRT offers political benefits to an elected mayor, the project will nevertheless run into difficulties if the mayor requires support from the transport minister, but the mayor and the minister are not politically aligned.

Multiple combinations of institutional features can enable BRT projects. In Curitiba, Brazil, deployment in 1974 was pioneered and led by an appointed mayor in an autocratic regime. In Bogotá, deployment was driven in 2000 by an elected mayor in a democratic regime. In Mexico City and Pimpri-Chinchwad, India, deployments in 2005 and 2015 respectively were chaperoned by appointed administrators. Nearly two dozen systems have been implemented in

[35] "In Lima [building the BRT corridor] was a little easier because part of the infrastructure was already there. Because there were these separated lines. So, they just had to do a little refurbishing of the stations, extend a little bit the line to the south, just buy the buses, create a concession. In that sense it was not that difficult" (C. Bouillon Buendia, interview, 24 April 2019 – *personal opinion only, not necessarily the view of the IDB*).

[36] "[Mayor] Castañeda said – he was in his second term already – 'If we again don't get bids for the metro concession [this time], then I have nothing to show for my administration'. Indeed, there were no bids for the metro concession. And suddenly he was interested in the BRT. And then really things moved" (G. Menckhoff, interview, 5 June 2019).

China, a complex autocratic regime. These observations call for a more systematic evaluation of potential enabling or disabling combinations of institutional features.

One common enabling institutional feature appears to be political decentralization.[37] Interviewees agreed that decentralization can enable BRT projects by offering greater weight to local policy preferences. This further supports the finding in Chapter 2 of how countries characterized by political decentralization are statistically more likely to adopt BRT systems. The interviewees also suggested, however, that decentralization can act as a driver only if accompanied by two conditions. The first is sufficient local technical capacity.[38] Lack of trained staff, for instance, can substantially complicate planning efforts. In fact, contrary to the dominant framing, several experts hypothesized that the central government must play a key role not despite regulatory decentralization, but rather because of regulatory decentralization[39], in order to help overcome sub-national regulatory coordination challenges. The second condition is rule-based access to intergovernmental transfers. Otherwise, local authorities must rely on political alignment between national and sub-national decision-makers regardless of regulatory authority and technical capacity, which can politicize planning efforts.[40]

[37] "I think devolution has been a good thing. I mean, for one thing, the theory would say if the people elected the mayor because of what he does in the city, and therefore something that is good for the city, it gives direct benefits [to the mayor]. The mayor in Curitiba, or Peñalosa in Bogotá, and then […] Castañeda in Lima, they were directly involved in reaping the benefits of those BRTs. The problem with this is that while [they're] closer to the people, but normally mayors or decision-makers prefer Metros, not BRTs. For good and bad reasons" (G. Menckhoff, interview, 5 June 2019).

[38] "I wouldn't underestimate the unpreparedness of many municipal and sometimes state governments to deal with [urban transport] problems. You have to understand, municipal governments sometimes barely function […] If they have a functioning computer in the transportation department, it's like already a big step forward […] And then suddenly [they are] being asked to manage an explosion of car and motorcycle use, and they don't have a clue what to do" (W. Hook, interview, 7 June 2019).

[39] "Then on the government side, since this is the first BRT, and also given the overall political decentralization structure in Cameroon, the national ministries are key players." (Anonymous, interview, 17 April 2019).

[40] "In Dar es Salaam, for instance, the mayor of Dar es Salaam was the first early adopter of the BRT concept. He adopted the Dar es Salaam BRT project as a municipal project that he wanted to use to make his reputation. But in the end, uh, he didn't have the power to implement it on his own. Because the development banks can't lend money to city governments. They have to lend it to national government. Unless the national government signed off, they couldn't get the money. So, in the end, the project essentially moved under the control of the national government. And that's pretty much true for any project in Africa where the process of decentralization of governmental functions has not moved very far" (W. Hook, interview, 7 July 2019).

Table 17: On the Deployment of BRT Systems

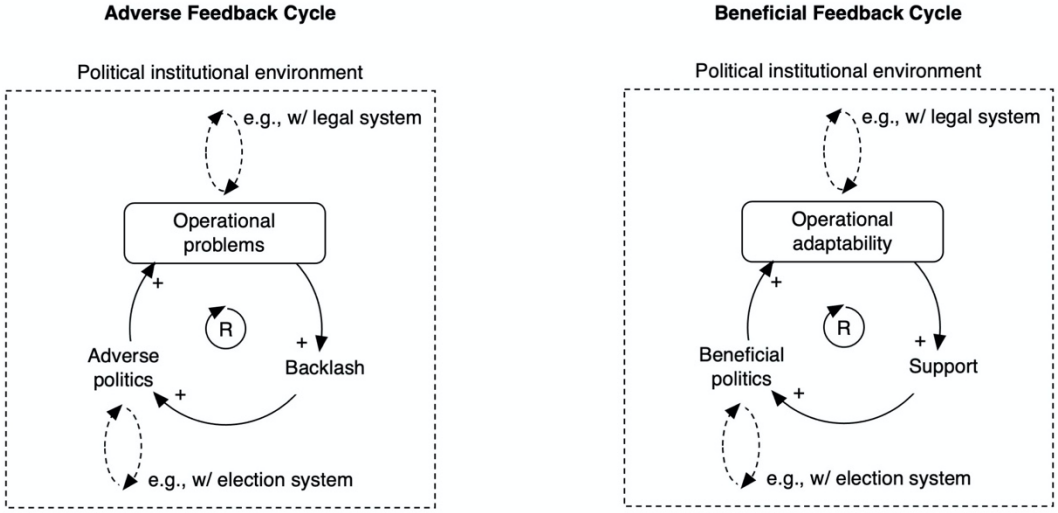
Existing Literature	Additions
Politics	
Mass transit projects are driven by urban transport needs. Initiatives begin with a public commitment by a local champion.	Urban transport needs are highly contested. Initiatives begin with the formation of a mass transit coalition.
Co-benefits (e.g., air pollution, traffic safety) can factor into mass transit policymaking.	Co-benefits are just as contested as transport needs. They play a key role for consolidating a mass transit coalition. Different kinds of co-benefits cater to different kinds of interests (see *Table 16*).
GHG mitigation is a local co-benefit.	GHG mitigation serves as an indirect local co-benefit *vis-a-vis* access to external resources.
BRT projects can trigger strong opposition from paratransit operators, residents, and car users, among other special interest groups.	BRT projects tend to pitch *broad but shallow support* against *deep and fierce opposition*. Projects move forward if they offer political benefits to powerful individuals.
Subway projects offer greater political benefits than BRT projects.	This 'prestige gap' can lead to policy gridlock. Branding of BRT as clean, modern, and prestigious is not only important to attract middle-class users, but also to close the 'prestige gap' and avert policy gridlock.
Institutions	
The *institutional design* of a system, understood in terms of the *organizational architecture*, shapes operational performance.	The *institutional environment*, understood in terms of *political structures*, can over-determine the effects of the *organizational architecture.*
Election cycles can interact with planning and implementation processes.	The type of election matters. Local elections can strengthen the policy preference for BRTs, while national elections can strengthen the policy preference for subways.
	Diverse *institutional environments* enable BRTs. Future research will have to systematically map out enabling or disabling institutional features.

Note. Summary of key insights from the existing literature juxtaposed to analytical additions from the expert interviews.

3.4.2. *Durability of BRT Systems*

In the next two sections I develop my second analytical framework for how politics and institutions shape the *durability* of BRT systems. My principal assertion is that BRT systems tend to 'cannibalize' themselves through cycles of *adverse policy feedback (Figure 5, left cycle).* I develop the framework in two steps. First, I uncover four further feedback mechanisms – in addition to the five from the existing literature – which can contribute to operational problems and thus trigger backlash (e.g., from the public, users, elites, interest groups). I argue that these feedback dynamics are part of a larger phenomenon which can characterize the governance of mass transit: a feedback cycle whereby operational problems trigger backlash, which ultimately increases the probability of compounded operational problems and further backlash. Over time such cycles can 'cannibalize' a system 'from the inside'. Second, I offer examples of how institutions determine whether operations are exposed to or insulated from such adverse feedback cycles, and briefly extrapolate how and under what conditions a *beneficial policy feedback* might come about *(Figure 5, right cycle*). As in the preceding sections, I support the framework with illustrative examples and quotes from the interviews. Extensive evidence is also provided in footnotes. An overview of the analytical contributions is provided in *Table 18.*

Figure 5: Mass transit operations and policy feedback



Note. Stylized representation of how BRT operations can experience self-reinforcing cycles of policy feedback. Arrows represent probabilistic causal relations. Operational problems increase the likelihood of backlash (e.g., from users, residents, elites, interest groups), which increases the likelihood of adverse politics, which in turn increases the likelihood of further operational problems, and so on (cycle on the left). On the flipside, operational adaptability can cultivate support, lead to beneficial politics, and over time strengthen operational adaptability and performance (cycle on the right).

3.4.2.1. *Politics*

Adverse policy feedback can start with an expectation that fare revenues must cover operating expenditures.[41] [42] "*TransMilenio* was originally sold as a system where public money would cover the infrastructure, and the operations would be covered by the fares", one expert noted referring to Bogotá's system. "But operations are difficult to cover from the fare box alone. With low fares – which may be set by governments rather than market forces – you need to cram passengers into the buses like sardines. This worked in the beginning, but once they added new extensions this model became less viable, [it just got worse]. […] And may operators faced bankruptcy" (H. Allen, interview, 22 May 2019). It is well documented that infrastructure promoters face incentives to exaggerate anticipated revenues, while construction firms face incentives to inflate implementation costs, especially if projects are 'too public to fail' and contract renegotiations would be costly (e.g., Flyvbjerg, Bruzelius, and Rothengatter 2003). As a result, projected revenues tend to be overestimated, and anticipated costs tend to be underestimated (cf. Pickrell 1992). The assessment suggests this dynamic not only shapes the politics of implementation, but also the politics of operations.[43] BRTs are likely to run into serious financial and political difficulties if fixed fares which cannot be raised for social and political reasons are expected to cover operating expenses, yet user rates are lower than anticipated. This dynamic is exacerbated if implementation costs were originally covered by the central government or a multilateral development bank, but operational responsibilities are assigned to local authorities.[44] Exaggerated revenue projections thus turn into a financial liability for local governments, which can trigger backlash from local decision-makers.[45] There are several indications that such a dynamic is affecting BRT systems in South Africa (cf. Venter 2018).

Feedback can also start with the tendency to satisfice concession contracts. BRT concessions have an expiration date, which is reached either after a certain time period or after the rolling stock has serviced a certain mileage. After the expiration date, concessions are ideally competitively tendered, and the rolling stock is renewed. In practice, however, this is not necessarily what happens. From the perspective of the decision-maker, it is much easier and less costly in the short run to simply prolong the original concession. An extension caters to the vested interests of existing bus operators and accommodates eventual resource constraints faced

[41] "If you look at the literature in the 2000s, you will see that people were saying that [for] BRTs, the transport fares should be set so that the OPEX was equal to the ticket revenues, thus BRTs demanding zero subsidies […]. But *ex-post*, with many cities failing to meet forecasted ridership and having additional costs – maintenance, productivity, technology – they say this doesn't need to necessarily be true. Hence, it is important that we move from the 'self-sustainable BRT' paradigm to the 'sustainable transport system' paradigm, where OPEX should equal your ticket sales plus additional funding, and that funding may come from parking fees, congestion charging, and public funding allocations, whatever" (L. Canon Rubiano, interview, 30 April 2019).

[42] "[V]ery few BRTs worldwide can cover capital and operating costs for the buses. Capital infrastructure costs are always subsidized" (Anonymous, interview, June 2019).

[43] "There was a notion earlier on that BRT could pay for themselves. […] Governments have gotten into trouble with that assumption that it does not require subsidies" (J. Mason, interview, April 10, 2019).

[44] "One big question is, who is going to subsidize the fares? Is it going to be the municipality or is it going to be the national government?" (C. Bouillon Buendia, interview, 24 April 2019 – *personal opinion only, not necessarily the view of the IDB*).

[45] "The best systems still have operational problems. They are not sustainable from a revenue perspective. But local officials hate on-going subsidies" (J. Mason, interview, April 10, 2019).

by public regulators.[46] Instead of a complex tendering process, all that is often needed is a signature. “It's much easier for the administration to just extend the contract”, one interviewee explained. “Because it's just signing it” (C. Pardo, interview, 27 June 2019). Over time, however, such satisficing can contribute to a gradual deterioration of the rolling stock, reduce the quality of the service, and ultimately trigger backlash. Such a dynamic appears to have played out in Bogotá.[47]

Yet another feedback is linked to multi-lateral development banks’ (MDBs) bias towards capital expenditure. MDBs finance capital investments, not operating expenditures. From the perspective of MDBs, BRT projects are completed once the public works have been finished (e.g., stations, pavement, etc.).[48] This can bias the distribution of resources and capacities towards the implementation rather than the operations phase, even though operating costs can exceed capital costs. “People inflate the benefits and deflate the costs, and then all these systems end up costing much more”, one senior expert noted. “Nobody accounts for the operational expenditure, which is several times the capital investment” (Anonymous, interview, June 2019) (cf. Ardila-Gomez and Ortegon-Sanchez 2016). In a handful of cases this has led to fully constructed but unused infrastructure.[49] San Salvador’s BRT system, for instance, remained unused for several years after El Salvador’s supreme court decided that the system’s exclusive busway was unconstitutional. Despite substantial multilateral assistance, insufficient planning had been devoted to setting up a robust legal structure. Operations did eventually commence, but only after significant delays and backlash.

Backlash can also be cultivated by public perception and misperception of co-benefits, irrespective of operational problems. The mechanism by which BRTs help improve traffic is counterintuitive. Interviewees explained that car users and public officials often find it difficult

[46] “The [private concessionaire] will want to retain the contract, find a legal way of extending it. […] If you want to continue operating, you have to bid again and buy new buses entirely and create a new structure. Of course, you will say, ‘No way, my buses are fine’. So, in the end, what they'll do is push the government to say, ‘Wait, what's wrong? Nothing is wrong’. […] And then they allowed it to go on. But then they kept postponing it […]. Nobody has any incentive to do anything” (C. Pardo, interview, 27 June 2019).

[47] “Towards the end of [the concession] contract, the buses are old. Service is not wonderful. [It] starts to decay. People start to get used to it. So, that's when the other politicians say, 'Why we don't do one other thing, let's have a Metro because this thing isn't working anymore'. And the other thing is that they say, ‘Well, the buses seem to be going well, we don't need to have a new contract. Let's just extend the existing one’. We have this clause in the contract, which allows you to extend it. So that will inevitably reduce the quality of the system” (C. Pardo, interview, 27 June 2019).

[48] “From the bank's point of view, because the bank only finances the infrastructure, it doesn't worry at all about the operational side, the political side of operations, because the infrastructure is the easiest thing to do. You just build the track, you build the stations. But then you have to take [into account] all the informal guys. […] But the bank doesn't want to enter into all of these thorny issues. So, they just build the infrastructure and then they hope that the [local] government and sometimes the central government, with the mayor of the city, will solve these issues. So, what has happened is that some countries don't have functioning BRTs” (C. Bouillon Buendia, interview, 24 April 2019 – *personal opinion only, not necessarily the view of the IDB*).

[49] “What we have found in our evaluations, is a very sad situation, which is that the infrastructure is there, but there are no buses. This was the case for El Salvador and that was the case for Honduras. So, you'll basically see empty BRT lines” (C. Bouillon Buendia, interview, 24 April 2019 – *personal opinion only, not necessarily the view of the IDB*).

to understand how fewer mixed traffic lanes can ease congestion and improve traffic flow.[50] [51] During the operations phase, this misperception is amplified by the visibility of BRT corridors, and the tendency of those corridors to appear 'empty' or 'unused' in comparison to adjacent mixed traffic lanes. One expert explained, "[w]hen you [as a car driver] see all this congestion in other lanes, and then people are perceiving only like one bus going, because they're not counting for volume, like as a snapshot, you're not seeing any buses going through that lane and people will be thinking, 'Wow, there's an empty lane [which] is not being used. So, let's just [open it to] private cars" (H. Tun, interview, 7 May 2019). If this misperception persists, it can challenge the legitimacy of the segregated corridor. Such a dynamic appears to have played out in Guangzhou, China, where the BRT corridor was eventually opened to mixed traffic during peak hours, all but undermining the system's ability to generate travel time savings.[52] This indicates that public perception of costs and benefits can be just as politically salient as material distribution of costs and benefits.

3.4.2.2. *Institutions*

Institutions structure how operational problems are governed. Enforcement and protection of property rights are particularly important institutional features. Concession contracts, for instance, must be upheld. Otherwise, BRTs cannot offer reliable transit services. There is evidence that concessionaires can try to exploit their market power to extract additional rent.[53] In Bogotá, for example, a concessionaire caused significant traffic disruption by initiating a service strike. Local authorities were able to discipline the concessionaire by signaling a credible threat

[50] "There's a challenge in trying to convince citizens that taking away one or two lanes from cars and putting it to buses is actually sort of democratic and the right way […] There's a lot of push back. What you'll hear a lot is 'There's going to be more congestion for us. This is going to increase our travel times, decrease our traffic quality'. […] People don't realize that actually this is an overall win equation for the city as a whole. Once you provide bus lanes, the gains in speed, efficiency and comfort increase the attractiveness of public transport – reduces travel times, emissions, crashes – by which, just by replacing one mixed traffic lane for a bus lane, you changed public transport's capacity and attractiveness so significantly" (L. Canon Rubiano, interview, 30 April 2019).

[51] "When your solution to congestion is 'I'm going to take one more lane from you guys [car drivers]'. It's always like, 'Hey, what the hell?' […] Because it's not a very visible benefit. So, when you start to talk about things like travel time [savings] if you're on a bus, if you're in the media or you're a driver […], these are concepts that are difficult to understand. It's not as tangible a benefit as building a new flyover or a highway. Because then you are immediately able to visualize, 'Oh, this flyover was going to smooth my commute by letting me fly over traffic' […] Even politicians, they find it hard to believe, like 'How is this going to help my city?'" (V. John, interview, 17 May 2019).

[52] "[The BRT in Guangzhou] is one of the best BRT systems in China. […] This has changed a bit because they are allowing all these private vehicles to go into all these dedicated lanes, […] [even though] that's one of the main advantages of BRT: you have all these segregated lanes, and then because you're only allowing the buses you can speed up much faster" (H. Tun, interview, 7 May 2019).

[53] "[Concessionaires] have a lot of power, because sometimes they serve a big area of the city and if they don't agree with your terms, they can always start [problems]. So, one day, for instance, we had a discussion with a company and the company said, 'Okay, I don't agree, tomorrow we're not doing service'. A private company, going against their contract. What do you do? Can you deal with like a million people that are served by this company?" (Anonymous, interview, 26 April 2019).

to tendering out the contract to competitors on grounds of a breach in contract.[54] This was only possible, however, because of a robust legal structure designed prior to the project.

At the same time, concessions must be protected against political interference from the government. Otherwise, concessionaires can run into financial difficulties.[55] For example, in Lima the municipality agreed to prohibit paratransit services along major sections of the *Metropolitano* corridor to assist concessionaires in achieving required passenger usage. Fearing political backlash from paratransit operators, however, the city never enforced this prohibition, which jeopardized concessionaires' financial planning. Concessionaires subsequently successfully sued the municipality for breach of contract (e.g., Post 2016).

Institutions also shape the distribution of public investment for infrastructure maintenance and upkeep. One prominent example, again, is the role of local elections.[56] To recall, BRT planning and implementation cycles are often linked to election cycles. The assessment finds that this dynamic can continue after deployment.[57] In a best-case scenario, campaign promises mobilize additional public resources. In a worst-case scenario, campaign promises for other priorities precipitate diversion of public investment away from maintenance and upkeep, which can hasten operational withering.[58]

Finally, politics and institutions can strongly interact. The BRT system in Lima, again, serves as a good example. In 2010, Mayor Castañeda rushed the system's inauguration because of the upcoming presidential elections.[59] Due to the rush, however, only a small fraction of the

[54] "[We called] the other companies and started offering the service [to them]. […] And when those guys [who stopped operations] heard that we have met with the other companies, and that they were bidding for the [the concession], they immediately backtracked" (Anonymous, interview, 26 April 2019).

[55] "The problem is, when the government decides to transfer the operation for the line to the private sector, the government says, 'But the price of the fare, we are [going to continue] to decide. You cannot say how much people will pay to travel […]. It's a public interest because I want to maintain the price affordable for people'. And the private sector says, 'Oh, okay, you want my money? But you want to decide my revenue? No, [those terms I cannot accept]'" (Anonymous, interview, 26 June 2019).

[56] "Decisions around transport projects [should be] ringfenced [so that] they can't be changed after elections. Politicians want to cut a ribbon. It is right to ask, 'Why?' and [newly elected politicians] will need to have the information to be able to understand the project. It might take three years to go through the official procedures which may be the same period as the elected official. But by then you're on to the next new politician cycle and you may have to start from square one" (H. Allen, interview, 4 April 2019).

[57] "You may [face] a political issue [when you try to] renovate the system. I'm speaking a lot from the point of view of Bogotá, but this has happened elsewhere. […] If [a system] is tied politically to someone, […] my prediction would be that the more it's not tied to a specific politician, the more it will fare well because then it's from the city, that's fine" (C. Pardo, interview, 27 June 2019).

[58] "The mayor [after Peñalosa], who got elected in 2000, 100 percent supported *TransMilenio*. So *TransMilenio* continued at that full speed until 2003. Another mayor came in 2004. He was not quite like the two previous ones, but he supported *TransMilenio* too. […] Then came the bad years. Then you had mayors who hated *TransMilenio*, basically because it was, uh, was Peñalosa's work […] There was neglect […], not paving the busway […]. The system really ran into terrible problems with bus overloading which could have been resolved with targeted improvements to the BRT lines" (G. Menckhoff, interview, 5 June 2019).

[59] "[Mayor] Castañeda said – he was in his second term already – 'If we again don't get bids for the metro concession, then I have nothing to show for my administration'. Indeed, there were no bids, and then really things moved. […]. Castañeda knew he had to produce something. And then between 2007 and 2010, [the BRT] got built" (G. Menckhoff, interview, 5 June 2019).

buses were available in time for the inauguration.[60] Several policy decisions constituted breaches of contract with the concessionaires, which resulted in them suing the municipality. The city government ultimately had to take on substantial financial debt from contractors (e.g., Post 2016). Castañeda's political motivations contributed to operational problems, which were then mediated by Peru's legal system, ultimately leaving the municipality – and by extension the BRT system – financially worse off. These findings suggest that, if institutional quality matters during deployment, institutional quality matters even more during operations, especially if multilateral resources are biased towards implementation. Institutions create important regulatory checks and balances which discipline concessionaires and policymakers alike, and thereby enable reliable transit services.

More broadly, the analysis begs the question, how and under what conditions *beneficial policy feedback* might come about. Effective transit operations could grow support (e.g., from the public, users, elites, interest groups), generate beneficial political dynamics (e.g., additional public resources for the system), and ultimately enable more effective transit operations and further support. While a comprehensive assessment of *beneficial policy feedback* exceeds the scope of this chapter, I extrapolate three potential enabling factors, alongside a high-quality system design. First, a resilient financial architecture. Financial resilience can take many forms but could include *dedicated public investment* to help cover operating expenses, as well as a phase-in period which anticipates gradually growing passenger demand over very long periods of time. Second, *aggressive adaptive management practices* by the operations team. Mitigating adverse feedback will require constant monitoring of socio-political feedback dynamics, agile organizational learning, and politically savvy public relations management. In this respect, a successful BRT operation might resemble a start-up more than a public agency. Finally, *proactive recruitment and retainment of a critical mass of users*. Potential strategies could include organizing regular 'car free/free fare days', leveraging 'club membership' benefits and perks (e.g., akin to collecting credit card points), and extensive public image marketing. Over time, these three factors could turn *adverse* policy feedback into *beneficial* policy feedback.

[60] "I was involved in the BRT in Lima. […] Its design called for operating with 300 buses. And the day we started operations, I was in Lima with the mayor, there were nine buses out of the 300. 3% of the buses, in other words." (Anonymous, interview, June 2019).

Table 18: On the Durability of BRT Systems

Insight from Existing Literature	Additions
Politics	
BRT operations are shaped by (i) technical system design, (ii) capacity expansion (or lack thereof), (iii) fleet rationalization, (iv) political legacies, and (v) multi-decadal regulatory cycles.	Additional factors which shape operations include (vi) norms and expectations around fares, (vii) satisficing of concession contracts, (viii) biased allocation of resources to implementation rather than operations, and (ix) perception of (co-)benefits. All these factors are part of a larger phenomenon: a feedback cycle whereby operational problems can trigger backlash, which ultimately increases the probability of further operational problems and further backlash
BRT operations prove durable when they perform well.	BRT operations prove durable when they adapt to adverse policy feedback.
Institutions	
BRT operations prove durable when they can rely on a robust legal system.	BRT operations prove durable when political institutions help discipline public authority and private concessionaires. Political institutions, such as elections, can shape the distribution of public investment for infrastructure maintenance and upkeep. Turning *adverse policy feedback* into *beneficial policy feedback* appears to require a resilient financial architecture, aggressive adaptive management practices, and a critical mass of users.

Note. Summary of key insights from the existing literature juxtaposed to analytical additions from the expert interviews.

3.5. Conclusions

Public resources for public infrastructure are significantly conditioned by politics and institutions. In this chapter I leverage this insight from political economy to explore how politics and institutions shape the deployment and durability of BRT systems. The employed expert elicitation offers two analytical frameworks for how to rethink transit policy and planning. First, the *deployment* of BRT systems can be understood as the result of *power politics*. The interviews suggest that politics fundamentally structures the policy problem presented by urban mass transit interventions. BRT projects tend to pitch *future broad and shallow support* against *present narrow and fierce opposition*. This captures a classical collective action problem and explains why urban transit projects are so inherently politically fraught. The interviews further indicate that political benefits – *forms of gaining political power* – can help overcome this collective action problem. Compared to interests linked to public benefits, interests associated with political benefits are more capable of competing politically with interests associated with private costs.

Institutions thereby structure the rules around political benefits. They determine who can gain power (e.g., mayors, governors, or bureaucrats), the forms of gaining power (e.g., winning an election, or ascending the ranks of the civil service), and important conditionalities for how to realize power (e.g., institutional checks and balances).

Second, the *durability* of BRT systems can be understood in terms of operational *adaptability* to cycles of adverse policy feedback. The interviews indicate that BRTs often suffer from adverse policy feedback, whereby operational problems lead to backlash (e.g., from users, car owners, or elites), which can exacerbate operational problems and lead to more backlash. Over time, such cycles can delegitimize BRT systems and result in closure, even when technical designs are of high quality. BRTs do not endure because they perform well, but because they adapt to and mitigate the worst effects of adverse policy feedback. Factors which could help turn *adverse* feedback into *beneficial* feedback include resilient financial architectures, aggressive adaptive management practices, and a critical mass of users.

Future research will have to test and refine both frameworks. There is a need to better understand how power politics can be more effectively leveraged to drive transit policy change. For example, research will have to examine urban transit coalitions and coalition formations more carefully. Alignment of private political and public social interests appears to play a particularly important role. Research will have to examine the broader conditions under which elite and public interests converge around transit projects; when, how, and why political campaigns running on urban transit platforms are successful; when, how, and why campaign promises lead to implementation; and how political divisions among urban transit coalitions can be avoided.

Research will also have to reassess planning risks and opportunities through an institutional lens. Future studies can help expose implicit, potentially misleading institutional assumptions 'baked into' dominant transit policy paradigms (e.g., norms around fares), and identify and map out variation in institutional configurations which structurally facilitate urban transit reform and investment.

Finally, there is a need to better understand *beneficial* and *adverse* policy feedback. Future research will have to study the origins, causal mechanisms, and relative power of different policy feedbacks. Key questions here include how different types of operational problems (e.g., financial vs. technical) lead to different types of backlashes (e.g., from users vs. car owners), and how these lead to different types of adverse politics (e.g., material vs. rhetorical attacks). There is also a need to empirically study which technical and organizational design features mitigate or weaken adverse policy feedback, and how and under what conditions *adverse* feedback can turn into *beneficial* feedback. Overarchingly, there is a need to examine when, how, and why adaptive management practices can be sustained and eventually institutionalized. Long-term transit planning appears to require *political capacity* alongside *technical capacity*, to navigate the ever-evolving urban and domestic politics of operations and maintenance.

Transport policy research has not yet taken full advantage of insights from political science. This chapter is an attempt to change that. By drawing on BRT as an empirical case, it shows how the deployment and durability of low-carbon urban transit are significantly shaped by politics and political institutions. As global GHG emissions from urban transport continue to escalate over the next decades, leveraging this insight for more effective low-carbon transit policymaking will only become more urgent.

3.6. Supplementary Materials

3.6.1. *Interview participants*

An overview of all interview participants is provided in *Table 19.*

Table 19: Interview Participants

Nr.	Name	Title	Affiliation[a]	Interview Type	Date
1.	Heather Allen	Independent Consultant		Remote	4-Apr-19
2.	Eduardo A. Vasconcellos	President, Technical Commission for the Environment	National Association of Public Transport of Brazil (ANTP – *Associacao Nacional de Transportes Públicos*)	Remote	8-Apr-19
3.	Juan Carlos Muñoz	Professor, Dept. of Transport Engineering and Logistics	Pontifical Catholic University of Chile (PUC – *Pontificia Universidad Católica de Chile*)	Remote	8-Apr-19
4.	Jacob Mason	Director of Research and Impact	Institute for Transportation and Development Policy	In-person	10-Apr-19
5.	Anonymous	Urban Specialist	Multilateral development bank	In-person	17-Apr-19
6.	Anonymous	Senior Urban Transport Specialist	World Bank	Remote	23-Apr-19
7.	Anonymous	Transport Planning Consultant	Institute for Transportation and Development Policy – Africa	Remote	23-Apr-19
8.	Cesar Patricio Bouillon Buendia	Principal Economist, Office of Evaluation and Oversight	Inter-American Development Bank	In-person	24-Apr-19
9.	Daniel Martinez	Research Fellow	Inter-American Development Bank	In-person	25-Apr-19
10.	Lynn Scholl	Senior Transport Specialist	Inter-American Development Bank	In-person	25-Apr-19
11.	Oscar Mitnik	Principal Economist	Inter-American Development Bank	In-person	25-Apr-19
12.	Anonymous	Senior Transport Expert	Inter-American Development Bank	In-person	26-Apr-19
13.	Anonymous	Senior Urban Transport Specialist	World Bank	Remote	26-Apr-19
14.	Benoit Lefevre	Former Director of Energy and Climate	World Resources Institute	In-person	30-Apr-19
15.	Leonardo Canon Rubiano	Urban Transport Specialist	World Bank	In-person	30-Apr-19
16.	Cristián Navas Duk	Consultant, Transport	Inter-American Development Bank	Remote	3-May-19
17.	Christopher Moon	Urban Finance Research Analyst	World Resources Institute	In-person	6-May-19
18.	Thet Hein Tun	Transportation Research Analyst	World Resources Institute	In-person	7-May-19
19.	Benjamin Welle	Director, Integrated Transport & Innovation	World Resources Institute	In-person	8-May-19

20.	Colin Brader	Chairman & International Director	Integrated Transport Planning Ltd.	Remote	14-May-19
21.	Vineet John	Research Analyst and Program Coordinator	World Resources Institute	In-person	17-May-19
22.	Gerhard Menckhoff	Transport Consultant		In-person	22-May-19
23.	Gerhard Menckhoff	Transport Consultant		In-person	5-Jun-19
24.	Walter Hook	Principal	BRT Planning International, LLC	Remote	7-Jun-19
25.	Carlos Pardo	Senior Manager, City Pilots	New Urban Mobility alliance (NUMO)	In-person	11-Jun-19
26.	Madhav Pai	Executive Director	World Resources Institute – India	In-person	18-Jun-19
27.	Marco Priego	Director of Urban Mobility	World Resources Institute – Mexico	Remote	19-Jun-19
28.	Adriana Lobo	CEO	World Resources Institute – Mexico	In-person	20-Jun-19
29.	Claudia Adriazola-Steil	Deputy Director, Urban Mobility and Director, Health & Road Safety	World Resources Institute	In-person	20-Jun-19
30.	Anonymous	Senior Urban Mobility Expert	World Resources Institute	In-person	26-Jun-19
31.	Arturo Ardila-Gomez	Global Lead for Urban Mobility and Lead Transport Economist	World Bank	In-person	27-Jun-19
32.	Carlos Pardo	Senior Manager, City Pilots	New Urban Mobility alliance (NUMO)	In-person	27-Jun-19

Note. (a) Affiliations at the time of the interview. All in-person interviews were conducted in Washington, DC.

3.6.2. *Interview guide from 6 March 2019*

To start, I have a few questions about BRT systems themselves:

1. DV Innovation: What makes BRT systems innovative?
2. DV Effectiveness: What are indicators of BRT systems that function well?
3. DV Impact: What is the best way to capture their environmental impacts?

My second set of questions asks why BRT systems are being deployed in developing cities:

4. IV General: What explains the deployment of BRT systems in developing cities?
    a. What is the 'big picture story' behind BRT projects?

5. IV Interests: Who tends to champion BRT initiatives? Who tends to oppose them?
    a. What role, if any, do the following actors play? Local governments, national governments, development banks, NGOs?

6. IV Environmental concerns: What role, if any, does concern for the environment play?
    a. Air pollution, GHG emissions?

7. IV Institutions: Which institutional contexts appear to enable BRT projects?
    a. What role, if any, do the following institutions play? Local elections, national elections, regulatory decentralization, fiscal decentralization?

8. IV Technology: Which technological features enable BRT projects?
    a. Price, performance, modularity?

9. IV Financing: To what extent does access to financing explain the build-up of BRT projects in developing cities?
    a. Who acts as a gatekeeper?

10. Triangulation: Based on what you know of the project, are there any further questions that you think are important? Are there any factors that I have overlooked?

This concludes my main questions.

11. Next Steps: Who else should I talk to?
12. Confidentiality: How confidential do you want to keep our conversation?

Thank you for your time.

DV – Dependent Variable; IV – Independent Variable.

3.6.3. *Interview guide from 7 June 2019*

To start, I have a few broad questions about BRT systems in [COUNTRY].

1. DV Deployment: What, in your view, explains the deployment of BRT systems in [COUNTRY]? What is the overarching story of BRT in [COUNTRY]?
    a. IV: Why are medium-sized cities in [COUNTRY] adopting BRT systems?

2. DV Durability: Which BRT systems in [COUNTRY], in your view, are working relatively well, in terms of service quality, ridership, maintenance, etc.?
    a. IV: What explains their relative success?

3. DV Durability: Which BRT systems in [COUNTRY] are not working so well?
    a. IV: Why are these systems not working so well?

4. DV Other: Do you know of any BRT systems which were planned but never built?
    a. IV: Why were they never built?

My second set of questions addresses the role of specific interests and institutions that might help explain the deployment and durability of BRTs.

5. IV Light rail interests: What role, if any, do rail technology companies play?

6. IV Automobile interests: What role, if any, do car manufacturers play?
    a. What role, if any, do car owners play?

7. IV Institutions: Which institutional contexts appear to enable BRT projects?
    a. What role, if any, do the following institutions play? Local elections, national elections, regulatory decentralization, fiscal decentralization?

8. IV International NGOs: What role, if any, do international non-profits play?
    a. WRI, ITDP?

9. IV Environmental concerns: What role, if any, does concern for the environment play?
    a. Air pollution, GHG emissions

10. Triangulation: Before we conclude I would like to prompt you with the initial findings from the first round of interviews, to see if you share my observations.

This concludes my main questions.

11. Next Steps: Who else should I talk to?
12. Confidentiality: How confidential do you want to keep our conversation?

Thank you for your time.

4. Institutional Foundations of Rapid Transit Investment: Evidence from Mexico, Peru, and Colombia

4.1. Introduction

Deep and durable decarbonization of urban transport calls for an expansion of rapid transit, especially in cities in middle-income countries not yet locked into car-centered transport systems (Seto et al. 2014; IEA 2016; cf. Joshua 2021). Without policy change, urban carbon emissions could otherwise nearly double by mid-century compared to 2013 (IEA 2016). Worse still, continued build-out of car-centered transport infrastructure could set growing cities on a nearly irreversible pathway of carbon-intensive urban development (Creutzig et al. 2016; Unruh and Carrillo-Hermosilla 2006). Decades of evidence demonstrates just how difficult it is to escape high levels of private vehicle motorization once locked in (Seto et al. 2016; Unruh 2002). This predicament creates an urgent need to better understand the drivers and enabling conditions of accelerated mass transit usage.

Political institutions critically structure policymaking (Lockwood et al. 2017). The energy transitions literature foregrounds important macro-political institutions associated with low-carbon policies and policy outcomes. Democracies, for instance, are much more likely to adopt ambitious climate targets than autocracies (Ward 2008; Lachapelle and Paterson 2013). However, the underlying meso-political institutional dynamics, that is, the specific institutional actors, frameworks, and mechanisms which lead to policy change, are far less well understood (Dubash 2021; Dubash et al. 2021). Yet it is these dynamics which typically afford policymakers agency to implement policy change. Issuing a new investment program, for example, presents a more feasible policy task than transforming an autocracy into a democracy.

In extending the debate on the role of enabling political institutions, this chapter argues there are four meso-political institutions which help scale up public investment for mass transit development in middle-income countries. These include *a powerful actor* who legitimizes and authorizes transfer of state capacity and resources to sub-national projects, *a framework* which facilitates the alignment of national and sub-national policy interests around shared policy goals, *a politically savvy funding mechanism* which disciplines public authority, and *a mechanism of fiscal redistribution*. Taken together these factors can drive rapid transit development, especially when there is a *policy gap* between sub-national regulatory responsibility over urban transport affairs and sub-national capacity to implement transit development. In putting forward this argument this chapter contributes to the broader scholarly debates on how to accelerate energy transition processes (Roberts et al. 2018) and "what kind of institutions matter and how" (Lockwood et al. 2017).

The argument builds on a comparative case study of public investment for Bus Rapid Transit (BRT) in two middle-income democracies in Latin America: Mexico and Peru. It also leverages supplementary evidence from Colombia, a shadow case study, to strengthen the external validity of its findings. Mexico adopted 11 BRT systems between 2003 and 2017, whereas Peru adopted only a single BRT corridor within the same timeframe. The *institutional similarities* between Mexico and Peru beg the question which *institutional differences* explain the variance in the policy outcomes. Colombia, in turn, adopted 7 BRT systems between 2000 and 2017. The *institutional differences* between Mexico and Colombia beg the question which *institutional similarities* explain the *convergence* in the policy outcomes. Focusing on one mass transit infrastructure type, BRT systems, makes investment decision-making more comparable across the countries. Methodologically, the chapter combines process tracing, historical analysis, and 30 semi-structured interviews.

The assessment shows how all four meso-political institutions have played an enabling role in Mexico and Colombia, yet have been absent in Peru. First, national investment for transit development in Mexico and Colombia was authorized by key actors in the national government and legitimized by existing legal frameworks. In Peru the national government has treated urban transport as an exclusively sub-national issue. Second, policy interests in Mexico and Colombia have coalesced around shared policy goals through existing institutional frameworks. In Peru, the institutional environment has tended to pitch national and sub-national interests against one another. Third, the funding mechanisms in Mexico and Colombia have disciplined public authority, whereas in Peru policymakers face incentives to prioritize megaprojects. Finally, the investment programs in Mexico and Colombia were intentionally designed to enable mass transit development in secondary cities. In Peru there is no mechanism which prevents Lima, the country's political capital and economic center, from capturing most national resources. Together, these factors offer a novel institutional explanation for why Mexico and Colombia, unlike Peru, have been able to scale up public investment for mass transit development.

The remainder of the chapter is structured as follows. Section 4.2 builds the theoretical argument. Section 4.3 explains the research design, case selection, and research strategy. Section 4.4 presents the cases and comparative findings. Finally, Section 4.5 summarizes the main conclusions and several policy implications. Detailed historical case studies, together with extensive primary evidence from the semi-structured interviews, are provided as supplementary materials in Section 4.6.

4.2. Explaining Policy Change with Institutions

4.2.1. *Macro-political institutions*

The energy transitions literature approaches political institutions in two distinct ways (Lockwood et al. 2017). The first treats *institutions as exogenous* to transition processes and explains transition outcomes in terms of institutional endowments (e.g., Ehnert et al. 2018). Institutions are in effect conceptualized as independent variables. The second approach views *institutions as endogenous* to transition processes, and examines how transition processes interact with institutional processes (e.g., Barnes et al. 2018). Institutions are mainly analyzed vis-à-vis institutional change. In this chapter, I follow the former approach and examine how political

institutions structure policymaking. Political institutions are understood as "the rules of the game in a society" (North 1990, p. 3). They shape distributional political conflict – "who gets what, when, how" (Lasswell 1936) – by determining which interests play a role, how interests are aggregated, and how interests interact with one another. For the acceleration of energy transitions, this begs the question "what kind of institutions matter and how" (Lockwood et al. 2017).

The literature foregrounds three fundamental sets of macro-political institutions. The first is *regime type*. Democracies compared to non-democracies are significantly more likely to adopt climate policy goals (e.g., Bättig and Bernauer 2009; Ward 2008; Lachapelle and Paterson 2013). This indicates that the politics of transition processes differ between democracies and autocracies. Then again, democracies are not necessarily associated with more effective climate policy outcomes (e.g., Bättig and Bernauer 2009; Ward 2008). More ambitious climate goals do not automatically lead to more effective climate mitigation. The relationship between regime types and transition outcomes therefore remains disputed (Povitkina 2018; Glantz 1979).

The second set is *government form*. Parliamentary systems compared to presidential systems are more likely to pass climate mitigation policies (Lachapelle and Paterson 2013; Ward 2008). It is possible that presidential systems entail more veto players, which makes environmental policymaking generally more cumbersome (Lachapelle and Paterson 2013). Evidence also indicates that electoral systems characterized by proportional rather than majoritarian representation are more likely to pass environmental legislation (Lockwood et al. 2017; Lachapelle and Paterson 2013). One potential explanation for this pattern is that proportional systems afford environmental interests greater representation.

The third set is a country's *distribution of regulatory responsibility*. For one, this distribution determines who is held accountable for what by whom, and thereby shapes policy preferences and incentives. For another, it defines who can act as a veto player, and thereby offers institutional checks and balances (e.g., Henisz and Zelner 2006; Henisz 2002). Checks and balances, in turn, are essential for generating regulatory commitment (e.g., Levy and Spiller 1994). By extension, different distributions of regulatory responsibility will lead to variance in how the politics of energy transitions plays out across different countries.

More recently, scholarship has started to re-examine the effects of *federalism* (e.g., Ehnert et al. 2018; Karapin 2020; Trachtman 2021). Federalism is often defined as a constitutional political system characterized by two essential features: a hierarchy of at least two levels of government, each of which possess a pre-defined sphere of public authority and political autonomy; and institutionalized checks and balances which self-reinforce this distribution of power (Riker 1964). The relationship between federalism and transition outcomes, however, is contested. On the one hand, federalism can drive bottom-up policy change: it can enable sub-national policy learning and innovation, which can spill over into other states through horizontal or vertical policy diffusion.[61] [62] On the other hand, federalism can contribute to policy

[61] Spillovers are driven by a combination of market, regulatory, and political forces (e.g., Trachtman 2021).
[62] Federalism in the US is often cited as an example. California's ambitious tailpipe emissions standards have been linked to a ratcheting up of emissions standards in other US states, a phenomenon which is sometimes called the "California effect" (Vogel 2018, 1997). Another example is the adoption of climate policies across US states, such as renewable portfolio standards (Matisoff 2008; Thombs and Jorgenson 2020; Karapin 2020).

gridlock: it can create powerful veto players, increasing regulatory coordination challenges and making transformational policy change less likely (Lockwood et al. 2017).[63]

I argue that there is a need to complement the literature's emphasis on macro-political institutions with a more nuanced understanding of meso-political institutions: the specific institutional actors, frameworks, and mechanisms which bridge macro-political institutions (e.g., the overarching regime type) and micro-political institutions (e.g., the unique institutional arrangement of a specific infrastructure project). Examples of meso-political institutions include, but are not limited to, the rules, roles, and procedures conferred by executive regulatory agencies, policy packages, and funding programs. While the literature has established predictable associations between macro-political institutions and climate policies, the underlying institutional dynamics remain far less well understood (Dubash 2021; Dubash et al. 2021). Moreover, meso-political institutions afford greater agency to policymakers who seek to accelerate energy transition processes. It is comparatively easier, for instance, to issue a new national investment program than to move from an autocratic to a democratic political regime. In the next section I therefore foreground four meso-political institutions which I expect to enable urban mobility transitions in middle-income countries.

4.2.2. *Meso-political institutions*

My argument starts with two basic observations. First, most scholarship on the relationship between political institutions and transitions draws on evidence from contexts characterized by high levels of state capacity. State capacity refers to "the government's ability to accomplish its intended policy goals" (Dincecco 2017). Even arguments which frame certain political institutions as barriers to policy reform often imply that governments could in principle enact policy change if they wanted to. The second observation is that political, regulatory, and fiscal decentralization, which are commonly framed as enabling macro-political institutions (Treisman 2007), are assumed to correlate with one another. Political decentralization can be understood in terms of regional and local elections, fiscal decentralization in terms of own-source revenue, and regulatory decentralization in terms of official public authority over certain public affairs (Rodden 2004; World Bank 2001). Politically decentralized countries are assumed to also be decentralized in fiscal and regulatory terms.

Neither of these two assumptions, however, are necessarily warranted in middle-income countries. For one, state capacity can be highly unevenly distributed across local governments within a country (Acemoglu, García-Jimeno, and Robinson 2015), with much capacity concentrated in political capitals and economic centers. State capacity in small- and medium-sized municipalities can be very limited. For another, decentralization in many middle-income countries is often limited to political and regulatory authority, and excludes devolution of fiscal authority (Gadenne and Singhal 2014; Bahl, Linn, and Wetzel 2013). What this means on the ground is the following: while sub-national governments can in theory be endowed with political and regulatory responsibility to enact policy change in certain policy areas (e.g., public transport), in practice they might lack the state capacity and financial resources to implement reform.

[63] The US again serves as a prime example. Federal US climate legislation has been repeatedly blocked by state-level interests, most notably in the US Senate (Karapin 2020). The "California effect" is often contrasted with the "Delaware effect", a regulatory 'race to the bottom'.

This policy gap – between official authority on the one hand and limited capacity and resources on the other – empowers the national government as a gatekeeper of access to external state capacity and financial resources (Bahl, Linn, and Wetzel 2013). If national and sub-national policy interests align, the national government can help fill the policy gap and enable sub-national policy change. If national and sub-national policy interests clash, the policy gap leads to policy gridlock.

I argue that in countries where such a policy gap exists, there are four meso-political institutional factors which facilitate urban policy change. The first is an institutional actor who authorizes and legitimizes transfer of state capacity and public resources to sub-national projects. A country's national government, typically the finance ministry, acts as a powerful gatekeeper to national and international resources (Bahl, Linn, and Wetzel 2013; Ingram, Liu, and Brandt 2013). Multilateral financing must typically be backed by sovereign guarantees. At the same time, a country's national government is not a monolithic actor. Ministries pursue competing policy interests. Large sums of public investment raise questions of priority. Transfer of capacity and resources for specific policy goals (e.g., deployment of mass transit systems) will require an actor who can negotiate with competing national policy interests and unlock access to state capacity and public resources.

The second factor is an institutional framework which helps align national and sub-national policy interests around share policy goals. Transfer of capacity and resources alone will not be enough. Policy interests *across* levels of government must coalesce around shared goals. This is often easier said than done. For instance, national actors might prefer 'white elephants', urban megaprojects which are prestigious but economically wasteful (Robinson and Torvik 2005; Henisz and Zelner 2006). Local governments will oppose 'white elephants' if these are associated with concentrated local costs. Alignment of policy interests will require a political institution which allows national and sub-national actors to find mutually beneficial policy objectives.

The third factor is a politically savvy funding mechanism which disciplines public authority and generates institutional accountability. Even when policy interests align, public investment can still be misappropriated. The investment decision-making process needs to generate regulatory commitment and insulate decision points from the influence of special interests (Levy and Spiller 1994, 1996; Bergara, Henisz, and Spiller 1998; W. J. Henisz 2002). Institutional design features which can help insulate decision points will include independent technical reviews, limited access, dedicated financial resources, and transparent funding criteria. Funding mechanisms can also combine elements of national and sub-national public authority and generate vertical institution accountability. National interests thus help discipline sub-national interests and vice versa.

The final factor is a mechanism of equitable fiscal redistribution. There will be a danger that powerful economic and political centers, such as national capitals, capture over-proportionate shares of public resources. Small- and medium-sized urban centers could thus face a structural disadvantage, even when investment decision-making processes are relatively insulated from special interests. To mitigate this danger, equity concerns must factor into the distribution of public outlays. In fact, small- and medium-sized municipalities with limited state capacity might need an over-proportionate share of public resources to be able to apply and qualify for national funding in the first place.

I argue that these specific four meso-political institutional factors, when combined, can enable major urban transit reform in contexts characterized by a sub-national policy gap. It is possible that these meso-political factors are more likely to come about in certain macro-political institutional environments. Nevertheless, in principle I expect all four meso-political factors to be possible in many diverse macro-political institutional contexts.

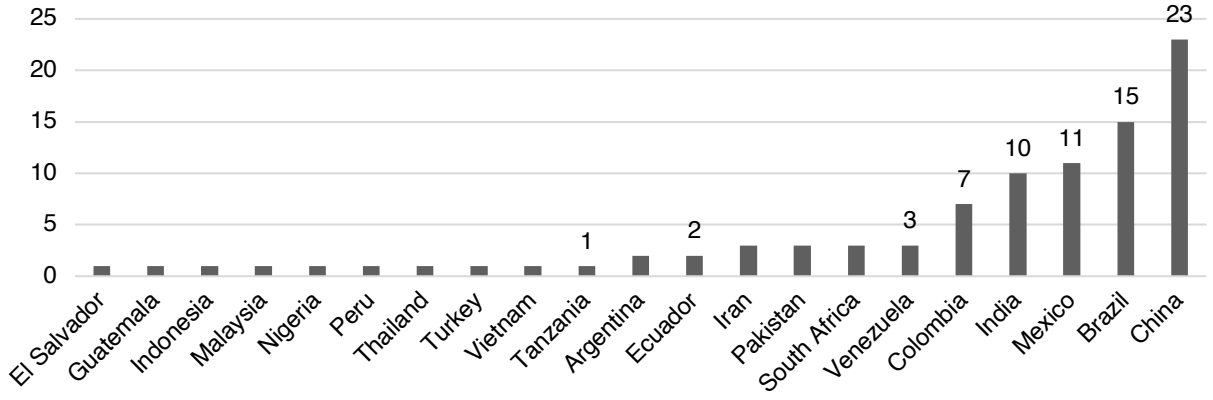
4.3. Methodology

4.3.1. *Research design: Cross-country analysis of public investment for Bus Rapid Transit*

To examine this argument, I conduct a comparative case study of public investment for Bus Rapid Transit (BRT) systems. BRTs present an ideal empirical setting for examining the political economy of urban transit reform. On the one hand, they offer significant passenger capacity at comparatively low cost (Mejía-Dugand et al. 2013; Hidalgo and Carrigan 2010). This helps explain their proliferation across low- and middle-income countries since the mid-2000s (Hidalgo and Gutiérrez 2013). On the other, BRTs require substantive capital investment, for instance for the busways, stations, communications technology, rolling stock, and the like (Lindau et al. 2008; ITDP 2017). Sub-national governments suffering from a policy gap are therefore expected to struggle to finance BRTs without inter-governmental assistance. Focusing on one type of transit intervention, in turn, allows to control for cross-system variation, which makes investment decision-making more comparable across different political economic contexts.

The distribution of BRT deployments across low- and middle-income countries is strikingly uneven. Over 70% of all BRT system adoptions between 1974 and 2017 are concentrated in only five countries: China (23), Brazil (15), Mexico (11), India (10), and Colombia (7) (*Figure 6*). All five are middle-income economies, four are governed democratically, three are characterized by federal political systems, and three are in Latin America (*Table 20*). National investment programs have been the instrument of choice for scaling up public investment for urban mass transit, as evidenced by national mass transit investment programs in four of the five countries (*Table 20*). The remaining 26 systems are distributed across 16 countries.

Figure 6: BRT system adoptions across low- and middle-income countries, 1974-2017



Note. Data from author extension of ITDP (2018) and BRT+ Centre of Excellence and EMBARQ (2020). See Chapter 2 for details.

Table 20: Top 5 BRT Adopters, 1970-2017

Country	Region	BRTs[(a)]	Percent	Governance type[(b)]	Regime type[(c)]	Income group[(d)]	National program
China	East Asia Pacific	23	25%	Unitary	Autocracy	Upper-middle	
Brazil	Latin America	15	16%	Federal	Democracy	Upper-middle	Yes[(e)]
Mexico	Latin America	11	12%	Federal	Democracy	Upper-middle	Yes[(f)]
India	South Asia	10	11%	Federal	Democracy	Lower-middle	Yes[(g)]
Colombia	Latin America	7	8%	Unitary	Democracy	Upper-middle	Yes[(h)]
All other		26	28%				
Total		**92**	**100%**				

Note. Sources and specifications: (a) BRT+ Centre of Excellence and EMBARQ (2020), (b) Forum of Federations (2020), (c) Center for Systemic Peace (2020), (d) World Bank (2020), (e) Brazil's Growth Acceleration Program (PAC), (f) Mexico's Public Transportation Federal Support Program (PROTRAM), (g) India's Jamal Nehru National Urban Redevelopment Mission (JNNURM), (h) Colombia's National Urban Transport Program (PNTU). It is also worth noting that all BRTs in South Africa have been built with national investment. The table excludes BRT systems in high-income countries. See Chapter 2 for additional details.

Despite this strong variation at the national level, comparative case studies in the BRT literature tend to focus on variation at the system level, either within or across countries (e.g., Ponnaluri 2011; Nguyen and Pojani 2018; Flores Dewey 2013). As a result, scholarship often cannot explain cross-country variation. My argument focuses on the role of meso-political institutions. Since meso-political institutions vary across countries rather than BRT systems, I employ two *country-level* comparative research designs. The first employs a 'most-similar systems' approach: it compares two reasonably similar countries, one with and one without a national investment program, and parses out which *institutional differences* explain the *variation* in the policy outcomes (investment program vs. no investment program). To strengthen the generalizability of the findings, I then complement this design with a second 'most different systems' *shadow case study*. The shadow case compares two reasonably different countries, both with a national investment program, and assesses which *institutional similarities* explain the *convergenc*e in the policy outcome (the existence of an investment program).

Neither research design alone could generate robust policy insights. The former helps identify causal mechanisms, but suffers from weak external validity. The latter enjoys stronger external validity, but cannot necessarily identify causal mechanisms. Two different countries

with similar policy outcomes could merely reveal two unique policy pathways. In combination, however, the two designs help leverage the advantages of comparative research while simultaneously acknowledging its imperfections (George and Bennett 2004; Lijphart 1971).

4.3.2. *Case selection: Mexico and Peru, plus Colombia*

The case selection is informed by the results of the survival regression analysis in Chapter 2. The survival analysis employs a broad political economic framework to explain variance in low-carbon urban infrastructure deployment across a larger set of countries. To recall, the analysis finds significant positive effects associated with regime type, income, region, and international non-profits: countries are significantly more likely to deploy BRTs when they are governed democratically, reach middle-income status, are in Latin America, and host an international NGO advocating for urban transit reform.[64] Moreover, the regressions show how federal countries are significantly more likely to adopt BRT systems when they are governed democratically.

My case selection builds on these observations. Following the design rationale outlined above, I compare Mexico and Peru. In political institutional terms, both countries are reasonably similar. In both countries, urban transport is governed at the sub-national level: in Mexico at the state level and in Peru at the municipal level. In both counties, the national government is mainly responsible for inter-urban transport, national transport infrastructure, and rail transport. Mexico and Peru are both characterized by relatively low levels of fiscal decentralization (e.g., Hernández-Trillo and Jarillo-Rabling 2008; Ahmad and García-Escribano 2008). Sub-national governments in both countries are therefore expected to experience a policy gap. Both countries have hosted offices affiliated with the World Resources Institute (WRI), an international NGO active in the BRT space. Moreover, Mexico and Peru share middle-income status, are in Latin America, and are governed by presidential democratic political systems. Compared to other middle-income economies in Latin America, such as Brazil and Colombia, Mexico and Peru are relative latecomers historically when it comes to the deployment of BRT systems.

Simultaneously, Mexico and Peru evidence significant variance in the policy outcome. Mexico implemented 11 BRT systems between 2003 and 2017, most of which were built with federal assistance through Mexico's Public Transportation Federal Support Program (PROTRAM – *Programa de apoyo federal al transporte masivo*). Peru implemented only one BRT corridor in Lima within the same timeframe, and to date has not issued a national investment program. Several attempts to expand the Lima BRT were unsuccessful. Arequipa, Peru's second largest city, came close to building a BRT, but ultimately did not succeed.

Needless to say, Mexico and Peru are very different countries. For instance, Mexico is governed by a federal political system, while Peru has a unitary system. Another important difference is their size. With 35 metropolitan areas[65], Mexico offers a much larger mass transit market than Peru, with at most eight urban centers.[66] Despite these differences, their *institutional*

[64] The analysis in Chapter 2 focuses on two specific NGOs which are particularly active in the BRT space: the World Resources Institute (WRI) and the Institute for Transportation and Development Policy (ITDP).
[65] See Mier y Teran (2012) for an overview.
[66] Alongside the Lima-El Callao metropolitan area with 9.8 million habitants, further urban centers each with over 450 thousand habitants include Arequipa, Chiclayo, Cusco, Iquitos, Piura, Pucallpa, and Trujillo (MTC 2019; cf. GIZ 2020).

similarities beg the question why a national investment program came about in Mexico but not in Peru. An overview of the comparative research design, including its key comparative dimensions, is listed in *Table 21.*

Table 21: Overview of main comparative research design

	Mexico	**Peru**
Dependent variables		
• BRT systems [(a)]	11	1
• Policy outcomes	Public Transportation Federal Support Program (PROTRAM)	Phases of BRT initiatives: Lima (1996-2003, 2003-2006, 2006-2010, post-2010) Arequipa (2007-2010, 2010-2015)
Institutional similarities		
• Regime type	Democracy	Democracy
• Government form	Presidential	Presidential
• Regulatory responsibility		
– Levels of government	3 levels: federal, state, and municipal (Mexico City is an exception)	4 levels: national, regional, municipal, district (Lima is an exception)
– Urban transport	Mostly governed at the state level	Governed at the municipal level
– National government	The Secretariat of Communications and Transportation (SCT) is responsible for inter-urban transport, national transport infrastructure, and rail transport	The Ministry of Transport and Communications (MTC) is responsible for inter-urban transport, national transport infrastructure, and rail transport
• Policy gap	Yes	Yes
Further similarities		
• Income-level	Middle-income	Middle-income
• Region	Latin America	Latin America
• Regional non-profit	CTS/WRI Mexico (2002-present)	EMBARQ/WRI Andino (2008-2014)
Important differences		
• Political system	Federal	Unitary
• Market size	35 urban centers	8 urban centers

Note. (a) Independently verified BRT deployments, 1970-2017. See Chapter 2 for details.

As my *shadow case study*, I triangulate supplementary evidence from Colombia, a middle-income democracy in Latin America which is governed by a unitary political system and has adopted comparatively many BRTs. Between 2000 and 2016, Colombia inaugurated seven BRT systems with the help of a national BRT policy. Mexico and Colombia's *institutional differences* beg the question why a national investment program came about in both institutional contexts.

4.3.3. *Research strategy: Process tracing, historical analysis, and interviews*

My methods combined process tracing, historical analysis, and semi-structured expert interviews. My research strategy fell into three steps. First, I identified specific policy outcomes to approximate the variance in the dependent variable. For Mexico this was straightforward: I focused on PROTRAM, which was developed in the second half of the 2000s, alongside a

handful of examples of how PROTRAM has played out in specific cities. For Peru, I decided to examine the various phases of the BRT initiatives which unfolded in Lima and Arequipa between 1996 and 2015, in order to deconstruct how Peru's political institutions have tended to shape urban transit projects. As part of this first step, I conducted extensive online desktop research and document analysis, and developed detailed timelines of how the policy outcomes came about.

Second, using the detailed timelines, I developed individual interview guides, one each for PROTRAM, Lima, and Arequipa. All three guides followed the same basic structure. A first set of questions helped clarify the policy outcomes (e.g., 'How does PROTRAM work?'). A second set formulated various versions of an open-ended question that prompted interviewees to formulate causal explanations of the policy outcomes (e.g., 'What explains the creation of PROTRAM?'). A third set confronted interviewees with competing explanations (e.g., 'To what extent, if any, does demand from cities help explain the creation of PROTRAM?). A final set helped triangulate findings from other interviews (e.g., 'I've been told X. To what extent, if any, do you agree with that explanation?'). Copies of the guides are provided in the supplementary materials.

Third, I implemented the semi-structured interviews. I recruited participants via email and conducted the interviews remotely using video conferencing software (e.g., Zoom). I formulated the questions as neutrally as possible to avoid biasing responses. Towards the end of each conversation, I asked for additional interview leads and clarified the confidentiality of the exchange. I conducted 30 interviews with 29 experts in this way between June and December 2021, 16 for Mexico and 14 for Peru (*Table 22*). Experts included transport specialists at development agencies (3), research institutions (3), international and domestic NGOs (11), multilateral development banks (6), and governmental organizations (3), among others (3). Conversations lasted between 25 and 150 minutes, and on average took 60 minutes. A list of all participants is provided in the supplementary materials.

In addition to these three steps, I also leveraged five interviews which I conducted for a preceding project between April and June 2019. In total, the analysis therefore builds on 35 interviews. An overview of all interviews is listed in the supplementary materials. To examine how PROTRAM has played out in specific cities across Mexico, three research assistants conducted case studies of the BRT projects in Acapulco, Chihuahua, Guadalajara, Ciudad Juárez, León, Monterrey, Pachuca, Puebla, and Tijuana. On average each case was investigated for 12 hours with online desktop research. The supplementary evidence from Colombia builds on select interviews and a document analysis.

Table 22: Expert interviews, June-December 2021

	Mexico		**Peru**		**Total**	
	Interviews	**Experts**	**Interviews**	**Experts**	**Interviews**	**Experts**
Development agency	0	0	2	3	2	3
Researcher	1	1	2	2	3	3
NGO	8	8	3	3	11	11
MDB	4	4	2	2	6	6
Policymakers	2	1	4	2	6	3
Other	1	1	1	2	2	3
Total	**16**	**15**	**14**	**14**	**30**	**29**

Note. Overview of the 30 interviews conducted in 2021. One interview was jointly conducted with multiple experts. I also in some cases held more than one interview with the same expert. This explains the difference between the number of interviews and experts. See Chapter 3 for an overview of the 32 interviews in 2019.

4.4. Results

4.4.1. *Mexico: Evidence from PROTRAM*

If the short story of why Mexico accelerated its deployment of BRTs is because it created a national investment program, the long version captures how the investment program came about. Interviewees unanimously agreed that Mexico's BRT trend since the mid-2000s cannot be explained without PROTRAM. An in-depth account of PROTRAM's origins is offered in the supplementary materials, along with extensive evidence from the semi-structured interviews. Here I only summarize the most essential historical developments to contextualize the comparative analysis in Section 4.4.3.

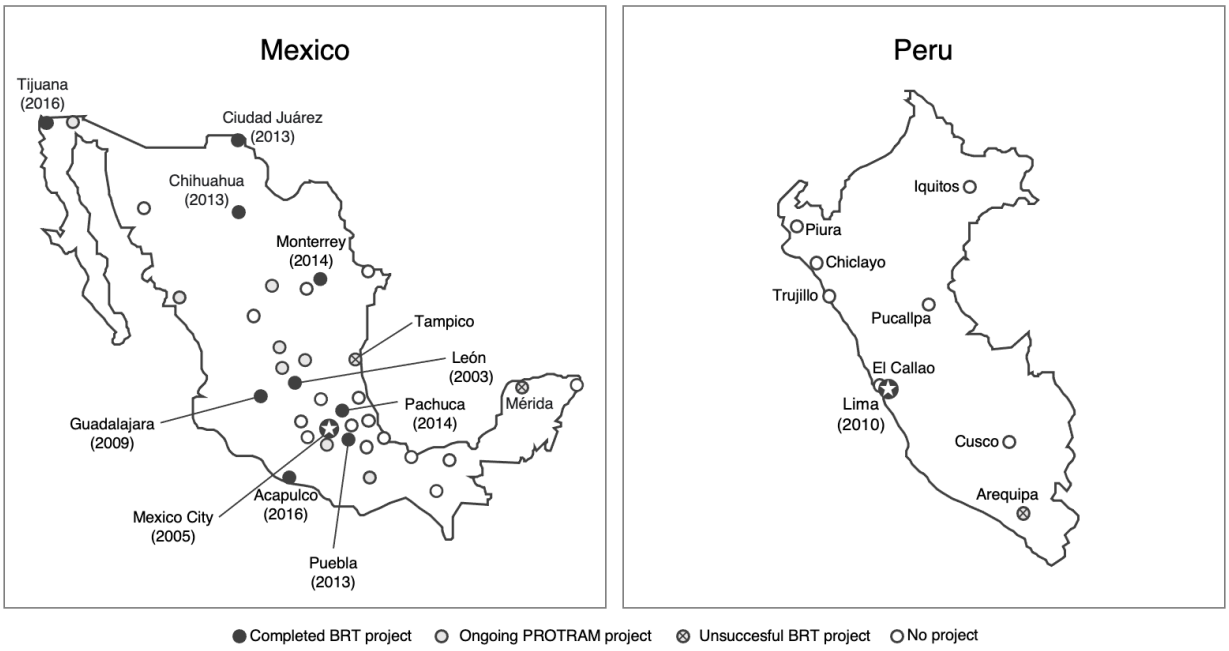
The seeds of PROTRAM date to the mid-1990s when Mexico's federal government created the Support Trust for the Rescue of Concessioned Highways (FARAC – *Fideicomiso de Apoyo para el Rescate de Autopistas Concesionadas*). The trust was designed to structure and service the debt of the country's nationalized toll roads, which the government had to bail out after many private concessionaires started to face bankruptcy. A decade later, FARAC would eventually turn into the National Infrastructure Fund (FONADIN – *Fondo Nacional de Infraestructura*), the trust fund of PROTRAM.

In the early to mid-2000s the first two BRT systems were adopted in Mexico without any federal support: the municipal government of León opened its *Optibús* in 2003 and the metropolitan government of Mexico City its *Metrobús* in 2005. Both projects were partially inspired by the *TransMilenio* system in Bogotá, Colombia. While both systems proved successful, only Mexico City garnered attention from national and international policymakers as a domestic proof of concept. León, a much smaller city compared to the county's capital, was seen as an outlier.

In the mid- to late-2000s, two further key developments came into play. First, Mexico's federal government experienced windfall income. An international commodities boom afforded the national government excess oil revenue, and at the same time the nationalized toll roads under FARAC unexpectedly became profitable. Mexico's federal government started to look for ways to invest this windfall income in infrastructure and replaced FARAC with FONADIN. FONADIN was set up to co-finance infrastructure in critical public sectors such as water, waste, and the like, and was to be replenished by the net revenue generated by the nationalized toll roads. Second, urban transport reform in secondary cities began to emerge on the federal policy agenda. Contributing factors to this agenda change included persistent advocacy by reform campaigners, a broader BRT trend across Latin America, and the emergence of climate change as a major policy issue which helped frame BRT as a low-carbon innovation. Both developments – the windfall income and the new agenda – converged when Hacienda, Mexico's finance ministry, hired the World Bank to assess whether FONADIN could be used to co-finance mass transit.

This assessment led to a policy report (World Bank 2008), a series of expert workshops on how best to design the envisioned program, and ultimately to the creation of PROTRAM at the end of the 2000s. Throughout the 2010s, the program enabled roughly a dozen completed BRT projects across the country *(Figure 7*). Many more projects are still ongoing to this day. Overall, PROTRAM is seen as a success.

Figure 7: BRT initiatives across Mexico and Peru



Note. The overview for Mexico is based on Mier y Teran (2012, 2013) and Vargas (2021). Not all cities are labelled to facilitate readability. The overview for Peru is based on MTC (2019).

4.4.2. *Peru: Evidence from Lima and Arequipa*

The question why Peru has so far not created a national investment program akin to Mexico's PROTRAM can only be answered indirectly. If the short story of why Peru has not adopted many BRT systems is because it never issued a national investment program, the long version captures the historical successes and failures of specific BRT initiatives. Detailed accounts of how the BRT projects in Lima and Arequipa unfolded are supplied in the supplementary materials, along with extensive materials from the semi-structured interviews. As in the previous section, here I focus on the most essential developments in preparation for the comparative analysis in Section 4.4.3.

4.4.2.1. *Lima*

Lima's BRT story began in the 1960s, with the opening of its *Vía Expresa* in 1969, an intraurban expressway with two exclusive bus lanes. Although the lanes did not qualify as a BRT, their innovation influenced the design of the first BRT in Curitiba, Brazil, in 1974 (cf. Lindau, Hidalgo, and Facchini 2010). Under President Alan García in the 1980s, Peru's national government attempted to build Lima's first metro line. But the project was a disaster. Only a fraction of the planned line was completed, and the system did not attract much ridership. Eventually, public service was closed. For years the line was serviced with empty trains to prevent corrosion, giving it the nickname *el tren fantasma*, the ghost train.

Under President Alberto Fujimori in the 1990s, Peru radically liberalized its public transport systems, leading to an explosion in semi-informality (Jauregui-Fung et al. 2019; Scholl

et al. 2015). By some accounts Lima's paratransit fleet grew by 350% between 1990 and 1998 (ITDP 2002; cf. Jauregui-Fung et al. 2019; Martínez and Cornejo 2003). Growing transport issues such as congestion and air pollution prompted the World Bank to propose a public transport project for Lima. But the proposal failed to materialize in the run-up to the 2000 general elections.

The idea of a BRT for Lima emerged from this initial proposal during the mayorship of Alberto Andrade. The World Bank was inspired by Bogotá's *TransMilenio,* and persuaded Andrade to buy into the proposal by arranging an in-person exchange with Enrique Peñalosa, Bogotá's former mayor. The project stalled, however, after Andrade lost the 2002 mayoral elections to Luis Castañeda, who campaigned on re-opening the Lima metro.

During his first term, Castañeda attempted to resurrect the metro, but was unable to solicit sufficient private investment to fully self-finance the project. The BRT initiative was de facto put on hold during this time and the World Bank internally classified it as a 'problem project'. During his second term, Castañeda changed his position and prioritized the BRT. He began to view the project as one means to win the 2011 presidential election. To this end, for instance, he made sure that plaques with his name were installed at BRT stations. Castañeda inaugurated the *Metropolitano* in 2010, shortly before he stepped down as mayor and launched his presidential campaign.

Overall, Lima's BRT is seen as a success. By 2018, it was servicing 700,000 passengers per day (GIH 2019). Its total investment is valued at USD 300 million over seven years of implementation (Scholl and Quintanilla 2015). Several attempts by Lima's municipal government during the 2010s to expand and extend the system, however, were blocked by the national government (cf. Scholl and Quintanilla 2015). Instead, the national government prioritized further public investment for the metro, which finally re-opened service in 2011. By 2019, the metro was serving 692,000 passengers per day (Andina 2019). Its total investment is estimated at USD 2 billion over 25 years of implementation (CAF 2016). In the late 2010s, the national government rejected the idea of a second BRT line, and instead began to build a second metro line for an estimated USD 5.3 billion (Georges Darido et al. 2015).

The above analysis refines several accounts of the history of the Lima BRT published elsewhere. Jauregui-Fung et al. (2019) argue, for instance, "[d]uring the first municipal government period of Mayor Luis Castañeda Lossio, the implementation of the first and only BRT system in Peru was proposed". My research shows how the BRT was proposed earlier, before Castañeda became mayor. Similarly, Mallqui and Pojani (2017) write "[i]n Lima, the BRT proponent was Mayor Alberto Andrade Carmona, who, after visiting Bogotá's *TransMilenio* system in 1998, decided to import the concept to Peru". My research suggests that it was the World Bank which introduced the concept to Peru; that Andrade did not support the proposal until he was running for re-election in the early 2000s; and that Andrade could not have visited the *TransMilenio* system in 1998 since the system only opened in 2000. Mallqui and Pojani (2017) moreover assert that after Andrade lost the election, "the next Mayor, Luis Castañeda Lossio, carried the project forward". My research indicates that Castañeda initially blocked the project. Like Andrade in 2002, Castañeda only started to support the BRT once he faced political pressure during his second term in 2006.

4.4.2.2. *Arequipa*

Arequipa's BRT story began in 2007 when EMBARQ, an NGO affiliated with WRI, invited the city's mayor Simón Balbuena on an international BRT study tour. The tour prompted Balbuena to initiate an integrated urban transport reform which included a BRT system: the 'Mistibus'. The project was set up as a collaboration of the Provincial Municipality of Arequipa (MPA), EMBARQ, and the Andean Development Corporation (CAF). The MPA would lead the initiative and host the planning team, EMBARQ would offer technical assistance and manage all finances, and CAF would supply a USD 81 million multilateral loan.

The project initially moved forward fast. Within less than a year the feasibility studies were completed. While the reform initiative stirred some local opposition from paratransit operators, as would be expected (e.g., Asimeng and Heinrichs 2021), it also generated broad local support (e.g., Correo 2009). Construction of the BRT's first phase commenced in early 2010 with financial resources from the MPA, the regional government, and a local mining company. The CAF loan was in preparation.

In late 2010, the project started to face problems. In order for CAF to disburse the loan, Peru's ministry of finance, the MEF, had to issue a sovereign guarantee. But the MEF did not respond to the loan guarantee request. The reasons for this delay are contested to this day, and appear to involve political and technical motives. On the one hand, the García administration was politically at odds with Balbuena. On the other, the MEF was concerned that the proposal underestimated the costs. For either reason, or a combination of both, the national government temporarily put the project on hold.[67]

In 2011 there were changes in government at both the local and national levels. Balbuena lost the mayoral election to Alfredo Zegarra, who changed the name 'Mistibus' to 'Arequipa Bus', but otherwise embraced the BRT project. At the national level, Ollanta Humala became president. His administration decided to review the project and asked the MPA to hand over all technical files to the ministry of transport, the MTC. In effect, the MTC assumed technical control (cf. MTC 2012). A new demand study was begun, which took several years to complete.

In 2013, an international consortium of the Brazilian construction firm Queiroz Galvão and the Canadian train manufacturer Bombardier submitted an unsolicited proposal to ProInversión, Peru's private investment agency, to replace the Arequipa BRT with an elevated monorail (ProInversión 2013). The MTC supported the idea and announced that the monorail, estimated at USD 1.2 billion, would be opened by 2016 (cf. WRI 2013).

The monorail proposal, however, triggered fierce local resistance. The MPA rejected the proposal on technical and financial grounds. Opposition also came from Arequipa's regional ministry for culture, local technical colleges, and a citizen's movement (Granda Acosta 2018; La República 2014; Mamani 2014). There were fears that the monorail would damage Arequipa's historic city center and jeopardize its standing as a UNESCO World Heritage Site. The monorail proposal eventually lost political legitimacy. In December 2015, ProInversión rejected the proposal.

To this day Arequipa does not have a mass transit system. Although the construction work for the first phase of the original BRT proposal was eventually completed, the infrastructure remains unused. Ex-Transport Minister Carlos Paredes and Queiroz Galvão were

[67] Additional evidence on the contested nature of the MEF's delay is offered in the supplementary materials.

later implicated in severe corruption allegations (e.g., La República 2019a, 2019b; Agenda País 2019).

4.4.3. *Comparative findings*

In the next sub-sections, I build my argument with comparative evidence. I show in detail how four meso-level institutions in Mexico enabled public investment for BRT projects, and how, in comparison, the institutional environment in Peru has made BRT interventions more difficult.

4.4.3.1. *An actor who unlocks state capacity and resources*

In the second half of the 2000s, Mexico's finance ministry, Hacienda, started to view lack of public investment for urban transport reform as a federal fiscal issue. It concluded that states were suffering from a policy gap, that this gap was hampering urban economic development, and that states therefore required federal assistance. Importantly, Hacienda neither challenged states' regulatory authority over urban transport, nor the federal government's regulatory focus on inter-urban transport and national transport infrastructure. Instead, it sought to develop a program which would combine sub-national regulatory authority with federal fiscal assistance. This became the core political rationale which eventually enabled the creation of PROTRAM.

In comparison, Peru's national finance ministry, the MEF, mainly acted as a fiscal veto player. It did not play a direct role in urban transport reform. The MEF delegated regulatory questions regarding transport to Peru's national transport ministry, the MTC. The MTC, in turn, did not view urban transport as a national policy issue unless it involved rail-based projects. It instead treated the governance of urban transport as an exclusively sub-national regulatory issue. Without support from either the MEF or MTC, municipalities in Peru continued to suffer from a policy gap. This is evidenced by Lima's inability to self-finance the *Metropolitano*'s northern extension and second BRT line, as well as by Arequipa's reliance on external capital, be it from CAF, the MEF and/or the MTC.

4.4.3.2. *A framework which aligns national and sub-national policy interests*

In Mexico, political institutions have offered a framework to align policy interests. Alongside Hacienda, BANOBRAS, one of the country's national development banks, has played an essential role. BANOBRAS is tasked with closing both national infrastructure gaps and investment gaps between federal states. For this reason, BANOBRAS is sometimes called "the bank of federalism" (Anonymous, interview, 16 September 2021). The bank's institutional mission aligns with fiscal federalism. When Hacienda started to design FONADIN and PROTRAM, BANOBRAS presented a natural institutional fit for the instrument.

Several interviewees argued that Hacienda intentionally did not want to set up the instrument under Mexico's transport ministry, the SCT. For one, the SCT had neither the technical capacity, nor the regulatory authority. For another, there were concerns that if the instrument were assigned to the SCT, this could politicize investment decision-making. One expert reflected, "if the SCT did the technical evaluations, then they'd have the control. They could decide who gets the funding and who does not yet get the funding. […] The STC would have been a more political filter" (G. Freiberg, interview, 16 August 2021). Similarly, another

remembered, "[there was] a fear that the Ministry of Transport would go ahead with certain projects because of political agreements" (J. Barbero, interview, 18 August 2021).

Formally, BANOBRAS and FONADIN-PROTRAM were set up as separate entities. Interviewees underlined that FONADIN is a trust fund and BANOBRAS serves as its fiduciary. This arrangement frees the instrument from BANOBRAS' internal constraints. BANOBRAS, unlike other national development banks, does not receive funding from the federal budget. Its investments must in sum break even. Investments under PROTRAM, however, are not subject to this constraint and can therefore assume more financial risk. This has enabled urban transit investments which would have otherwise not been possible.

In practice, BANOBRAS and PROTRAM are closely connected. The instrument is managed by a small team from within BANOBRAS.[68] As such, the instrument has benefited from the bank's technical and political capabilities. Specifically, BANOBRAS has supplied multi-annual financial planning, complementary lending instruments, a network of political relationships with governors and mayors, privileged access to national decision-makers, and stable elite management.

Peru's institutional environment, in comparison, has not afforded urban transport projects with an institutional framework akin to BANOBRAS. Peru does not have a public institution specifically tasked to help overcome fiscal differences across regions and provinces. Interviewees characterized COFIDE, Peru's national development bank, as a comparatively weak financial institution which has not been significantly involved in urban transit projects.[69]

When COFIDE is involved, the bank tends to act on behalf of national policy interests. For instance, Lima's *Metropolitano* BRT project was set up as a sub-national project and was led by the Metropolitan Municipality of Lima (MML). Peru's national government neither offered technical nor financial assistance. However, the concessions were tendered through COFIDE. COFIDE was mandated by the national government to expand Peru's domestic liquified natural gas (LNG) demand, to help fulfill national financial obligations towards private investors of a gas pipeline project (Scholl and Quintanilla 2015). This helps explain why COFIDE linked the concessions of the Lima BRT to LNG buses, even though this *increased* the planning risk of the project.

Furthermore, when Peru's MTC got involved in urban transport projects, it appears to have prioritized national over sub-national policy interests. The failed BRT project in Arequipa serves as an example. The MTC was pushing the monorail proposal in opposition to sub-national interests. Interviewees noted that the Arequipa's monorail is just one instance of two broader patterns in Peruvian infrastructure politics. First, there is a bias towards capital-intensive projects. "The system is designed to execute big projects" (M. Alegre Escorza, interview, 12 August 2021). Second, national and sub-national interests compete for political recognition. "Everyone wants to benefit from the project. The bigger and more expensive the project, the better" (K. Heising, interview, 14 July 2021).

Infrastructure planning in Peru is further complicated by high ministerial turn-over. Unlike BANOBRAS' PROTRAM team, which remained under the same leadership for over a

[68] This explains why many interviewees described PROTRAM as a fund 'under' or 'within' BANOBRAS, even though this is technically not correct.

[69] "COFIDE has financed some bus operations. But they have not been very involved in infrastructure, in the metro, the stations, and the like. [COFIDE] is not active like regional development banks" (L. Roca, interview, 23 August 2021).

decade, Peru's MTC typically changes hands several times per administration. This high turn-over has jeopardized planning efforts which extend beyond a single ministerial appointment. One expert asserted, "[the transport minister] might talk about a coast train, then he gets fired. Then the next minister starts talking about ports and is fired. Then the next minister talks about airports and gets fired" (L. Roca, interview, 23 August 2021). Similarly, another explained, "[e]very time [the minister changes], they try to get some benefit, try to make another study. With every change of the president, the process starts again" (S. Granda Acosta, interview, 29 June 2021).

4.4.3.3. *A politically savvy funding mechanism which disciplines public authority*

Interviewees characterized PROTRAM as a federal support program for mass transit infrastructure with clear rules and requirements, and whose funding is excluded from the federal budget. As such, the instrument has offered four internal institutional design features which have helped to discipline public authority around urban transit reform. First, as a federal support program, PROTRAM requires regulatory and financial participation from sub-national actors. States and municipalities are expected to take the lead on project development and provide co-financing. In effect, this means that the instrument mixes national and sub-national public authority, which helps generate vertical institutional accountability: national authority keeps sub-national authority in check, but also vice versa.

Second, PROTRAM was designated for mass transit infrastructure in general. Interviewees emphasized that it was not set up as a BRT program. In principle, it can co-finance any form of urban mass transit, pavement- or rail-based. In practice, however, it has mainly co-financed BRTs. This demonstrates that project proposals undergo a vetting process aimed at disciplining investment decisions. PROTRAM's internal process entails at least two critical veto points, both of which are relatively insulated from special interests. One is Hacienda's Investment Unit, which examines proposals in terms of their financial feasibility. Not even BANOBRAS has easy access to this unit.[70] The other is PROTRAM's technical sub-committee, which assesses proposals in terms of their technical designs. The sub-committee is comprised of independent consultants, who themselves sometimes collect field data to verify quantitative assumptions. Combined, these two assessments tend to point to BRT over metro systems as the most feasible solution for medium-sized cities between 500,000 and 1 million inhabitants. PROTRAM's internal organization is sketched in *Figure 8.*

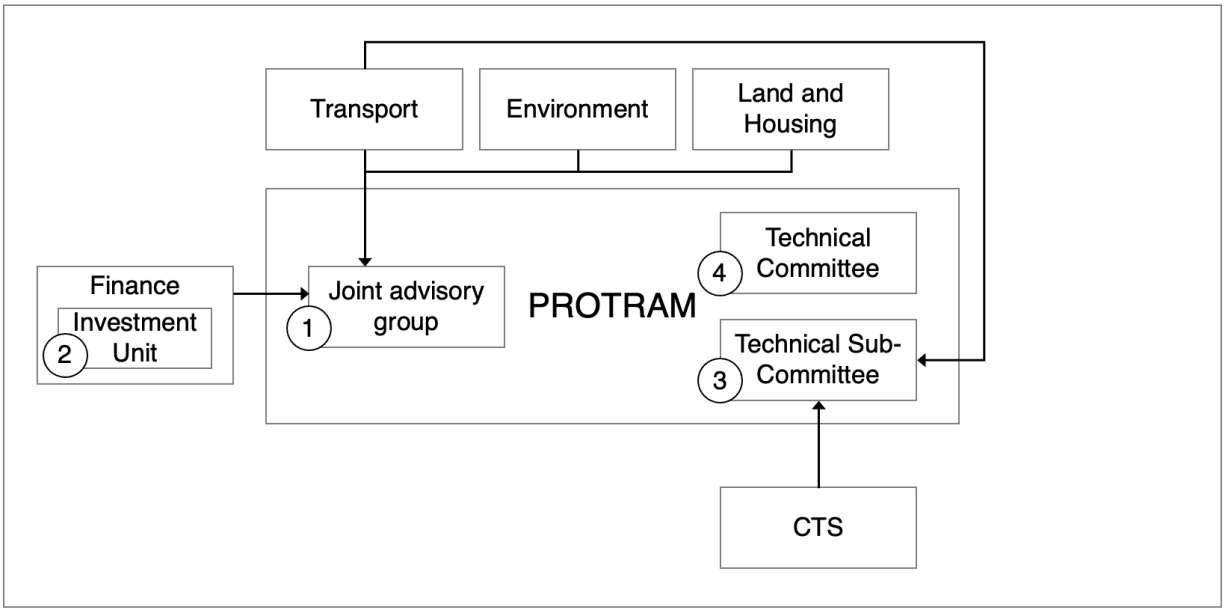
Third, PROTRAM follows specific rules and requirements. Interviewees asserted that transparent rules are essential for de-politicizing investment decision-making. If projects fulfill a pre-defined set of criteria, they receive funding. If the criteria are not met, then projects cannot move forward. Rules render verdicts transparent and intelligible, and thus deter discretionary decision-making. Notably too, PROTRAM explicitly precludes states from institutionally locating their urban mobility team under their department for home affairs (*Secretaría de Gobernación*). A senior policymaker explained that this conditionality was added as a strategy to de-politicize decision-making at the sub-national level (Anonymous, interview, 16 September 2021).

[70] "The Investment Unit is very powerful. It decides whether or not to register a project. [It's the first gate,] quite insulated. It's quite difficult to have a meeting with them [even for us]. They don't want pressure from the sponsor" (Anonymous, interview, 16 September 2021).

Finally, PROTRAM is not considered to be part of Mexico's federal budget. Interviewees explained that Hacienda purposefully set up FONADIN in this way to enable multiannual financial planning. If FONADIN were to require annual approval from Mexico's congress, the prospect of unexpected budget cuts would increase planning uncertainty. Such uncertainty would be detrimental for multiyear infrastructure investments. This suggests that PROTRAM's institutional requirements not only help depoliticize decision-making at the sub-national level; FONADIN's institutional set-up also depoliticizes decision-making at the national level.

Whether PROTRAM has depoliticized urban transit investments altogether remained an issue of contention among interviewees. Partisan alignment of national and sub-national political interests was characterized either as not important or an enabling factor. Importantly, however, nobody identified political misalignment as a reliable barrier. A review of political constellations supports this assertion: between 2009 and 2012, four out of seven PROTRAM projects were approved under a governor affiliated with a political party other than the federal administration (see *Table 25* in the supplementary materials).

Figure 8: Organizational design of Mexico's PROTRAM



Note. Projects follow four steps. First, a joint advisory group consisting of members from various federal ministries verifies a proposal's eligibility. Second, Hacienda's Investment Unit reviews the finances. Third, a technical sub-committee reviews the technicalities with external support, e.g., from CTS. Finally, a technical committee of key political stakeholders approves the project. The figure is highly stylized to facilitate readability.

In comparison, Peru demonstrates very different institutional patterns. Overarchingly, interviewees stressed that institutions are at the heart of Peru's mass transit infrastructure gap. One observed, "[people] will argue 'You need to give the Ministry of Transport more authority!' or 'We need to give more autonomy to cities!' But you need a good diagnosis. We don't talk about the institutional problem" (L. Roca, interview, 23 August 2021).[71] Unlike Mexico, Peru

[71] Similarly, one senior expert asserted, "when you try to move [projects] into the political institutional environment, [implementation] is harder than just planning for how many people are moving, are they moving North to South,

does not have an instrument like PROTRAM which could help discipline urban transit investment decision-making with clear rules and procedures. Projects do not necessarily follow a pre-defined process mixing national and sub-national regulatory responsibility. Projects tend to be either developed by the national government (e.g., the Lima metro or Arequipa monorail) or sub-national government (e.g., the Lima BRT or Arequipa BRT). As a result, national and sub-national policy interests are often misaligned or even conflictual (e.g., COFIDE's LNG conditionality, Arequipa monorail proposal, Lima's second BRT line). Investment decision-making therefore tends to be "very messy" (L. Roca, interview, 23 August 2021).

Urban transit investment decision-making in Peru is also subject to veto points, rules, and procedures, but compared to Mexico these appear less insulated from special interests. Consequently, special economic interests in Peru can more easily capture projects. Arequipa serves as an example, where multinational corporate interests captured national policy interests. Lack of sub-national technical capacity alone seems an unlikely explanation for policy outcome in this case given the significant involvement of CAF and EMBARQ. Most country experts also expressed concern for corruption, which supports the assertion that rent seeking has tended to play a larger role in Peru than in Mexico.

Comparatively high levels of vertical political competition rather than accountability between national and sub-national political interests, alongside the power of special interests, help explain why political misalignment between national and sub-national government actors has played a more significant disabling role in Peru than in Mexico. There are reasons to believe that vertical competition has factored into transit planning in Lima and Arequipa alike, be it under President Fujimori and Mayor Andrade in the 1990s (Lima), President García and Mayor Balbuena in the 2000s (Arequipa), or President Humala and Mayor Zegarra in the 2010s (Arequipa). This would also help explain why project cycles in Peru so closely follow political cycles, as under President García in the 1980s and 2000s (Lima), Mayor Andrade in the early 2000s (Lima), Mayor Castañeda in the mid- and late-2000s (Lima), Mayor Balbuena in the late-2010s (Arequipa), or Mayor Zegarra in the early-2010s (Arequipa).

4.4.3.4. *A mechanism of fiscal redistribution*

PROTRAM has served Mexico as a mechanism of fiscal redistribution. The program was set up for Mexico's 35 largest cities, defined as urban agglomerations with over 500,000 habitants (Mier y Teran 2012, 2013). However, Mexico City has to this day not received financial assistance through PROTRAM, even though it is the country's political and economic center. In effect, this means that PROTRAM is a support program for secondary cities. It is also striking how dispersed PROTRAM projects have been across Mexico (*Figure 7*). It is thus possible that equitable allocation of public resources across federal states has either explicitly or implicitly influenced the distribution of public outlays. At least one city with less than 500,000 inhabitants has received PROTRAM support: Zacatecas. A senior policymaker explained "one loan was issued to Zacatecas, which is only above 300,000 [habitants], because it's a state capital which is facing security issues and an economic downturn. […]" (Anonymous, interview, 16 September 2021). This indicates that PROTRAM can indeed sometimes operate on a needs basis.

East to West, how many buses do we need, what is the frequency. All of that is great. But the politics, the institutional set-up is a project in itself" (C. Adriazola-Steil, interview, 20 June 2019).

Peru, in comparison, does not have an equivalent institutionalized mechanism of fiscal redistribution. Instead, there are political and economic incentives to focus most national investment in Lima. Nearly one third of Peru's population lives in Lima. This generates incentives for politicians to focus on the capital. "Usually, if you win Lima in a national election, you win the election" (M. Stiglich, interview, 19 August 2021). At the same time, Lima is Peru's economic center. The city generates the majority of the country's GDP and tax revenue, and therefore captures Peru's highest concentration of infrastructure demands.[72]

This has two consequences. For one, secondary cities in Peru are politically and financially overlooked.[73] [74] For another, there is a political premium for urban megaprojects. "[Peru's] political class is attracted to megaprojects. […] The bigger the better" (Anonymous). This helps explain García's metro project in the 1980s, Castañeda's prioritization of the metro in the early 2000s, and the MTC's monorail initiative in Arequipa in the early 2010s. It also offers a rationale for the national government's most recent efforts to expand the Lima metro rather than the BRT. While some interviewees argued that Lima, as a sprawling megacity, needs an expanded metro system, others raised equity concerns. "USD 5 billion for the metro in Lima? Even though [an investment of this size] could have financed BRTs across the country? The metro is sucking all the money" (C. Adriazola-Steil, interview, 29 September 2021).

4.4.3.5. *Additional comparative findings*

Beyond the role of the four meso-political institutional factors, the analysis revealed additional similarities and differences between Mexico and Peru. Several institutional similarities further strengthen the comparative design. For instance, the interviews show how sub-national governments in both countries indeed suffer from a policy gap. One expert explained, "[in Mexico] municipalities are important but have no resources. They rely on intergovernmental transfers" (Anonymous, interview, 13 August 2021). Similarly, another observed "[in Peru] financing goes through the Transport Ministry. Cities have the responsibility, but no funding" (K. Heising, interview, 14 July 2021). Moreover, sub-national governments in both countries often lack technical and institutional capacity, politicians in both countries generally prefer metros over BRTs, urban transit projects often follow election cycles, and special interests interfere with implementation plans.

But the analysis also revealed important differences. As expected, many interviewees highlighted that Mexico presents a larger mass transit market than Peru. Interviewees thus hypothesized that this difference in market size could have led to stronger sub-national demand for fiscal support in Mexico compared to Peru. However, process tracing shows that demand for fiscal support in Mexico *followed* the supply of PROTRAM. In fact, BANOBRAS felt compelled to organize a promotional tour across states to advertise the new program. The

[72] "Everything happens here [in Lima]. It makes sense to focus infrastructure investment here. It's the biggest city with the most infrastructure needs. […] There is not a lot of interest to invest outside of Lima" (L. Roca, interview, 23 August 2021).

[73] "If cities want to make change, they must ask the central government. But it's not that the central government has the initiative to improve cities, the central government only focuses on Lima" (S. Granda Acosta, interview, 29 June 2021).

[74] "Peru is a very centralized country. Cities have been basically forgotten. I would not say this publicly" (Anonymous).

difference in market size could thus help explain a difference in program size, but not necessarily the difference in the policy outcome.

Another important finding is that policy diffusion of BRT in Mexico was aided by an epistemic network (cf. Haas 1992). Many actors who promoted BRT in the mid-2000s formed a tightly knit coalition which helped foster technical and political capacity in Mexico. For instance, Claudia Sheinbaum, Mexico City's Secretary for the Environment who envisioned and led the *Metrobús* project, personally knew Professor 'Lee' Schipper, an instrumental figure for setting up the regional WRI office in Mexico City in 2002[75], from her time at UC Berkeley in the early 1990s. Sheinbaum also personally knew Walter Vergara from a consultancy in the late 1990s; he arranged exchanges with Enrique Peñalosa, the mayor of Bogotá who pioneered the *TransMilenio* system. Vergara mobilized external grant support from the Global Environment Facility, and advised Hacienda on how to design PROTRAM. Later, this network expanded with key actors located at Hacienda, BANOBRAS, and the World Bank. For Peru, the analysis did not reveal an epistemic network of this nature.

Additionally, the analysis uncovered that the creation of FONADIN was enabled by high oil prices (cf. Varela 2015; Reuters 2007). Mexico's federal government at the time was experiencing windfall profits thanks to a commodities boom, and was looking for ways to invest the windfall income. This begs questions about the structural relationship between fossil fuels and low-carbon investments. Since fiscal rents from natural resources have also dramatically increased since the 1990s in Peru, but have not been invested in transit development, a boom in commodities alone cannot explain the variance in the policy outcome.

[75] Originally, the office was called Center for Sustainable Transport (CTS). Later, it was rebranded as EMBARQ, before it was eventually named WRI Mexico.

Table 23: Overview of comparative findings from Mexico and Peru

Propositions	Mexico	Peru
1) An actor who enables transfer of capacity and resources	***Hacienda views urban transport as a federal fiscal issue.*** - Hacienda concluded that the policy gap is a federal issue, but neither challenged the SCT's role nor sub-national regulatory authority. Instead, it set up a support program. - PROTRAM helps fill the policy gap.	***MEF and MTC treat urban transport as a sub-national issue.*** - The MEF acts as a fiscal veto player but delegates transport-related questions to the MTC. - The MTC treats urban transport as a sub-national issue. - Municipalities continue to experience a policy gap.
2) A framework which aligns national and sub-national policy interests	***BANOBRAS offers an institutional fit for PROTRAM.*** - BANOBRAS, Mexico's 'bank of federalism', supplies multiannual planning, complementary lending instruments, a network of political relationships, and stable leadership.	***Peru does not have an institution akin to BANOBRAS.*** - Both the MTC and COFIDE tend to act on behalf of national policy interests (e.g., the LNG conditionality, the monorail in Arequipa). - Transport institutions are characterized by high political turn-over (e.g., MTC, ProTransporte^{+}).
3) A politically savvy funding mechanism which disciplines public authority.	***PROTRAM disciplines investment decision-making.*** - The program (i) generates institutional accountability; (ii) offers veto points which discipline modal choice; (iii) provides clear rules which depoliticize sub-national decision-making; and (iv) is excluded from the federal budget which depoliticizes national decision-making. - Political misalignment does not act as a reliable barrier (*Table 25*). - PROTRAM's institutional process also generates political legitimacy and buy-in (e.g., from governors, the SCT, and other ministries).$^{+}$	***Institutional weaknesses lie at the heart of Peru's mass transit gap.*** - National and sub-national policy interests are often misaligned (e.g., COFIDE's LNG conditionality; Arequipa's BRT vs. monorail; Lima's BRT vs. metro extension; Lima's northern BRT extension^{+}). - Projects do not necessarily follow a clear implementation process (e.g., projects are 'messy'; there are no clear rules; national law had to be changed specifically for Arequipa^{+}). - Projects suffer from regulatory capture (e.g., Arequipa's monorail; corruption allegations). - Political misalignment shapes transit planning (e.g., Fujimori-Andrade 1990s; García-Balbuena 2000s; Humala-Zegarra 2010s). - Project cycles follow political cycles (e.g., García 1980s, 2000s; Andrade 2000s; Castañeda 2003-2006, 2006-2010; Balbuena 2007-2010; Zegarra 2010-2014).
4) A mechanism of fiscal redistribution.	***PROTRAM distributes public outlays across federal states.*** - PROTRAM is a program for secondary cities. - Projects are distributed across the country (*Figure 7*). - Mexico City, the capital, has not received PROTRAM support. - Needs influence funding allocation (e.g., Zacatecas).	***Lima attracts most political attention and public investment.*** - Political and economic incentives concentrate public outlays in Lima, the capital (e.g., voters and infrastructure demand). - There are incentives to prioritize megaprojects (e.g., the Lima metro, Arequipa monorail, Lima metro expansion).
Additional comparative findings	***Additional similarities between Mexico and Peru strengthen the comparative research design.*** - Local governments in both countries often lack technical capacity. Politicians want to build metros. Special interests can interfere with projects. Projects are often shaped by election cycles. ***Mexico presents a larger mass transit market than Peru.*** - But this alone cannot explain the difference in the policy outcome. ***PROTRAM was enabled by an epistemic network and high oil prices.*** - These factors call for further research.	***Peru is starting to enact urban transport reform.***$^{+}$ - E.g., the creation of ATU for Lima and El Callao; the National Urban Transport Law; a pledge to invest $400 million. - But policy change remains uncertain. ***Transport projects are often shaped by international interests.***$^{+}$ - E.g., the World Bank, CAF, IDB, WRI-EMBARQ, multi-national companies, development agencies. ***Nearly all interviewees mentioned corruption as a major problem.*** - This evidences pervasive mistrust in public institutions.

Note. Additional evidence from the cases not included in the text is marked by '+'.

4.4.4. *Supplementary evidence from Colombia*

Colombia, a middle-income democracy in Latin America governed by a unitary political system, serves as a *shadow case study* alongside Mexico and Peru. It the context of BRT adoptions, Colombia is a first mover. It was one of the first countries in Latin America in the 2000s to direct national investments towards BRT projects. After the success of Bogotá's *TransMilenio* system in 2000, Colombia's first BRT system, the national government developed a national policy to promote and co-finance BRTs across the country (World Bank 2010b; Hidalgo and Díaz 2014). The national government agreed to co-finance up to 70% of the total capital investment, which led to BRT systems in six further cities: Pereira (2006), Cali (2009), Medellín (2011), Barranquilla (2010), Bucaramanga (2010), and Cartagena (2016) (BRT+ Centre of Excellence and EMBARQ 2021a). Internationally, Colombia's national policy is to this day often cited as a best practice example of national BRT policymaking (World Bank 2010b; Hook and Hughes 2015).

Preliminary evidence suggests that all four meso-political institutional factors uncovered by the in-depth comparison between Mexico and Peru have also played a role in Colombia. First, Colombia's national government early on authorized transfer of public resources to municipalities. Like in Mexico and Peru, urban transport in Colombia is governed at the sub-national level, yet municipalities often lack the resources and state capacity to implement transit reforms. Already in 1996 the national government passed several laws which granted national co-financing for urban transport projects (Hidalgo and Díaz 2014). These laws became the legal basis for the National Urban Transport Program (PNTU – *Programa Nacional de Transporte Urbano*) in 1996, which later became the basis for the national BRT policy in 2002-2003. Similar to how Mexico's PROTRAM was enabled by Hacienda and fiscal federalism, Colombia's national BRT policy was enabled by select actors in the national government and an existing legal framework.

Second, Colombia's institutional environment helped align national and sub-national policy interests around shared policy goals. The national BRT policy was implemented through a series of policy documents by the National Council of Economic and Social Policy (CONPES – *Consejo Nacional de Política Económica y Social*), a cabinet-level committee chaired by Colombia's president (e.g., CONPES 2002, 2003). This high-level political support and strategic guidance appears to have harmonized policy interests across key actors within the national government, including the Ministry of Finance, Ministry of Transport, and the National Planning Department. A designated Coordination Unit under the Ministry of Transport, in turn, seems to have played a key role in liaising with local authorities on technical issues (Turner, Kooshian, and Winkelman 2012a).

Third, Colombia's funding mechanism was set up to insulate investment decisions from special interests. Proposals go through a rigorous vetting process. Projects only move forward when certain criteria are met. Unlike Mexico's PROTRAM, however, Colombia's national BRT policy was not originally backed by domestic financing. Instead, it was mainly funded by dedicated multilateral support from the World Bank, Inter-American Development Bank (IDB), and the Andean Development Corporation (CAF) (Hook and Hughes 2015). Windfall tax revenue from a commodities boom, as experienced by Mexico, thus does not seem to be a necessary enabling condition.

Finally, concerns around equity factored into Colombia's national BRT policy from the onset. In the late-1980s and early-1990s, Medellín, Colombia's second largest city after Bogotá, had sought to self-finance a metro. But the project ran out of funding before completion. The national government agreed to help Medellín finish the project and avoid sunk costs, but anticipated pushback from other cities. One expert explained, "[t]he national government realized, if you do this for Medellín, all the other cities are going to scream 'Why do you give [investment] to Medellín, and not to Cartagena or Barranquilla or Bogotá? Medellín, those guys who just jumped the gun!?' So, the national government passed a law saying that 70% of transport infrastructure would be funded by the national government" (G. Menckhoff, interview, 19 June 2019). This suggests that fair access to national resources factored into the rationale behind the national policy from its inception.

Alongside these factors it is also important to acknowledge that the *TransMilenio* system in Bogotá became a powerful demonstration project which afforded the Colombian government significant international recognition (cf. World Bank 2010; Turner, Kooshian, and Winkelman 2012). Without Bogotá's success, Colombia's national BRT policy might not have come about so swiftly, if at all. Together with the evidence from Mexico and Peru, this suggests that a successful domestic pilot project serves as a necessary but insufficient enabling condition. The fact that Colombia, a unitary democracy, issued a national BRT policy indicates that a federal political system is not a necessary enabling condition. Federalism could make the four meso-political factors generally more likely, which would help explain why so many BRT systems are located in middle-income democracies governed federally. But this is a hypothesis which will have to be examined by future research.

4.5. Conclusion and Policy Implications

In this chapter I examine the institutional foundations of public investment for mass transit development in middle-income countries. I posit there are four specific meso-political institutions which can drive mass transit development when there is a policy gap between sub-national regulatory responsibility and limited sub-national capacity and resources: an actor who unlocks public capacity and resources, a stable framework which aligns national and sub-national policy interests, a politically savvy funding mechanism which disciplines public authority, and a mechanism of equitable fiscal redistribution. Together, these factors can catalyze public investment for mass transit deployment and help mitigate continued build-out of car-centered transport systems.

I develop this argument with comparative evidence from Mexico and Peru, and supplementary evidence from Colombia. I show how all four factors have played an enabling role in Mexico and Colombia, yet have been absent in Peru. National co-investment for sub-national transit development in Mexico and Colombia was authorized and legitimized by key actors in the national government and aided by existing legal frameworks. Peru's national government, in comparison, has tended to treat urban transport as an exclusively sub-national issue. National and sub-national policy interests in Mexico and Colombia have coalesced around shared policy goals through existing institutional frameworks (e.g., BANOBRAS and CONPES). Peru's institutional environment, in contrast, has tended to pitch national against sub-national policy interests. The funding mechanisms in Mexico and Colombia have disciplined public

authority. This explains, for instance, why PROTRAM in Mexico has mainly financed BRTs even though it is not a BRT program. In Peru, policymakers are politically and economically incentivized to invest in megaprojects. Finally, the investment programs in Mexico and Colombia were designed for mass transit projects in secondary cities. The programs de facto serve as mechanisms of fiscal redistribution. In Peru there is no mechanism which prevents Lima, the political and economic capital, from capturing most national resources.

In developing this argument, this chapter makes several scholarly contributions. For one, it sheds detailed light onto the specific meso-political institutional actors, frameworks, and mechanisms which can drive rapid transit transitions. It thus offers a new institutional explanation for why so many BRT systems are concentrated in so few middle-income countries. The chapter thereby speaks to the debates on "what kind of institutions matter and how" (Lockwood et al. 2017) and how to accelerate energy transition processes (Roberts et al. 2018). For another, the findings challenge the popular framing of cities as climate leaders (e.g., Barber 2017). They demonstrate how urban transition processes are profoundly shaped by national and regional actors (cf. Andonova, Hale, and Roger 2017; Marvin and Guy 1997). While mayors have garnered much scholarly attention, governors, ministers, and presidents might be just as important for urban transformation. Finally, the chapter makes an empirical contribution by offering the first political-historical case studies on Mexico's PROTRAM, Lima's *Metropolitano* (1996-2010), and Arequipa's BRT project (2007-2015). It thus refines related case studies published elsewhere (e.g., Mallqui and Pojani 2017; Jauregui-Fung et al. 2019).

The chapter points to three high level policy implications. First, it underlines meso-political institutions as essential enablers of mass transit development in cities. Much meso-political institutional groundwork must be achieved before policy reform can be accelerated. Mexico and Colombia could serve as policy models for other middle-income democracies experiencing rapid private-vehicle motorization. Second, the chapter shows how national co-investment programs can be a highly effective instrument to drive sub-national policy change, especially in institutional environments characterized by weak state capacity at the local level. Policymakers seeking to accelerate urban energy transitions are advised to investigate the political feasibility of low-carbon investment programs, not only for transport but also for other key urban sectors, such as energy, buildings, waste, and blue and green infrastructure. Finally, the findings show that program design matters. Effective programs use fiscal interests to discipline political interests, generate vertical institutional accountability, and insulate investment decision-points from special interests. Decision-points can be insulated through a combination of independent technical reviews, veto points, limited access, dedicated financial resources, and transparent rules, roles, and procedures.

Deep and durable transport decarbonization calls for policy which challenges, retrenches, and altogether avoids car-based transport systems – especially in cities which are not yet locked into GHG-intensive automobile infrastructure. Widespread adoption of affordable mass transit offers one pragmatic response to this call. As GHG emissions from urban transport continue to escalate over the next few decades, leveraging meso-political institutions to accelerate into the rapid transit turn will only become more critical.

4.6. Supplementary Materials

4.6.1. *Interview participants*

An overview of all interview participants is provided in *Table 24.*

Table 24: Interview Participants

Nr.	Name	Position	Affiliation[(a)]	Case	Type	Date
1.	Sheyla Luciana Granda Acosta	Researcher	University of Potsdam	Peru	Remote	29-Jun-21
2.	Klas Heising	Project Leader (2016-2021), Peru's NAMA on sustainable urban transport	German Corporation for International Cooperation (GIZ) Peru	Peru	Remote	14-Jul-21
3.	Gustavo Guerra García Picasso	Partner	DEE Consultores	Peru	Remote	14-Jul-21
	Anonymous	Transport Specialist	Bilateral development agency	Peru	Remote	14-Jul-21
	Anonymous	Transport Specialist	Bilateral development agency	Peru	Remote	14-Jul-21
4.	Gerhard Menckhoff	Transport Consultant		Peru	Remote	23-Jul-21
5.	Paloma Ruiz	Main Executive, Directorate of Analysis and Technical Evaluation of Infrastructure	Andean Development Corporation (CAF)	Peru	Remote	23-Jul-21
6.	Anonymous	Urban Transport Specialist	Multilateral development bank	Mexico	Remote	26-Jul-21
7.	David Uniman	Urban Design and Mobility Consultant	World Bank	Mexico	Remote	06-Aug-21
8.	Nain Martinez	Researcher	College of Mexico	Mexico	Remote	11-Aug-21
9.	César Hernández Muñoz	Public Transport Manager	Institute for Transportation and Development Policy Mexico	Mexico	Remote	12-Aug-21
10.	Fernando Páez	Director, Urban Mobilty	World Resources Institute Mexico	Mexico	Remote	12-Aug-21
11.	Mariana Alegre Escorza	Executive Director	Lima Como Vamos	Peru	Remote	12-Aug-21
12.	Marco Priego	Director of Operations	Data-Pop Alliance	Mexico	Remote	13-Aug-21
13.	Anonymous	Urban Transport Specialist	World Bank	Mexico	Remote	13-Aug-21
14.	Germán Freiberg	Principal Consultant	REDES Planejamento e Política Pública	Mexico	Remote	16-Aug-21
15.	Walter Vergara	Senior Fellow	World Resources Institute	Mexico	Remote	17-Aug-21
16.	José Barbero	Senior Transport Specialist	World Bank	Mexico	Remote	18-Aug-21
17.	Matteo Stiglich	Researcher	Pontifical Catholic University of Peru	Peru	Remote	19-Aug-21
18.	Leonie Roca	President	Association for the Promotion of National Infrastructure (AFIN - *Asociación para el Fomento de la Infraestructura Nacional*)	Peru	Remote	23-Aug-21
19.	César Simborth	Consultant for Sustainable Transport and Urban Mobility		Peru	Remote	23-Aug-21

20.	Anonymous	Urban Transport Specialist	World Bank	Mexico	Remote	25-Aug-21
21.	Ulises Navarro	Consultant	Modelistica	Mexico	Remote	09-Sep-21
22.	David Escalante Sánchez	Urban Transport Specialist	World Resources Institute Mexico	Mexico	Remote	10-Sep-21
23.	Anonymous	Senior Policymaker	Banco Nacional de Obras y Servicios Públicos (BANOBRAS)	Mexico	Remote	15-Sep-21
24.	Anonymous	Senior Policymaker	Banco Nacional de Obras y Servicios Públicos (BANOBRAS)	Mexico	Remote	16-Sep-21
25.	Holger Dalkmann	CEO	Sustain 2030	Peru	Remote	22-Sep-21
26.	Reyes Juárez Del A.	President and Director General	Felipe Ochoa & Associates (FOA Consulting)	Mexico	Remote	23-Sep-21
27.	César Simborth	Consultant for Sustainable Transport and Urban Mobility		Peru	Remote	28-Sep-21
28.	Claudia Adriazola-Steil	Acting Director for Urban Mobility	World Resources Institute	Peru	Remote	29-Sep-21
29.	César Simborth	Consultant for Sustainable Transport and Urban Mobility		Peru	Remote	30-Sep-21
30.	Juan Suito	Independent Senior Consultant		Peru	Remote	09-Dec-21

Note. (a) Affiliations at the time of the interview.

4.6.2. *Interview guide for PROTRAM, Mexico*

1. DV Open ended: How did PROTRAM come about?

2. DV Specific:
    a. Where did the *idea* of PROTRAM come from?
    b. Who was the main advocate for the creation of PROTRAM?
    c. Who are key veto players? Who ultimately controls PROTRAM?

3. IV Open ended: What *explains* the creation of PROTRAM?

4. IV Structural funding gap:
    a. Demand from states/cities
    b. Emergence of infrastructure on national policy agenda

5. IV Politics: Which political incentives, if any, contributed to the creation of PROTRAM?
    a. Relationship between federal govt. and states/cities
    b. Election cycles (city, states, and federal)

6. IV Policy diffusion:
    a. Domestic demonstration projects (Leon in 2003, Mexico City in 2005)

7. IV Funding
    a. Existence of FONADIN (domestic financing)
    b. High oil prices (domestic financing)
    c. Financial package offered by World Bank/climate finance (intl. financing)

8. IV International interests: World Bank, EMBARQ

9. Co-benefits: Urban air pollution, traffic safety, GHG emissions

10. Specific cases: What happened in Merida/Tampico?

11. Triangulation: I would like to briefly share my working hypothesis, to see if you generally agree or disagree.

12. Triangulation: Is there anything important which we have not yet discussed?

13. Further contacts: Is there anyone else you think I should talk to?

14. Confidentiality: How confidential do you want to keep our conversation?

Thank you for your time.

4.6.3. *Interview guide for Lima, Peru*

1. DV Open ended: How did Lima's *Metropolitano* BRT system come about?

2. DV Specific:
    a. Where did the *idea* of a BRT for Lima come from?
    b. Who was the main advocate?
    c. Who were the main players?

3. IV Open ended: What *explains* the delayed implementation of the BRT project between 2003 and 2010?
    a. The BRT has not been extended. What explains this?

4. IV Lack of financing/structural funding gap
    a. Insufficient domestic funding/lack of multilateral assistance

5. IV Lack of institutional capacity

6. IV No domestic demonstration project

7. IV Election cycles

8. IV Political interests
    a. Relationship between the president and mayor
        i. Fujimori-Andrade
        ii. Toledo-Andrade
        iii. Toledo-Castañeda
        iv. García-Castañeda
    b. Ministerial interests/competition
    c. Competing policy preferences (e.g., metro vs. BRT, megaprojects)

9. Triangulation: Countries like Mexico, Colombia, and Brazil have adopted public investment programs. Why has Peru not issued such a program?

10. Triangulation: I would like to briefly share my working hypothesis, to see if you generally agree or disagree.

11. Triangulation: Is there anything important which we have not yet discussed?

12. Further contacts: Is there anyone else you think I should talk to?

13. Confidentiality: How confidential do you want to keep our conversation?

Thank you for your time.

4.6.4. *Interview guide for Arequipa, Peru*

1. DV Open ended: What's the 'big picture story' of the BRT project in Arequipa?
    a. How did the 'Mistibus' come about?
    b. How did the 'Arequipa Bus' come about?
    c. How did the monorail proposal come about?

2. DV Specific:
    a. Where did the *idea* of a BRT for Arequipa come from?
    b. Who was the main advocate?
    c. Who were the main players?

3. IV Open ended: What *explains* the project outcome?
    a. Why did the MEF not respond to the loan request in 2010?
    b. Why did the MTC propose a monorail in 2013?
    c. Why did the monorail not come about?

4. IV Lack of financing/structural funding gap
    a. Insufficient domestic funding/lack of multilateral assistance

5. IV Lack of institutional capacity

6. IV Lima's *Metropolitano* BRT did not serve as a demonstration project

7. IV Election cycles

8. IV Political interests
    a. Relationship between the president and mayor
        i. García-Balbuena
        ii. Humala/Paredes- Zegarra
    b. Ministerial interests/competition
    c. Competing policy preferences (e.g., monorail vs. BRT, megaprojects)

9. Triangulation: Countries like Mexico, Colombia, and Brazil have adopted public investment programs. Why has Peru not issued such a program?

10. Triangulation: I would like to briefly share my working hypothesis, to see if you generally agree or disagree.

11. Triangulation: Is there anything important which we have not yet discussed?

12. Further contacts: Is there anyone else you think I should talk to?
13. Confidentiality: How confidential do you want to keep our conversation?

Thank you for your time.

4.6.5. *Political alignment in Mexico*

Table 25: Overview of political alignment of Mexican actors at time of funding approval

City	Promoter[(a)]	PROTRAM approval[(a)(b)]	Mayor	Governor	President	Mayor-Governor	Governor-President
State of Mexico – Mexibus	n/a	07/27/2009	n/a	Enrique Peña Nieto (PRI)	Felipe Calderón (PAN)	n/a	Not aligned
Chihuahua	State Govt. of Chihuahua	07/13/2011	Marco Adán Quezada Martínez (PRI)	Cesar Duarte Jaquez (PRI)	Felipe Calderón (PAN)	Aligned	Not aligned
Puebla	State Govt. of Puebla	11/29/2011	Eduardo Rivera Pérez (PAN)	Rafael Moreno Valle Rosas (PAN)	Felipe Calderón (PAN)	Aligned	Aligned
Monterrey	State Govt. of Nuevo León	09/14/2013	Margarita Alicia Arellanes Cervantes (PAN)	Rodrigo Medina de la Cruz (PRI)	Enrique Peña Nieto (PRI)	Not aligned	Aligned
Pachuca	State Govt. of Hidalgo	12/19/2012	Eleazar Eduardo García Sánchez (PRI)	Francisco Olvera Ruiz (PRI)	Enrique Peña Nieto (PRI)	Aligned	Aligned
Acapulco	State Govt. of Guerrero	12/19/2012	Luis Walton Aburto (MC)	Angel Aguirre Rivero (PRD)	Enrique Peña Nieto (PRI)	Not aligned	Not aligned
Tijuana	State Govt. of BC and Municipality of Tijuana	12/19/2012	Carlos Bustamante Anchondo (PRI)	Jose Guadalupe Osuna Millán (PAN)	Enrique Peña Nieto (PRI)	Not aligned	Not aligned
Guadalajara	n/a	n/a					
Juárez	n/a	n/a					

Notes. (a) FONADIN (2021). Dates not available for Guadalajara and Juárez. (b) Dates document the signature of the Financial Support Agreement. Mexico City and León are excluded because their respective BRT projects predate PROTRAM. The table serves illustrative purposes and is not intended to be comprehensive. PAN – National Action Party; PRI – Institutional Revolutionary Party; MC – Citizens' Movement; PRD – Party of the Democratic Revolution.

4.6.6. *Full case studies*

4.6.6.1. *PROTRAM, Mexico*

Historical context, 1990s

Mexico's PROTRAM story started in the mid-1990s with the 100 Cities Program (*Programa 100 ciudades*) and the Support Trust for the Rescue of Concessioned Highways (FARAC – *Fideicomiso de Apoyo para el Rescate de Autopistas Concesionadas*). The 100 Cities Program was a joint initiative by the federal government and the World Bank to build institutional capacity around urban transport planning across the country. It sowed the seeds for the city of León to later implement its *Optibús* BRT system. But León would remain an exception. In other municipalities the 100 Cities Program did not have much of a lasting impact.[76]

Meanwhile, in 1997 the federal government created FARAC to bail out private highway concessions. Between 1989 and 1994 the government had issued private concessions to build over 5,000 kilometers of toll roads. By 1996, however, many of these concessions were facing severe financial difficulties. To save the highways, the government decided to nationalize the toll roads and absorb the debt. FARAC was set up to structure and service this debt. A decade later, FARAC would turn into the National Infrastructure Fund (FONADIN – *Fondo Nacional de Infraestructura*), the trust fund of PROTRAM.

León and Mexico City, early- to mid-2000s

In 2003, León inaugurated its *Optibús*. León became the first city in Mexico to adopt a BRT, and the first city in all Latin America to realize an integrated urban transport reform. In comparison to earlier interventions, like the one in Curitiba, Brazil (1974) or Bogotá, Colombia (1999), the *Optibús* was introduced as part of a more holistic reorganization and formalization of the city's public transport network. Interestingly too, the *Optibús* was fully implemented without any federal fiscal support or international assistance. Although León was seen as a success, national policymakers and other Mexican cities appear to have viewed it as an outlier rather than a policy model.

In 2005, Mexico City opened the *Metrobús* system, its own first BRT. The idea of a BRT for Mexico's capital had crystalized several years earlier, inspired by the *TransMilenio* system in Bogotá, Colombia. The project was spearheaded by Claudia Sheinbaum, Mexico City's Secretary of the Environment, under Mayor Andrés Manuel López Obrador ('ALMO'). Sheinbaum was looking for a flagship project to help address urban air pollution. Her efforts were supported by a network of trusted experts, including Walter Vergara at the World Bank. Sheinbaum and Vergara knew each other from a World Bank project on air pollution in the late 1990s for which Vergara had hired Sheinbaum as a consultant. Vergara helped the BRT project tap into grant support from the Global Environment Facility (GEF), and arranged an in-person exchange between ALMO, Sheinbaum and Enrique Peñalosa, Bogotá's mayor who pioneered the *TransMilenio* system. Later, the Mexican team would visit Bogotá.

[76] "If you want to go to the genesis [of PROTRAM], you must look into the 100 Cities Program. It paved the scholarship for the pioneers of León in the 1990s. León was the only [city] that used the knowledge from the 100 Cities Program" (Anonymous, interview, 16 September 2021).

Sheinbaum was also supported by Professor 'Lee' Schipper and a team of international transport experts at the Center for Sustainable Transport (CTS – *Centro de Transporte Sostenible*), an NGO affiliated with the World Resources Institute (WRI). Sheinbaum knew Schipper from her doctoral studies at the University of California, Berkeley. Schipper, in turn, was affiliated with WRI and helped found the CTS in Mexico City in 2002 with grant support from the Shell Foundation. The CTS was created to assist Mexico City plan and implement the *Metrobús*. In effect, the CTS acted as a non-profit transport consultancy and hired BRT experts from Colombia and Brazil.

Initially, the *Metrobús* was heavily criticized. Its launch in June 2005 seemed rushed. It took several months after the inauguration for the construction to be completed. ALMO appeared to have wanted to open the system before the end of his mayoral term in July. He later revealed presidential ambitions and indeed in 2018 won Mexico's general elections.

Over time, the *Metrobús* became a success. Subsequent mayoral administrations supported the imitative. The system was gradually upgraded and expanded. Over the next few years, the city would come to inaugurate an additional six lines, alongside expansions to its metro system. This 'BRT trend' in Mexico City, several interviewees independently explained, played a crucial role for demonstrating proof of concept. While urban transport reform was not yet a major political issue in most states and cities, key decision-makers in the federal government and the World Bank were taking note of the *Metrobús* success.

Windfall income and a new agenda, mid- to late-2000s

By the mid- to late- 2000s two key parallel developments came into play. First, the federal government generated windfall income. Mexico experienced a commodities boom. International oil prices were up and afforded the federal government excess oil revenue (cf. Reuters 2007). Additionally, the nationalized toll road concessions under FARAC unexpectedly became profitable and FARAC was no longer needed to service the debt. A new instrument was required to manage the highway concessions and windfall income. When Felipe Calderón assumed the presidency in 2006, he intended to invest Mexico's windfall income in public works and become the 'president of infrastructure'.[77] By presidential decree he created Mexico's first National Infrastructure Fund (FONADIN – *Fondo Nacional de Infraestructura*), which absorbed FARAC. FONADIN was designed to co-finance public infrastructure in key sectors, and was to be replenished through the revenue generated by the toll roads. BANOBRAS was designated FONADIN's fiduciary.

Second, urban transport reform emerged on the policy agenda among key decision-makers in the federal government.[78] Several factors converged. For one, the BRT in Mexico City offered a domestic demonstration project. For another, BRT was becoming a trend across Latin America. This helped reform advocates such as the World Bank and CTS to call attention to urban transit as an issue. Moreover, several potential urban mobility projects crystalized from

[77] "FONADIN is a trust fund created in 2008 by President Calderon, the 'president of infrastructure'. Calderon was looking where to find funding and how to use it. He created FONADIN with different priorities, like roads, highways, ports, airports, water, waste, and the like" (D. Escalante Sánchez, interview, 10 September 2021).
[78] Urban transport reform was not yet a prominent public or sub-national issue. "In 2006, most governors did not care about transport, not specifically at least", one expert recalls. "I know this because governors' speeches only started to talk about transport after 2012" (M. Priego, interview, 13 August 2021).

conversations between the World Bank and states adjacent to the Federal District of Mexico City. Additionally, climate change was becoming a major policy issue, and BRT was increasingly framed as a low-carbon solution. The GEF project on urban air pollution was expanded to include GHGs and led to an electric-gas hybrid bus pilot project, the first of its kind in Latin America. All of this was unfolding after years of advocacy.

These two factors – windfall income and a changing policy agenda – converged when Hacienda hired the World Bank to assess whether FONADIN could be used to co-finance urban mass transit investments. The assessment was led by Walter Vergara and Arturo Ardila-Gomez, and in 2008 and led to a recommendation for the creation of a special program for mass transit (World Bank 2008). Hacienda, under Gerardo Rodríguez, Head of Public Credit (2005-2011), initiated a consultation on how best to design the envisioned program. The details were worked out through a series of meetings and workshops with participants from the federal government, the World Bank, CTS, and other experts. CTS was tasked to propose funding rules and requirements, as well as standardized metrics for project evaluations. This process eventually led to the creation of PROTRAM.

PROTRAM, late-2000s

PROTRAM was organized around six key features. First, it was set up as a fiscal *support* program. To this day it is not a federal *investment* program. States and municipalities must supply co-financing to become eligible, alongside a minimum amount of private investment. Second, the program was organized to be agnostic to modal choice. The program can in principle finance any form of mass transit as long as proposals fulfill the funding requirements. While in theory it can co-finance metros, in practice it has mainly supported BRTs. Third, sub-national governments are required to develop an integrated transport reform plan and create an urban mobility team which cannot be hosted by the respective local Department of the Interior (*Secretaría de Gobernación*). These conditionalities were created to generate institutional capacity and depoliticize subnational investment decision-making. Fourth, its funding source, the excess revenue from the nationalized toll roads, is not considered part of Mexico's federal budget. PROTRAM is therefore not subject to annual congressional approval, which has enabled multiannual financial planning and depoliticized federal investment decision-making. Fifth, the program was set up to afford two independent technical reviews, one financial and one technical. Both reviews serve as critical veto points and are comparatively insulated from special interests.[79] Sixth, it was organized to generate political buy-in from key political actors[80] , even though ultimately the instrument is controlled by Hacienda.

[79] Hacienda's internal Investment Unit reviews the financials of all projects. It is very difficult to arrange a meeting with the unit, even for staff at BANOBRAS. A technical sub-committee within PROTRAM reviews the technicalities of all projects. At the beginning, consultants from CTS would sometimes even go into the field to collect new primary data and verify project estimates. Interviewees emphasized that CTS only offered a technical recommendation and did not have any regulatory authority. BANOBRAS' contractual arrangement with CTS appears to have ended in the second half of the 2010s.

[80] For instance, ministries other than Hacienda, such as the Secretariat of Communications and Transportation (SCT – *Secretaría de Comunicaciones y Transportes*), Secretariat of Environment and Natural Resources (SEMARNAT – *Secretaría del Medio Ambiente y Recursos Naturales*), and Secretariat of Agrarian, Land, and Urban Development (SEDATU – *Secretaría de Desarrollo Agrario, Territorial y Urbano*) are involved at various stages of the decision-making process.

Alongside PROTRAM, the World Bank issued the Urban Transport Transformation Program (UTTP), an independent complementary loan program (World Bank 2009). The UTTP offered PROTRAM projects access to cheap climate finance through the newly created Clean Technology Fund. It thus indirectly reified PROTRAM as a low-carbon investment program, and simultaneously accommodated the World Bank's search for green projects (cf. Meckling and Allan 2020).

Several interviewees independently asserted that demand from states and municipalities for PROTRAM funding *followed* the creation of the instrument. In effect, this means that demand followed supply. This assertion is supported by the observation that BANOBRAS felt compelled to organize a promotional tour across Mexico to advertise and explain the new program. A senior policymaker observed, for instance, "[d]emand came after the instrument was created. […] Demand came after the program creation because before that cities, local authorities, asked for funding to improve fleets, not to develop transport projects, because they have no idea about infrastructure" (Anonymous, interview, 16 September 2021). Similarly, a senior transport specialist explained, "when the national government offers subsidies, municipalities respond. The [–] Mexico program is an example of that" (Anonymous, interview, June 2019, see Chapter 3). This sequence of developments provides crucial evidence that subnational demand for fiscal support cannot itself explain the adoption of the instrument: demand came after the issuance of the instrument, not vice versa.

Impact, 2010s

Throughout the 2010s, PROTRAM enabled roughly a dozen BRT projects across Mexico (Mier y Teran 2012, 2013; SHCP and BANOBRAS 2017).[81] Another dozen projects are still ongoing (Vargas 2021). In a handful of cases, the program co-financed metro projects. Its staple, however, has been BRTs. The main reason for this focus is the program's techno-economic vetting process. In most medium-sized cities demand, urban density, and financial considerations, among other factors, point to BRT as the most feasible modal choice. Overall, PROTRAM is viewed as a major success. All interviewees agreed that Mexico's wave of BRT projects cannot be explained without the program.

The World Bank's UTTP, in comparison, remained under-subscribed. Only a fraction of its funding was eventually disbursed, and the World Bank eventually classified its outcome as "unsatisfactory" (World Bank 2019). Interviewees expressed two potential explanations. On the one hand, applying to PROTRAM is complex. Applying to the complementary UTTP, with its many additional conditionalities, made projects even more complex. This additional layer of complexity appears to have deterred subnational governments from using the program. On the other hand, availability of capital was not the main barrier. Several interviewees noted that projects often stand or fall based on either their bankability or sub-national financial constraints. A senior policymaker explained, for instance, "[t]he problem with Mexico is not liquidity. We run out of bankable projects. We don't need international money, we need projects. We need states and municipalities to be less dependent on the federal budget" (Anonymous, interview, 16 September 2021).

[81] A list of independently verified BRT adoptions between 1970 and 2017 is provided in the annex.

Further findings and examples

Investigation of how PROTRAM has played out in specific cities highlights how governors have acted as critical local champions, how PROTRAM has incentivized sub-national policy change, and how each project has unfolded in many idiosyncratic, context-specific ways. Local politics, including subnational elections and resistance from paratransit operators, has shaped project outcomes. In Guadalajara, for instance, the system has faced problems because of a change in local government: "In Guadalajara, they got a good institutional framework, and everything was going well, but they had a major political problem. The system was too young and still fragile when there was a change in government and the new government did not support the system. So, the system became an orphan" (A. Lobo, interview, 20 June 2019, see Chapter 3). Investigation was not, however, able to uncover evidence for overt pork barrel politics: that is, PROTRAM being used to buy political support at the federal level. This cannot rule out that pork barrel politics has played a role in more subtle ways, but it suggests that the program's rules, roles, and procedures have effectively disciplined public authority.

To assess whether projects have failed because of misalignment between federal and sub-national political interests, I moreover investigated two unsuccessful PROTRAM projects: Tampico and Merida.[82] Interviewees suggested that the project in Tampico struggled because of lack of local planning capacity, not vertical misalignment of interests. The financials were structured poorly, there were problems with the feasibility study, and the proposed transit corridor would have cut off the city's main market, among other complicating factors. Similarly, the project in Merida did not materialize because it did not fulfill the eligibility criteria. In fact, a senior policymaker recalls that there was some political pressure to greenlight the funding for Merida, but this pressure was ultimately futile: the project had to fulfill the criteria and follow the process. "I do remember a case where there was a little pressure to support [a project] in a specific city. But the city was not eligible. We did not support it. […] This city was Merida […] They should have used their political support to fulfill the criteria" (Anonymous, interview, 16 September 2021).

Finally, the investigation uncovered at least one city which received PROTRAM support even though it has less than 500,000 habitants: Zaccatecas. The senior policymaker explained that Zaccatecas received support because it is a state capital facing an economic downturn. This suggests on the one hand that PROTRAM's minimum population criteria is a soft requirement, and on the other that fiscal redistribution across federal states can factor into the program's decision-making process.

[82] I identified these unsuccessful projects by comparing different versions of PROTRAM's project pipeline. In 2012 Tampico and Merida were listed as 'under evaluation' (Mier y Teran 2012). By 2013, however, both projects are no longer mentioned (Mier y Teran 2013).

4.6.6.2. *Lima, Peru*

Historical context, 1969—1996

Lima's BRT story started in the late 1960s with the inauguration of the *Vía Expresa*, an intraurban expressway which to this day runs through the city from north to south (Poole-Fuller 2017).[83] Already in the 1960s, before BRT existed as a concept, the expressway had two exclusive bus lanes, one in each direction. In the 1970s, these lanes inspired Latin America's first BRT system in Curitiba, Brazil.[84] While scholarship often presents Curitiba as "the cradle of BRT" (Lindau, Hidalgo, and Facchini 2010), one can make the case that the history of BRT in Latin America started in Lima, even though Lima's first official BRT corridor, the *Metropolitano*, would open over 35 years later in 2010.

In 1985, Alan García became president of Peru. One of his flagship projects was Lima's first metro. García inaugurated the metro at the end of his term in 1990, but the project was a disaster (cf. ITDP 2002): only a short section outside the urban center was completed, the system did not attract much ridership, maintenance was expensive, incomplete infrastructure scarred the urban landscape, and there were serious corruption allegations. Public service of the metro was eventually terminated, but the line was run with empty trains to prevent corrosion. This gave the metro the nickname *el tren fantasma*, the ghost train.[85]

When Alberto Fujimori became president in 1990, Peru was facing a severe economic crisis. In response, Fujimori implemented a series of neoliberal reforms, including three major policy changes in the transport sector. First, he liberalized the public transport system (Legislative Decree 651; see Jauregui-Fung et al. 2019). Anyone with a vehicle could now offer paratransit services. Second, he retrenched the public sector and dismantled the National Urban Transport Company of Peru (ENATRU). Third, he liberalized the import of used cars (Law No. 25789 and Degree DS 080-91-EF; see Scholl et al. 2015).

Throughout the 1990s, these reforms contributed to an explosion in semi-formal paratransit services in Lima. Estimates vary, but by some accounts the number of transit vehicles grew by 350% between 1990 and 1998 from 10,500 to over 46,000 vehicles (ITDP 2002; cf. Jauregui-Fung et al. 2019; Martínez and Cornejo 2003). With an average age of 16 years most of the transit vehicles were old and polluting (Scholl et al. 2015). Lima began to experience significant traffic congestion, air pollution, and safety problems. This set the historical context in 1996, when the World Bank proposed the *Metropolitan Area Urban Transport Project*, the project which would later lead to Lima's *Metropolitano* system.

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[83] Here, I focus on the *politics* of Lima's BRT system. For complementary case studies of urban transport in Lima, including the *Metropolitano*, I refer to Poole-Fuller (2017), Scholl et al. (2015), Scholl and Quintanilla (2015), Oviedo et al. (2019), Mallqui and Pojani (2017), Coq-Huelva and Asián-Chaves (2019), and Martínez and Cornejo (2003). See Jauregui-Fung et al. (2019) for a history of electric trams in Lima between 1904-1965.

[84] "In the 60s [–] the origin of the BRT was the *Vía Expresa*. It was not a BRT back then. But Curitiba, Brazil, copied the segregated lane model with truncated buses" (G. Guerra García, interview, 14 July 2021).

[85] "[The metro] was called the 'ghost train' because you had all the infrastructure, so the train had to run empty every day to keep it going. Otherwise, it would all rust. It's close to the ocean, so it would be terrible. [The government] had to spend a million dollars every year to just keep it up, empty" (C. Adriazola-Steil, interview, 20 June 2019).

Alberto Andrade, 1996—2003

Lima's contemporary BRT story started in 1996, when Alberto Andrade was elected mayor of Lima. Lima was starting to face severe urban traffic problems, linked to the policy reforms of the early 1990s (Jauregui-Fung et al. 2019; Poole-Fuller 2017). The World Bank proposed the *Metropolitan Area Urban Transport Project*, a program intended to help Lima address its growing congestion (Scholl and Quintanilla 2015). The project was to be prepared in collaboration with Peru's national Ministry of Transport and Communications (MTC). The Metropolitan Municipality of Lima (MML) was only tangentially involved, in part because of a difficult political relationship between Mayor Andrade and President Fujimori.[86] Although the project preparation initially made headway, it was removed from the World Bank program in 1999 because of President Fujimori's opposition.[87]

The idea of a BRT system for Lima emerged from this first proposal. By 2000, the *TransMilenio* system in Bogotá, Colombia, was being heralded a success. Bogotá inspired the World Bank and Inter-American Development Bank (IDB) to propose a new urban transport project, the *Metropolitan Lima Urban Transport Program* (Scholl and Quintanilla 2015). This second proposal was different from the first in two important ways: first, for the first time it included a BRT corridor; and second, it was set up under the MML, not the MTC.[88] Andrade, however, was initially not particularly enthusiastic about the proposal. "We had a meeting with the mayor", Gerhard Menckhoff, the project adviser of the World Bank, recalled, "who was lukewarm at best" (G. Menckhoff, interview, 5 June 2019).[89]

To persuade Andrade, the World Bank hired Enrique Peñalosa, Bogotá's former mayor, to meet with Andrade and discuss the idea. Peñalosa convinced Andrade to back the BRT.[90] By 2002, Lima's mayoral elections were underway, and Andrade began to view the BRT as a political platform to win the race. "By the time [Andrade] reacted and said, 'I think the BRT is the right thing to do'", Claudia Adriazola-Steil observed, "the political campaign was ongoing, and he wanted to be re-elected" (interview, 20 June 2019).

The project was envisioned as two sub-national loans to the MML, the first of their kind in Peru (Scholl and Quintanilla 2015).[91] The national government would back the loans with sovereign guarantees, but would otherwise not be involved. To implement and operate the BRT, the MML established ProTransporte, an executive regulatory agency (Municipal Decree No.

[86] Several interviewees independently noted that the relationship between Mayor Andrade and President Fujimori was conflictual (e.g., G. Menckhoff, interview, 5 June 2019; M. Alegre Escorza, interview, 12 August 2021; M. Stiglich, interview, 19 August 2021).

[87] "The project [–] was actually thrown out of the World Bank pipeline because Fujimori did not want it. We had started on it and sort of accepted it up to a point, but then came the moment when the relationship between Fujimori and the rest of the political people in Peru became worse and worse" (G. Menckhoff, interview, 5 June 2019).

[88] In the early 2000s, after Fujimori left office, Peru was undergoing a wave of regulatory decentralization.

[89] "It was very interesting to come from being in the Ministry of Transport, and then to join the Municipality [of Lima]. When I joined the municipality, in the ministry this BRT project was high profile. In the municipality [the project] was almost not an option" (C. Adriazola-Steil, interview, 20 June 2019).

[90] "[Peñalosa] came to Lima. We were there too, but the meeting was arranged with the mayor, so he and the mayor of Lima could meet on their own […]. We purposely didn't want to be involved. We [were] hoping that mayor-to-mayor conversation [would] do the trick. And it did! It worked like a charm. Suddenly the mayor of Lima was all interested in doing the BRT" (G. Menckhoff, interview, 5 June 2019).

[91] For a detailed breakdown of the project's financial architecture, I refer to Scholl and Quintanilla (2015).

035). With Andrade on board and the loans underway, Lima's BRT was on track to be implemented.

Luis Castañeda, 2003—2010

Andrade ended up losing the election. Instead, the winner was Luis Castañeda, who campaigned on the promise to resurrect Lima's failed metro, which at this point was running on empty trains to prevent the infrastructure from corroding. After Lima's metro project was launched in the 1980s under President Alan García, by the early 2000s its regulatory responsibility had been devolved from the MTC to the MML.

After Castañeda assumed Lima's mayorship, the BRT project again faced difficulties. For one, Castañeda downsized ProTransporte.[92] For another, he prioritized extending and re-opening the metro on a self-financing basis. Efforts by the World Bank and IDB to persuade Castañeda in favor of the BRT remained unsuccessful.[93] Although Castañeda signed the loan agreements – he did not outright reject the multilateral assistance on offer – by the mid-2000s the World Bank had internally classified Lima's BRT as a 'problem project'. Construction work had still not begun, and the project outcome again was uncertain.

Castañeda wanted to fully self-finance the metro through private concessions. But his plan did not materialize. Although he was re-elected in 2006, several attempts to solicit private investors failed. The metro's regulatory responsibility was eventually handed back to the national government and Castañeda changed his position in support of the BRT. After being unable to resurrect the metro, he was looking for another flagship project to help him win the upcoming 2011 presidential election. The BRT became the solution. Menckhoff recalled, "[Mayor] Castañeda said – he was in his second term already – 'If we again don't get bids for the metro concession, then I have nothing to show for my administration'. No valid bids were received, and suddenly he was interested in the BRT. And then really things moved" (Menckhoff, interview, 5 June 2019).[94]

Construction of the BRT began in 2006, along Lima's *Vía Expresa*. The MML, World Bank, and IDB covered the capital costs. COFIDE, Peru's national development bank, tendered out the operations through four private concessions. Notably, concessionaires were required to service the system with liquified natural gas (LNG) buses, even though this *increased* the planning risk of the project.[95] This requirement was set by COFIDE upon request of the national government, which was seeking to grow Peru's domestic LNG demand and fulfill financial obligations to private investors linked to a gas pipeline project (Scholl and Quintanilla 2015). Concessionaires managed to develop LNG-buses specifically for the Lima system, the first of its

[92] "He dismantled the organization that was trying to put together the BRT" (C. Adriazola-Steil, interview, 20 June 2019).

[93] "During a meeting with Castañeda I told him about Kuala Lumpur and Bangkok, [self-financing metro projects in Asia which had to be bailed out by the government]. He listened, looked up my name on the sheet in front of him, and said 'Senior Menckhoff, you depress me'. And then he talked about the metro" (G. Menckhoff, interview, 23 July 2021).

[94] "Planning documents and papers often say that the implementation process of the Lima BRT was very slow, 2003-2010. But that's only partly correct. Once the mayor prioritized the project it went very fast. The real work happened in 2007-2010" (G. Menckhoff, interview, 23 July 2021).

[95] "[T]he choice of compressed natural gas (CNG) as fuel was risky for a full BRT system" (Scholl and Quintanilla 2015, p. 11).

kind in the world. The *Metropolitano* eventually commenced operations in summer 2010, just in time for Castañeda to resign as mayor and launch his presidential bid.

Developments after inauguration

Overall, Lima's BRT is seen as a success. By 2018, the *Metropolitano* was servicing 700,000 passengers per day (GIH 2019), up from 220,000 after its initial opening (Scholl et al. 2015). In 2013, the system was ranked as 'Gold' by the BRT Standard, the highest possible category. Impact assessments indicate that the BRT has reduced corridor-level GHG emissions by 33% (Scholl and Quintanilla 2015). Its total investment is appraised at USD 300 million (*ibid*). Elements of the concessions, however, are contentious. When the system was inaugurated in 2010, for instance, only a fraction of the LNG-buses was available. The rolling stock was gradually phased-in after delays (Scholl and Quintanilla 2015). Concessionaires later successfully sued the MML for several breaches of contract. In 2016, the MML's total financial liability associated with seven lawsuits was valued at $170 million (C. Post 2016), a significant amount given Lima's total municipal budget of roughly $380 million.

Lima's metro was eventually resurrected. In 2006, Alan García was re-elected president. After the regulatory responsibility of the Lima metro was handed back to the national government, García re-launched the project as a public works venture. This time his plan succeeded. The metro was extended to the north and re-opened to the public. García 'cut the ribbon' of Metro Line 1 shortly before the end of his term in 2011. By 2019, the metro was serving approximately 692,000 passengers per day (Andina 2019), a significant amount but less than the BRT. The metro's total investment since the beginning of its construction in the 1980s is estimated at USD 2 billion (CAF 2016). García was later implicated in severe corruption allegations linked to the Odebrecht scandal and the Lima metro (Charner, Mezzofiore, and Romo 2019).

Several attempts by the MML to extend or expand the BRT were unsuccessful. Under Mayor Susana Villarán, the MML tried to finance a northern extension of the corridor (Schlaikjer 2011). The loan, however, was blocked by the national government.[96] Only after several years of delays the national government eventually issued an approval. Likewise, the MML, in collaboration with the World Bank, proposed a second BRT line, which was envisioned to run from east to west and connect the original north-south corridor with the Lima metro. However, this proposal, too, was not supported by the MTC.[97]

Instead, the national government began to pursue a second metro line, along the same corridor as the proposed BRT line. Its total implementation cost is estimated at USD 5.3 billion (Darido et al. 2015). Interviewees expressed conflicting views on how to evaluate the Metro Line 2 project. Some noted that Lima, given its size, simply needs a metro. Others, however, voiced concern that the national government's decision to prioritize the metro extension over the BRT extension ultimately came down to a political decision and was not informed by rigorous analysis. The World Bank initially backed the second metro line, but later retracted its participation. Construction appears to be underway, but the outcome remains uncertain.

[96] "The extension to the north, although not part of the initial loan agreement, could easily have been built and ridership improved, if the government had approved it" (Scholl and Quintanilla 2015, p. 22).
[97] "Circa 2012, Lima announced a second BRT line. But the national government announced a second metro line along the same road. So, Lima had to cancel its BRT project" (M. Stiglich, interview, 19 August 2021).

By the late 2010s and early 2020s, three urban transport policy reforms were underway. First, regulatory responsibility for urban transport in the Lima-El Callao metro area was delegated to the newly created Urban Transport Authority for Lima and El Callao (ATU), an executive agency tasked to help overcome regulatory coordination challenges between the two provinces. Regulatory responsibility for both the BRT and the metro was in effect subsumed under the national government. Second, the MTC issued Peru's first National Urban Transport Policy (MTC 2019) – a clear signal that urban transport has begun to emerge on the country's national policy agenda. Finally, Peru's national government pledged USD 400 million for sustainable transport projects in Trujillo, Arequipa, Piura, Cusco, and Chiclayo (GIZ 2020). The effects of these reforms and pledges remain to be seen, especially after Peru's most recent change in government in 2021.

4.6.6.3. *Arequipa, Peru*

Simón Balbuena, 2007-2010

Arequipa's BRT story started in 2007 when Luis Gutiérrez, EMBARQ's Director for Latin America, invited Simón Balbuena, Arequipa's newly elected mayor, and Juan Manuel Guillén, governor of the Arequipa region, on a BRT study tour.[98] The tour prompted Balbuena to launch the city's first BRT project, the 'Mistibus', as one component of a broader urban transport reform: the Arequipa Integrated Transportation System (SIT). The project was organized as a collaboration of the Provincial Municipality of Arequipa (MPA), EMBARQ, and CAF. The MPA would lead the project, EMBARQ would offer technical assistance, and CAF would issue finance assistance. As part of the arrangement, EMBARQ opened a regional office in Arequipa in 2008.

The institutional set-up of the project was unique. The planning team was made up of local, national, and international experts, hosted by a designated unit within the MPA's transport department. All financial matters, however, including the team's employment contracts, were managed through EMBARQ. Under this arrangement, all preparatory studies were completed within less than a year by mid-2009. The total investment was appraised at roughly $81 million, $60 million of which would be covered by a loan from CAF.

While the project faced initial resistance from paratransit operators, as would be expected (e.g., Asimeng and Heinrichs 2021), it also garnered significant local support (e.g., Correo 2009). A project manager recalls, "we had social acceptance. There was a lot of social work to explain the project [to the public]" (J. Suito, interview, 9 December 2021). In July 2009, Balbuena announced that construction work of the first phase would begin in October. "Arequipa has a terrible transportation service based on combis and Tico [cars]. We are going to become a model city for modern transportation" (Balbuena in Andina 2009). The first phase of the project included roadwork in the city's historic center and several overpasses. The phase was financially backed by the MPA, the regional government, and a contribution from a local mining company. The CAF loan was in preparation.

[98] Mr. Luis Gutiérrez was looking to launch a BRT pilot project in the Andean region. He had personal connections to Peru and CAF.

After delays, construction work for the first phase began in early 2010. Shortly before the end of his mayoral term in September 2010, Balbuena began the tendering process. 80 routes would be serviced through private concessions. Bids were requested by 2 November. Concessions would be awarded on 15 November. Contrast would be signed on 30 November.

At this point, however, the project started to run into major difficulties. The CAF loan needed to be backed by a sovereign guarantee. The MEF, however, delayed responding to the loan guarantee request. The reasons for this delay are to this day contested. The interviews revealed at least two explanations. The first highlights political motives. "[This] was about politics. Alan García [Peru's outgoing president] and Ollanta Humala [Peru's presidential frontrunner] were the leaders of political parties in rivalry. Balbuena was from the party of Humala. It was perceived that the National Government was not very proactive in helping Balbuena's administration, especially at the end of his political term" (C. Simborth, interview, 30 September 2021). The second explanation emphasizes cost estimates.[99] "The [local] engineer who was estimating the construction costs underestimated the project by a big chunk. That was one of the things the ministry said. 'There is a big difference […] We have to review the whole project'" (C. Adriazola-Steil, interview, 20 June 2019). For either reason, or a combination of both, the national government put the BRT project on hold.[100]

Alfredo Zegarra, 2011-2014

At the same time, there were changes in government at both at the municipal and the national level. At the local level, Balbuena lost the mayoral race to Alfredo Zegarra. Although the tendering process of the concession contracts eventually fell though (El Buho 2011), this change in mayorship did not derail the BRT project. Zegarra renamed the project 'Arequipa Bus', but otherwise endorsed the reform plans. The handover from Balbuena and Zegarra enabled the first phase of the construction work, the downtown roadwork and the overpasses, to eventually be implemented. At the national level, Ollanta Humala became Peru's new president. His administration decided to review the project, and thus requested that all technical files from Arequipa's planning team be handed over to the MTC. In summer 2012, the MTC in effect took technical control of the project (cf. MTC 2012).

With multilateral assistance from CAF, the international consulting firm Steer Davies Gleave was contracted to conduct a second demand study. This extra step delayed the project by several years. The study found, among other things, that the BRT system could face operational difficulties at peak demand. To mitigate this risk, the study recommended additional overpassing lanes and larger stations. The Humala administration eventually authorized Arequipa's SIT, but decided not to use the loan from CAF. Instead, the reform package would be financed through public outlays.[101]

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[99] This assertion is supported by two independent interviews and the findings by Granda Acosta (2018, p. 31-32). See also La República (2013).

[100] A third explanation for the delay alludes to the MPA's alleged refusal to provide technical files to the national government (see La República 2013). However, I was not able to triangulate this claim.

[101] It remains unclear why the Humala administration did not want to use the loan. Peru's economy was performing well, which is why the national government might have had available funds. Alternatively, there could have been purely technical reasons. The government might not have been able to issue additional debt because of other loan agreements.

Around 2013, an international consortium of the Brazilian construction firm Queiroz Galvão and the Canadian train manufacturer Bombardier pitched a monorail project for Arequipa to the national government. The consortium submitted an unsolicited proposal to ProInversión, Peru's public agency tasked to foster public-private partnerships (PPPs). The proposal was officially dated October 2013 (ProInversión 2013). Several interviewees noted that the consortium would have submitted its proposal only after informal talks with national decision-makers. It is therefore very likely that informal talks happened earlier. Political support for the monorail allegedly extended to President Humala. Carlos Paredes, Peru's Minister of Transport, thereupon replaced the BRT with a monorail project (cf. WRI 2013).[102] The monorail was scheduled to commence operations by 2016. From this moment onwards, Arequipa's urban transit project fell apart.

The monorail proposal sparked strong local resistance in Arequipa. The MTC conducted yet another round of feasibility studies, but only compared different rail-based solutions. The studies excluded a comparison with the BRT proposal. The monorail was projected to cost US 1.2 billion. Paredes pressured Zegarra to publicly endorse the new proposal, but the municipality's transport team vehemently opposed the project on technical and financial grounds. A technical advisor at the MPA remembered a difficult meeting with Minister Paredes: "We had a very hot debate. It was very tense. We did not agree with the technical proposal of the monorail that was presented to us. We as a team presented to the Minister officials a series of technical difficulties to integrate the monorail line into the Integrated System of Public Transportation, the SIT ArequipaBus, to be operated by buses" (C. Simborth, interview, 28 September 2021).

Local opposition eventually spilled beyond technocratic circles into the broader public. Arequipa's regional ministry for culture filed a complaint to the MTC and UNESCO that the monorail would deface Arequipa's historic center and jeopardize its standing as a UNESCO World Heritage Site (La República 2014). Local technical colleges, most notably the College of Architects and the College of Engineers, voiced public concern (Mamani 2014). A citizens movement, "Muevete Areqauipa", filed complaints with the MTC, MEF, Ministry of Culture, ProInversion and UNESCO (Mamani 2015). The proposal quickly lost political legitimacy. Eventually, in December 2015, ProInversion rejected the project.

By this point the original BRT proposal had lost all momentum.[103] While select urban transport reform efforts continued (e.g., La República 2018; El Buho 2017), Arequipa to this day does not have a mass transit system. Several years later, Ex-Minister Carlos Paredes was implicated in severe corruption allegations linked to Queiroz Galvão and Peru's 'Construction Club' scandal (e.g., La República 2019a, 2019b; Agenda País 2019). The allegations suggest that Paredes was pushing the monorail proposal in exchange for bribes (La República 2019b).

[102] Paredes's brother was a close friend of Humala, which is why the minister serves as a confidant of the president.
[103] EMBARQ closed its regional office in Arequipa in 2014.

5. Conclusion

5.1. Revisiting the Policy Challenge and Research Question

This dissertation set out to investigate when, how, and under what conditions cities deploy and maintain low-carbon infrastructure systems, with a focus on urban transportation. Without aggressive policy action GHG emissions from transport could nearly double from 7.0 Gt CO2eq in 2010 to 12 Gt CO2eq per year by mid-century (Creutzig et al. 2014). The transport sector is already the fastest growing single source of global emissions (Wang and Ge 2019). The Covid-19 pandemic is unlikely to change this trend in the medium- and long-term and could even accelerate it (Quéré et al. 2020; World Bank 2020a). This situation points to scaling up the deployment of durable public mass transit systems as an urgent climate policy strategy, especially in countries still characterized by comparatively low rates of private vehicle motorization, in order to lock-out future GHGs and concurrently lock-in low-carbon transport systems (Creutzig et al. 2014; Ürge-Vorsatz, Rosenzweig, Dawson, Sanchez Rodriguez, Bai, Salisu Barau, et al. 2018; Creutzig et al. 2018). Mass transit systems can help *avoid* motorized travel, s*hift* trips from private to public transport modes, and *improve* modal efficiencies (H. Dalkmann and Brannigan 2007; Dario Hidalgo and Huizenga 2013). At the latest UN climate change conference in 2021 in Glasgow, Scotland, a coalition of mayors, governors, and NGOs warned that in order to achieve the 1.5°C target of the Paris Agreement, "[p]ublic transport must double in cities over the next decade" (C40 and ITF 2021).

How to achieve rapid and widespread deployment of durable mass transit infrastructure, however, is not yet well understood. Most climate policy insights on how to advance urban decarbonization build on evidence from industrialized countries. It is unclear to what extent, if any, urban energy transitions unfold along similar pathways across different political economic contexts and levels of economic development. While the energy transitions literature has taken an institutional turn, it has not yet taken full advantage of insights from comparative political economy to examine how *political institutions* shape transition outcomes. Transport planning studies, in turn, often focus on the technical 'ins and outs' of planning and implementation, at the expense of a more nuanced understanding of how *political interests* fundamentally enable or disable projects. Moreover, current theoretical frameworks cannot yet explain the distribution of mass transit systems across low- and middle-income economies, which appear concentrated in only a handful of middle-income democracies governed by federal political systems.

To address these research gaps, this dissertation examines the political economy of Bus Rapid Transit (BRT) systems. BRTs are an ideal empirical system to analyze low-carbon infrastructure in cities: they have been widely deployed across low- and middle-income countries and therefore offer a rich empirical basis for comparative research, evidence a track record of

GHG mitigation, and have been labelled a key low-carbon transport innovation by major development organizations.

This dissertation focuses on three broad types of variables: *political institutions*, *political interests*, and *public investment*. It thereby follows a classical political economy approach. While all three substantive projects touch on all three variables, the first emphasizes *political institutions*, the second *political interests*, and the third *public investment.*

5.2. Political Institutions

The first substantive chapter, *When Do Cities Deploy Low-Carbon Infrastructure? Evidence from the Global South* (Chapter 2), examines how formal *macro-political institutions* shape transit policy outcomes. Current theoretical frameworks cannot yet explain why so many BRT systems are distributed across so few countries: among 138 low- and middle-income countries, over 70% of all BRT systems are located in just five countries. The remaining 30% are distributed across only 16 countries. The chapter tests three hypotheses: first, whether countries characterized by political decentralization are generally more likely to adopt BRTs; second, whether politically decentralized countries are only more likely to adopt BRTs when they are governed by a democratic political system; and third, whether the regional operations of international environmental NGOs make the adoption of BRT systems more likely.

For evidence, the chapter employs a novel dataset of all 92 BRT adoptions across all 138 low- and middle-income countries between 1970 and 2017. All adoption dates were manually cross-referenced to ensure that the assessment builds on the most accurate data available. For the analysis, it conducts three sets of survival regressions: two at the country-level and one nested at the city level. To my knowledge, it is the first research project to quantitatively test hypotheses on enabling macro-political institutions of urban energy transitions with panel data from such a large set of countries.

The findings paint a nuanced picture. Countries characterized by political decentralization are indeed more likely to adopt BRT systems. Several robustness checks support this assertion. However, both the country- and city-level regressions suggest that political decentralization only enables BRT adoptions when accompanied by democratic governance. This finding indicates that institutional accountability is key. Regarding the role of NGOs, the evidence is mixed. On the one hand, countries hosting an NGO are more likely to adopt a first BRT system. On the other, countries hosting an NGO are not necessarily more likely to deploy multiple BRT systems. International NGOs thus seem to enable domestic demonstration projects, but are less important once a pilot system has been adopted.

5.3. Political Interests

The second substantive chapter, *Governing Rapid Transit: Power Politics and Adaptability* (Chapter 3), explores how *political interests* shape transit policy outcomes alongside macro-political institutions. Although the BRT literature often acknowledges the political nature of BRT projects, it has not yet systematically harnessed insights from political science. The chapter

is an inductive hypothesis-generating exercise and offers a new analytical vantage point for understanding and navigating urban transit policy and planning.

The chapter develops two analytical frameworks. The first, regarding the deployment phase, argues that political interests fundamentally condition the policy problem structure presented by mass transit planning. BRTs tend to pitch broad, shallow public support against narrow, fierce private opposition, which renders proposals inherently contentious and difficult to implement. This collective action problem can be overcome, however, if projects generate private political benefits for powerful policymakers, such as mayors or governors, who then push through the projects. Political institutions, such as political elections, shape project outcomes by setting the rules around political benefits: they determine who can reap them, the form of the benefits, and important conditionalities for how to realize them.

The second frameworks, regarding the operations phase, asserts that the durability of a BRT system can be understood in terms of *adaptability* to adverse policy feedback. BRT operations often suffer from cycles of adverse policy feedback, whereby operational problems lead to backlash, which can worsen operations further and eventually lead to even more backlash. Over time, such cycles can result in perpetual financial instability, loss of social legitimacy, or even closure. The framework implies, contrary to mainstream thinking, that BRTs do not necessarily endure because their operations perform well, but rather because they successfully adapt to and mitigate adverse policy feedback. Political institutions determine the extent to which operations are exposed to or insulated from such adverse policy feedback.

The analytical frameworks build on evidence from 32 semi-structured expert interviews, which I conducted between April and June 2019 in Washington, DC. Their overarching implication is that the politics of transit policy changes over the lifecycle of a transit system. Long-term transit planning requires *political capacity* alongside *technical capacity* to 'muddle through' the urban politics of rapid transit operations, maintenance, and investment.

5.4. Public Investment

The third and final substantive chapter, *Institutional Foundations of Rapid Transit Investment: Evidence from Mexico, Peru, and Colombia* (Chapter 4)*,* analyzes how *meso-political institutions* and *political interests* interact with one another to either enable or disable *public investment* in urban mass transit projects. The survival regressions from the first research project (Chapter 2) show that BRT adoptions are concentrated in middle-income democracies characterized by political decentralization. The institutional mechanisms underlying this pattern, however, remain a puzzle. The driving question of the final project therefore is this: what are the meso-political institutional foundations of scaled-up public investment for mass transit development?

The chapter argues that there are four distinct enabling factors: an *institutional actor* who legitimizes and authorizes transfer of state capacity and resources to sub-national rapid transit projects, a *policy framework* which facilitates the alignment of national and sub-national policy interests around shared transit policy goals, a *politically savvy funding mechanism* which disciplines public authority and depoliticizes investment decisions, and a mechanism of equitable fiscal redistribution. Together, these four factors facilitate rapid transit development, especially

when there is a policy gap between sub-national regulatory responsibility over urban transport affairs and sub-national capacity to implement transport reform.

This argument is examined with a 'most-similar systems' comparative case study of public investment for BRT projects in two middle-income countries in Latin America: Mexico and Peru. The analysis shows how the institutional environment in Mexico facilitated the creation of the public investment program PROTRAM, which catalyzed transit projects across nearly a dozen of secondary cities, yet how the institutional environment in Peru has made transit projects comparatively more difficult. The chapter also offers supplementary evidence from Colombia as a shadow case study to show how federal macro-political institutions are not a necessary pre-condition for the four meso-political enabling factors. Methodologically the project combines historical analysis, process tracing, and 30 semi-structured expert interviews which I conducted between June and December 2021.

5.5. Research Implications

The findings from the three projects highlight several research needs. For one, the arguments will have to be refined with additional evidence. The hypotheses developed in the first substantive chapter (Chapter 2), for instance, ought to be re-tested as better standardized, sub-national data on urban congestion, air pollution, and traffic safety become available. Likewise, the theoretical frameworks put forward by the second project (Chapter 3) on the role of *power politics* and *adaptability* will have to withstand scrutiny with further evidence from comparative case studies. Special attention will have to be devoted to how and under what conditions transit operations successfully cultivate adaptive management practices, and how and under what conditions these practices become institutionalized over time. The third project (Chapter 4) invites investigation into how public investment programs have come about in other key countries, such as Brazil, India, and South Africa. Research could also assess how the investment programs in these countries differ in terms of their institutional design and performance, and how and under what conditions investment programs prove particularly effective. Programs might prove especially effective at scaling up mass transit systems if they are backed by domestic rather than multilateral financing (cf. Post and Murillo 2016).

Furthermore, the arguments will have to be refined with evidence from low-carbon infrastructure other than BRT systems, to scrutinize their generalizability. The three projects currently cannot neatly parse out which findings are BRT-specific and which ones apply to low-carbon infrastructure systems more broadly. Future research could develop a typology of low-carbon urban systems, and then repeat the analyses with other types of systems in key urban sectors. For instance, BRT systems could be classified as an example of a system characterized by *high modularity* and *moderate capital intensity* in the *urban transport sector*. City-integrated renewable energy systems, such as rooftop PV and solar water heating, in comparison, could serve as cases of systems characterized by *high modularity* and *low capital intensity* in the *urban energy sector*. It could prove invaluable, for instance, to analyze how India's *Solar City Programme*, a federal support program for city-integrated energy systems, came about and compare whether its enabling meso-political factors mirror those of India's *Jamal Nehru National Urban Redevelopment Mission*, a federal support program for mass transit systems.

I expect, for instance, that differences in *capital intensity* determine the size of the *policy gap* between sub-national authority and capacity: lower capital intensities will be associated with smaller policy gaps, while higher capital intensities will be associated with larger policy gaps. By extension, smaller policy gaps will be associated with greater sub-national capacity to plan and implement transformational policy change. Accelerating urban energy transitions in institutional environments characterized by weak state capacity would thus invite 'transformational effort sharing', whereby local governments mainly direct their efforts to climate issues characterized by small policy gaps. Over time, such effort sharing could help grow transformational capacity. Other key urban policy sectors alongside transport and energy which need further investigation include urban buildings, waste, and green and blue infrastructure.

All three projects also call for deeper investigation into the history and role of international environmental NGOs. Their enabling influence appears both over- and under-stated. This begs the question how and under what conditions NGOs enable transformational policy change. Research will have to delve into the history of how and why NGOs became 'BRT champions' and assess which special interests have shaped their agenda. As uncovered by the second project (Chapter 3), for instance, the BRT initiatives at both WRI and ITDP were initially launched with grant support from philanthropies associated with fossil fuel interests. Given the long political history of how fossil fuel interests have sought to strategically jeopardize climate policymaking over decades (cf. Franta 2018; Oreskes and Conway 2011), this observation demands careful investigation into why fossil fuel interests have expressed a policy preference for BRT initiatives, and to what extent, if any, fossil fuel interests have influenced NGO interests.

Moreover, future research will have to address what BRT reveals about low-carbon innovation more generally. To recall, BRT was never designed to mitigate GHGs. It was developed in the 1960s and 70s as a low-cost mass transit system. In the 1990s and early 2000s, BRT was framed as a solution to address urban air pollution. Only from the mid-2000s onwards was BRT retrospectively labelled 'green', 'low-carbon', or 'climate friendly', which coincides with the rise of climate change and green growth policy on the global policy agenda (cf. Meckling and Allan 2020). This could suggest, provocatively put, that its green label catered to the changing interests of powerful international actors: development banks were looking for green investments, national governments were looking for cheap financing, private financial interests were looking for new public-private partnership investment opportunities, and fossil fuels interests were looking for ways to frame fossil fuel-based systems as climate friendly. Making BRT eligible under the UN's Clean Development Mechanism, which required the development of a new GHG accounting methodology, appears to have acted as a catalyst for the low-carbon label. BRT thus begs the question of how and under what conditions technology becomes 'green' and who decides what qualifies as 'green'.

Before concluding with several policy implications, I want to briefly comment on broader trends in the literature and suggest opportunities for future collaboration across scholarly fields. I posit, for instance, that energy transitions theory has outpaced policy practice, while transit policy practice has outpaced theory. Significant analytical leverage could be gained if both fields learned from one another. I further observe that quantitative techno-economic disciplines are calling for more qualitative case-based research, while qualitative case-based disciplines are arguing for more comparative and generalizable research. However, both types of research already exist. The challenge therefore is not to implement more case studies or to conduct more

econometric analyses. The challenge lies in making quantitative studies more accessible to qualitative research, and vice versa.

5.6. Policy Implications

Overarchingly, this dissertation suggests that low-carbon infrastructure systems are governed by two distinct policy spheres, one techno-economic and one political-institutional. While scholarly disciplines often privilege one over the other, policy issues will rarely be exclusively technical or exclusively political. Rather, policy issues will simultaneously be more-or-less technical and more-or-less political. Moreover, the 'position' of an issue in this techno-political space can change over the lifecycle of an infrastructure system. The key policy challenge thus lies in navigating both policy spheres as skillfully as possible. The former demands *technical capacity*, the latter *political capacity*.

I derive four implications for policy. First, policymakers are advised to navigate each lifecycle phase of a BRT system with distinct strategies. During the *planning phase*, projects stand or fall because of *coalition politics*. Reform advocates are advised to focus on coalition building, as well as alignment of broad social interests with narrow elite interests. In the absence of strong political institutions, reform efforts will tend to move forward if they offer political benefits to powerful individuals. During the *implementation phase*, success is determined by *technical capacity* and *speed*. When projects pitch broad yet shallow support against narrow yet fierce opposition, 'the cards tend to be stacked against BRT proposals'. Projects need to demonstrate proof of concept quickly, to minimize costs, outpace political opposition, and grow a local transit coalition that can support and sustain the new system. During the *operations and maintenance phase*, the sustainability of a system requires *managerial adaptability, iteration*, and *organizational learning.* Otherwise, systems will face the danger of adverse policy feedback, which can lead to perpetual instability, loss of social legitimacy, or even closure. Ideally, over time adaptive management practices become institutionalized and help grow technical and political capacity for further mass transit development.

Second, calls by policymakers and scholars alike to empower city governments with additional legal and fiscal authority ought to be qualified by the political regime type. In the absence of effective institutional accountability mechanisms, empowering sub-national governments could otherwise decrease the chances of effective urban climate policy. Put more provocatively, regulatory and fiscal devolution in institutional contexts characterized by weak accountability could lead to a surge in unfinished subway lines rather than completed BRT systems. Policymakers are thus advised to support and foster decentralization reform only when institutional accountability is high.

Third, at the urban level, policymakers are advised to focus on social and economic arguments for accelerated mass transit development. GHG emissions or concern for climate change are not the main drivers of low-carbon infrastructure systems in low- and middle-income countries. GHG mitigation can factor into policy decisions as a tertiary co-benefit, but the main drivers are infrastructure needs (e.g., growing demand for mobility), alongside primary and secondary co-benefits (e.g., better air quality, improved traffic safety, and urban economic development). Environmental interests do have an important role to play, but mostly at the international level. They can put significant pressure on multilateral development banks to create

and offer favorable financing for low-carbon systems (e.g., BRTs) and retrench support for carboniferous systems (e.g., automobile-centered urban transport).

Finally, policymakers are encouraged to assess the political feasibility of national investment programs – not only to transform urban transport, but also urban energy, waste, water, and green and blue infrastructure. The Mexican and Colombian case studies show that public investment programs can be powerful drivers of sub-national policy change.
They also demonstrate that program design matters. To be effective, programs must generate vertical political accountability rather than competition, and insulate decision-making from special interests. The influence of special interests can be curbed by a combination of independent technical reviews, limited access by interest groups, dedicated financial resources not dependent on legislative allocation, and transparent funding rules, procedures, and criteria. As such, investment programs offer a unique policy instrument for growing technical and political capacity for transformational urban infrastructure change.

Policy decisions over the next few decades will determine our collective future. This shared predicament calls for pragmatic research on when, how, and why cities build and maintain infrastructure systems which not only mitigate but altogether avoid carbon emissions compared to historical patterns of production and consumption. I hope this dissertation serves this call in a meaningful way.

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7. Appendices

7.1. Appendix A: Review of Bus Rapid Transit Impact Assessments and Evaluations

The results of the systematic literature review are documented in *Table 26* (cf. *Table 1*).

Table 26: Review of BRT impact assessments and evaluations

Paper	System and City	Country	Findings	Evidence	A	S	I	O
Abbasi, Hadji Hosseinlou, and JafarzadehFadaki (2020)	Tehran	Iran	The BRT system is pursuing increased efficiency measures by converting shared lanes into exclusive lanes, revising bus stations, and implementing controlled stop lights for buses. This may reduce emissions of CO, NO and PM; it may also reduce commute times and fuel consumption. The article also finds that the payback of implementing efficiency measures would be quite rapid.	Supportive			X	
Kim et al. (2019)	Seoul	Korea	Kim et al. simulate expected energy savings and environmental impacts from a median bus lane in one of Seoul's BRT corridors. They find that energy consumption could be reduced by 18.5% and emissions by 19.3–31.4%. Emissions reductions vary across pollutants (CO, CO 2, PM10, PM2.5, NOx). Their simulation suggests that median bus lanes not only benefit bus operations, but also increase traffic flow in general-purpose lanes, which further reduces emissions.	Supportive			X	
Li and Li (2019)	Yinchuan	China	Li and Li assess the energy savings and emissions reduction potential of the BRT system in Yinchuan City. In comparison to a business-as-usual scenario, electrification of buses, enhancement of vehicle energy efficiency, and an optimization of the bus network could cumulatively reduce CO2 emissions by 171,700-185,000 tons from 2018 to 2030.	Supportive			X	
Bel and Holst (2018)	*MetroBus*, Mexico City	Mexico	This study quantifies SO2, CO, NOx and PM10 emissions in Mexico City following the implementation of the *MetroBus* BRT. It finds that *MetroBus* accounted for significant emissions reductions, including decreases in CO between 5.5% and 7.2%, NOx between 4.6% and 6.5%, and PM10 between 7.3% and 9.2%. The reductions in emissions are also credited to the use of new modern diesel buses, which replaced gasoline powered buses.	Supportive			X	

Dreier et al. (2018)	Curitiba	Brazil	Dreier et al. use Curitiba, Brazil, as a case to compare the CO2 emissions and energy use of two-axle city bus types: hybrid buses, plug-in electric hybrid buses and conventional two-axle city buses. Their study finds that hybrid-electric buses reduce CO2 emissions by 30%, while plug-in hybrid-electric buses reduce emissions by 72%. The biodiesel mandate in Curitiba demonstrates relatively small emission reductions, which suggests that new technology is the more effective way to reduce emissions and energy use.	Supportive			X	
de Bortoli, Fresnet, and Leurent (2017)	Fort de France	France	The authors argue that life cycle analysis (LCA) can be used to better understand the impacts of bi-articulated buses compared to standard diesel buses in a BRT scenario. Bi-articulated buses evidence large positive impacts regarding acidification (increasing acidity in soil and water globally), eutrophication (excessive rich nutrient discharge creating excessive plant growth leading to excessive light, space, and oxygen consumption) and climate change (using the 2001CML characterization method). LCA is often still not used by decision makers, however, because of lack of easily usable tools.	Supportive			X	
Hahn et al. (2017)	Seoul	South Korea	Hahn et al. examine the sustainability of Seoul's BRT. Sustainability is operationalized along two dimensions: equity, determined by the price of the system; and environmental impact, based on emissions of CO, HC, NOx, PM, and CO2. The study finds that the sustainability of Seoul's BRT could be improved if the system were to implement median bus lanes, convert conventional buses to compressed natural gas buses and pursue general cost savings.	Supportive			X	
Ambarwati et al. (2016)	Surabaya	Indonesia	Ambarwati et al. evaluate the effects of urban sprawl in Surabaya, Indonesia, and specifically the extent to which public transportation, including BRT corridors, can increase public ridership and reduce emissions of CO, CO2, NOx, PM10 and hydrocarbon. They find that urban sprawl is the core problem, leading to more emissions-heavy commutes, especially via motorcycles. They argue that encouraging polycentric urban development is the best strategy to enable effective public transit.	Supportive	X			

Cheng, Madanat, and Horvath (2016)	San Francisco	USA	This study finds that large cities, which have longer average travel distances with hierarchical mass transit systems such as metro and trunk routes, are more efficient in terms of both costs and emissions compared to non-hierarchical transit systems. Small cities, on the other hand, are better served by trunk-only bus systems. The study analyzes demand elasticities and transit hierarchies to inform decision-making for cost and emissions savings.	Supportive		X		
Clark (2016)			This article reviews literature on BRTs from around the world. It summarizes the effectiveness of BRTs to attract passengers and reduce GHG emissions through a modal shift away from passenger cars towards public transit. It cites an EMBARQ study from 2013 which reports emission savings of 27,000 tons of CO2 in Mexico City, 40,000 tons in Johannesburg and 61,000 tons of CO2 in Istanbul, along with improved local air quality and increases in land value.	Supportive		X		
Mitropoulos and Prevedouros (2016)			Mitropoulos and Prevedouros develop a sustainability framework to evaluate conventional, hybrid and alternative fuel vehicles and buses. The framework considers energy use, CO2 emissions, operation and maintenance costs, production costs and user availability. It finds that transportation vehicles can rapidly improve their sustainability performance when they use alternative fuels or hybrid technologies and increase vehicle occupancy.	Supportive			X	
Nakamichi et al. (2015)	Khon Kaen	Thailand	This article seeks to estimate truck trips in Khon Kaen and compare projected CO2 emissions for 2050 from different scenarios. The findings indicate that transit oriented development (TOD) (incl. 5 BRT lines) and EV dissemination would have the largest impact on 2050 emissions, with emissions reductions of 442.3 and 436.4 tons of CO2 per day respectively. Land use change to support TOD and focus employment and residency around the BRT infrastructure is cited as a critical aspect of CO2 reduction.	Supportive	X			

Bubeck, Tomaschek, and Fahl (2014)	Gauteng Province	South Africa	Bubeck et al. show how extending Gauteng province's BRT system could generate more ridership by creating a modal shift away from private car use. Ridership volume could increase dramatically if the system reaches high-density areas. They find that an expansion of both the BRT and light rail systems, which is assumed will increase ridership of these modes, can reduce emissions by between 1.1 and 2.7 Mt CO2e between 2014 and 2040. The study also suggests that changing the target group for the system expansion, and specifically attracting mini-bus taxi riders to BRT and light rail transit, could reduce emissions by 2.7–7.0 Mt CO2e.	Supportive		X		
Mahendra and Rajagopalan (2015)	Indore	India	This article tries to quantify the potential public health impacts of Indore's BRT system. Specifically, it estimates the impact of the BRT on fatalities, focusing on three mechanisms: more biking and walking, less private vehicle use, and less air pollution exposure. It finds that, following implementation, PM 2.5 emissions could drop by 11%, while the mortality risk from PM2.5 exposure could decrease by 1.1%. The study concludes that implementing the BRT could reduce fatalities by 10.8%.	Supportive		X		
Nahlik and Chester (2014)	G and L Line, Los Angeles	USA	Nahlik and Chester use lifecycle analysis to determine the impacts of mixed-use land development around Los Angeles' light rail and BRT systems. They evaluate the impacts of changing commercial development, focusing specifically on TOD in commercial areas surrounding light rail and BRT infrastructure. They find that changing commercial development has the highest impact on CO2 emissions, followed by modal shifts towards using transit. The combination of changing commercial development and residential commute shifts creates a reduction of 470 Gg CO2e per year, PM10 smog reductions of 28–35% and a user cost reduction of USD 3,100 per household per year.	Supportive	X			

Jun et al. (2015)	Seoul	Korea	This study analyzes the accessibility of Seoul's BRT system, which was established after a large transportation reform in 2004. It finds that the BRT was the preferred mode of transit over automobile and subway for commuters who work close to the BRT catchment area. Moreover, it finds that subway riders use the BRT more often than car drivers: public transit users shifted their preference away from the subway to the BRT, but automobile users did not necessarily shift their preference to public transit.	Supportive		X		
Mitric (2013)			Mitric provides a meta-analysis of the World Bank's involvement with urban transport projects. More specifically, he looks at how the bank has formulated projects, focusing on private sector involvement through local government support, tightening up weakly regulated informal sectors, and introducing private delivery in sectors that were previously operated fully publicly. The article cites how BRT has presented a unique opportunity for the bank, as it provides high service capacity, low operation cost and high-cost recovery potential. The article suggests that while the bank has focused on transportation investment, it needs to pay more attention to urban roads and road design.	Supportive				X
Chen et al. (2012)	Beijing	China	Chen et al. compare emission reduction impacts between diesel BRT buses and conventional diesel buses. They use a power-based emissions estimation approach to compare the emissions of heavy-duty diesel-powered buses with conventional buses. Emissions characteristics are compared in two scenarios: bus-lane usage versus non-bus-lane usage. BRT diesel buses evidence significant positive impacts on emissions, with a 25.62% to 27.37% reduction of NOx, HC, CO, and PM per kilometer. The bus-lane scenario found emissions reductions between 12.76% and 14.01%. Exclusive bus lanes reduce emissions for both modes, but BRT diesel buses show the largest reduction.	Supportive			X	

Hidalgo and Gutiérrez (2013)			Hidalgo and Gutierrez explore the expansion of the BRT industry worldwide, especially the rapid deployment of low-cost high-yield BRT systems over the past decade, and address some of the issues faced by the industry. The authors also bring up interesting developments within the BRT industry, including a shift towards integrated BRT systems, higher interest from national and state governments, and more academic initiatives to foster collaboration. Their meta-analysis calls for more coordination within the BRT industry to achieve better consolidation, which, in turn, could lead to more success stories and level out BRT's reputation as second best to light rail.	Supportive				X
Nelson, Nelson, and Kruijne (2012)			Nelson et al. study the Clean Development Mechanism (CDM) from the 1997 Kyoto Protocol and evaluate its ability to finance transport projects in developing countries, including BRT, light rail, freight initiatives and alternative fuel projects. Their review of CDM projects finds that, in order to increase the chances of success, projects should start early, focus on efficiency, and garner support with publicly available information about other CDM projects. The analysis illustrates some emissions reduction numbers of CDM projects, citing transportation to have capacity to reduce 46 million tons CO2 by 2030. A major takeaway of the study is that metro rail projects, while capital intensive, often have a positive impact on urban mobility, community integration and economic development, but frequently score low regarding air quality and energy benefits.	Supportive				X
Turner, Kooshian, and Winkelman (2012)	*TransMileno,* Bogotá	Colombia	Turner et al. examine the success story of Bogotá's *TransMilenio* BRT: how the implementation attracted large ridership, created jobs, and led to safer and healthier communities, as well as how the system ultimately became a model for the rest of the country. The study also finds that Colombia's National Urban Transportation Program helped both the country and Bogotá overcome barriers to designing and implementing a transformative system. Collaboration among Colombian cities, as well as local and international support to strengthen institutional capacity, were also critical factors contributing to the success of *TransMilenio*. Further implementation of integrated mass transit systems has become a priority for the country to grant better mobility to growing urban populations. Diffusing transit systems is estimated to reduce 1 million tons CO2 per year.	Supportive				X

Deng and Nelson (2012)	Beijing	China	A passenger survey from Beijing's Southern Axis BRT (Line 1) shows that 12.4% of BRT users shifted from private cars.	Supportive		X		
Hughes and Zhu (2011)	Guangzhou	China	This article examines Guangzhou's BRT. It argues that the system's massive ridership and overall urban transport improvements demonstrate the viability of metro-scale BRT in China. In its first year of operation, the BRT reduced CO2 emissions by an estimated 45,000 tons through an increase in transit share, bus speed, mixed traffic speed and bus-vehicle kilometers traveled (measured distance traveled by bus). The article concludes that the BRT's largest impacts are yet to come, as the massive ridership will likely change commercial development around the BRT line and diminish growing car ownership in Guangzhou.	Supportive		X		
Mitropoulos and Prevedouros (2011)			The authors compare six vehicle types (internal combustion engine vehicle, hybrid electric vehicle, fuel cell vehicle, electric vehicle, plug-in hybrid vehicle, gasoline pickup truck, diesel bus and BRT bus) using a sustainability index based on environmental, technological, energy, economic and user-based indicators. Their findings rank BRT as the most sustainable mode, which scored highest regarding environment, technology, and energy, at 85%, 63% and 99% respectively. Under this lifecycle sustainability framework, the authors argue to label BRT a relative optimum because it has not been compared to other forms of mass transit, and further suggest using their lifecycle sustainability framework to do so.	Supportive			X	

Zusman and Romero (2011)			The authors create a framework to quantify the co-benefits from transport projects in Asia, including reductions in CO2 and conventional air pollutants, time savings, vehicle operating costs, and accidents. Development co-benefits of public transport tend to be higher than CO2 emission co-benefits; economic benefits include faster commutes; and social benefits include enhanced mobility. Modelled with Manila's proposed BRT, time costs reduce by 1,266,142,228 Philippine peso/ year and operating cost by 144,456,600 Philippine peso/year. NOx, CO, and PM emissions reduce by 159, 9,963 and 40 kg/day respectively. The BRT is estimated to reduce CO2 emissions by 10 tons/year. Modelled with Bangkok's proposed BRT, time costs reduce by 3,167,226,369 Baht/year and operating cost by 5,156,488,885 Baht/year. NOx, CO, and PM emissions reduce by 1,458, 12,676 and 15 kg/day respectively. The BRT is estimated to reduce CO2 emissions by 424 tons/year.	Supportive				X
Zhang, Zang, and Wang (2011)	Jinan	China	Zhang et al. develop a methodology to compare Jinan's existing BRT with other transit modes in terms of energy conservation and emission reductions of hydrocarbons, NOx, CO and PM10. They find that BRT can save 11.4% fuel consumption compared to normal buses, and up to 88.3% fuel consumption compared to cars. The emissions from BRT were 58.8% of that from buses of national standard II (standards are based on their emissions; standard II pollutes more than standard III), 41.5% of that from buses of national standard III, and 36.95% of that from cars. They conclude that BRT is a very effective transit mode, and that Jinan should focus more on sustainable transport initiatives and integrating transit modes, like implementing bike sharing around BRT stations.	Supportive			X	
Callaghan and Vincent (2007)	Los Angeles	USA	A ridership survey from Los Angeles' Orange Line BRT finds that 18% of BRT users previously drove private cars.	Supportive		X		

Hook et al. (2010)			This paper seeks to develop a CO2 mitigation potential framework for proposed BRT systems. The framework draws on the BRT systems in Bogotá, Mexico City, and Jakarta to estimate overall GHG impacts from BRT investment. Using existing emissions measurement methodologies, the CO2 impact is quantified for each system, which, in turn, is used to quantify their respective CO2 benefit (the culminating CO2 impact when system speeds, effects on traffic and ridership are taken into account). Differences in CO2 impacts are due to these factors used for the CO2 benefit. Bogotá's projected CO2 savings average 246,563 tons per year. Mexico City's initial 19.3km *Insurgentes* corridor (one of the city's busiest avenues) would reduce 25,887 tons of CO2 per year, whereas a 73.7km system is projected to save 3.26 million tons of CO2 per year. Jakarta's 119.5 km system is projected to save 60,670 tons of CO2 annually. As more data is collected, the author concludes, CO2 benefits should be able to be determined using projected ridership, system length, modal shifts towards BRT use and system speed.	Supportive			X	
McDonnell, Ferreira, and Convery (2008)	Dublin	Ireland	This article investigates the impact of exclusive bus lanes on CO2 emissions. It develops a case study for a quality bus corridor (QBC) in Dublin, Ireland. The author creates various scenarios, including a factual scenario where the QBC is built, a counterfactual scenario where the QBC is not built, and a 15% modal shift as well as a 29% modal shift by car users. The factual scenario demonstrates decreasing emissions with the QBC implementation: between 1998 and 2003, CO2 emissions from cars drop from 22,000 to 12,000 tons, with the emissions share from cars falling from approximately 90% to 66%. Scenarios with increased ridership demonstrate additional emission reductions: a 15% modal shift reduces emissions by another 750 tons compared to the factual scenario, while a 29% modal shift reduces CO2 emissions by 1,500 tons compared to the factual scenario.	Supportive		X		

Susilo et al. (2007)	Jakarta	Indonesia	This article examines the motorization trends in Jakarta over the decade preceding 2006, and the role that implementing BRT has had on vehicle ownership. The city sought to develop BRT as a means to suppress rapidly increasing motorization. An initial line was built over a nine-month period and hosted 44,000 passengers per day (approx. 3,600 persons/hour/two directions). Based on its large ridership after opening, the BRT has been considered successful, but the article calls for more stringent action from the government to support public transit and curb rapidly increasing motorization.	Supportive		X		
Ernst (2005)	Jakarta	Indonesia	Ernst explores the implementation process of Jakarta's BRT system, how it has performed, the next steps for the system, and how it can improve and expand. Jakarta sought a BRT system in the face of rapid urban growth, increasing traffic congestion, rapidly expanding motorization and urban air pollution. Because the city is also dependent on its existing road infrastructure, BRT proved the best transit option. The system attracted large ridership after implementation, but the $1.6 million/mile spent was inadequate to smoothly resurface roads, construct large capacity terminal stations and install single platform-level doors on each side of the buses resulting in uneven passenger distribution. The system has achieved a 20% mode shift from private cars to BRT, reduced NO emissions by 20 kg/day and PM10 by 1.1 kg/day. The system operators are pushing for system expansion and the city has made efforts to improve sidewalks along the BRT corridor.	Supportive		X		
Stutsman (2002)	Los Angeles	USA	Stutsman compares the Los Angeles light rail system with its BRT system in terms of environmental impact, financial stability, and community response. The BRT is found to create a larger reduction in traffic congestion and to be a cheaper system, with capital cost of $300 million total for BRT vs. $650 million total for LRT. The LRT was preferred by residents, in large part due to a strong outreach plan to educate residents about the system. The LRT also projected larger ridership and a smoother, quieter ride.	Supportive				X
Rabinovitch and Hoehn (1995)	Curitiba	Brazil	An analysis based on passenger surveys and use statistics finds that 20-25% of BRT users shifted from private cars.	Supportive		X		

Rodriguez-Valencia (2013)	Bogotá	Colombia	Rodriguez-Valencia seeks to understand the role of taxi service in Bogotá compared to the city's *TransMilenio* BRT system in terms of cost, user convenience, congestion and environmental impact. The findings show how large taxi fleets and low fares increase both rider and driver demand, making taxi service competitive with the BRT system. The abundance of taxis effectively substitutes private vehicle use with taxi use, and increases rider convenience by reducing wait times. For comparison, taxis cover a total of 12,500,000 km daily vs. 330,000 km daily for the BRT; taxis carry 880,000 passengers vs. 1.55 million BRT passengers; taxis bring in 140,000 million COP per month vs. 58,000 for the BRT; taxis emit 3,080 tons of CO2 daily at 530.0 g CO2/passenger whereas the BRT emits 488 tons CO2 daily at 34.90 g CO2/passenger; taxis account for 39% of NOx, 10% CO2, and 15% CO of citywide emissions. The study concludes that, considering the current role of taxis in Bogotá, this mode deserves more attention from decision-makers.	Mixed			X	
Gu et al. (2019)		China	Gu et al. (2019) employ linear regression analysis to assess the effectiveness of TOD on pollution (NO2 and PM10 concentrations) in Chinese cities, basing their model on 37 Chinese cities with existing light rail and/or BRT systems. Their literature review cites the effectiveness of TOD in other parts of the world, mostly in Europe. The study also draws on information from commercial and residential activity in China and their respective proximity to TOD infrastructure. Gu et al.'s results suggest that, within China, BRT TOD has neither had a significant impact on emissions nor on air quality.	Contradictory	X			
Lindau et al. (2016)	Rio de Janiero	Brazil	This paper examines the transformation of Rio de Janeiro's transport system, where mass transit daily share of ridership is expected to increase from 18% to 63%. The city won the bid for the 2016 Olympics in part because of its commitment to develop and implement a comprehensive transportation plan including four BRT corridors and several exclusive bus lanes.	Other				X

Swamy, Pai, and Kulshrestha (2015)	Ahmedabad	India	Swamy et al. compare exposure to PM 2.5 across different transport modes: BRT buses, conventional buses, private four-wheel vehicles, two and three-wheel vehicles, cycling, and walking. Closed modes of travel with air conditioning evidence the lowest levels of PM 2.5 exposure. In fact, BRT buses with air conditioning demonstrated the lowest exposure across all modes.	Other				X
Weiwei, Yue, and Xiaojing (2016)		France	Weiwei et al. compare BRT systems with guided bus and trolley systems in terms of their environmental impacts and costs. Their analysis suggests that, during unidirectional peak demand at 8,000 rides per hour, trolley systems are the most cost-effective and lowest emission mode, because it is fueled by electricity.	Other				X

Note. 10 papers could not be accessed and were thus excluded from the review. The review was implemented in summer 2020. A – Avoid; S – Shift; I – Improve; O – Other.

7.2. Appendix B: Documentation for Manual Coding

7.2.1. *BRT adoption dates*

Table 27: Manual verification of BRT adoption dates

Country	Code	Income Group[a]	Region	City	BRTData[b]	ITDP[c]	Verified	Explanation
Argentina	ARG	UM	LAC	Buenos Aires	2011	2011	2011	
Argentina	ARG	UM	LAC	Buenos Aires - Metro Area	2017			Buenos Aires has two BRT systems: one that serves the city proper and another that serves the greater metropolitan area. Since I am interested in time to first BRT adoption per city, I use the 2011 date, which is verified by both datasets, and exclude the 2017 date. Moreover, according to BRTData both systems are called the same, which suggests that they are in fact a single system. This further supports only using the 2011 date.
Argentina	ARG	UM	LAC	Córdoba	2014		2014	The first corridor of the BRT system in Cordoba opened in December 2014 (Municipality of Cordoba 2014; Simo 2017). I therefore use 2014 as the system's adoption year in the analysis.
Brazil	BRA	UM	LAC	Curitiba	1974	1974	1974	
Brazil	BRA	UM	LAC	Goiânia	1976	1976	1976	
Brazil	BRA	UM	LAC	Porto Alegre	1977	1981	1977	The BRT in Porto Alegre can be dated to 1977 (Hidalgo 2012, Table 4; ITDP 2007, p. 772; Meirelles 2000, p. 6).

Brazil	BRA	UM	LAC	São Paulo - SPTrans	1980		1980	While SPTrans is Sao Paulo's main BRT system, dating its adoption is quite difficult. Several credible sources cite different adoption dates. BRTData cites 1980. Hidalgo (2012) cites 1979 (Table 4), referencing a document by Brazil's National Public Transport Association (ANTP), which unfortunately could not be verified since the link to the document did not work (reference 36). Meirelles (2000) implies that Sao Paulo's "bus priority system" was opened at the beginning of 1979, after implementation in 1977 and 1978 (p. 10). To err on the side of caution, I use 1980 as the more conservative proxy for the systems adoption date.
Brazil	BRA	UM	LAC	Belo Horizonte	1975	2014	1981	The 2007 BRT Planning Guide (ITDP 2007) dates Belo Horizonte's BRT system to 1981 (p. 23). Similarly, Meirelles (2000) dates the city's first bus priority system to 1981 (p. 7). However, Hidalgo (2012) cites 2004 as the system's adoption year (Table 4), referencing a document by Brazil's National Public Transport Association (ANTP), which unfortunately could not be verified since the link to the document did not work (reference 36). Parreiras and Lopes (2015) and WRI (2014), in turn, state that the city's MOVE system began operations in 2014. Because there is clear evidence of a BRT system prior to 2014, and since Meirelles (2000), who authored his report as Traffic Planning Manager for the Belo Horizonte Transport & Traffic Authority, is a credible source, I use 1981 as the system's adoption year in the analysis. This is consistent with the BRT adoption years for Curitiba (1974) and Goiania (1976), which are dated the same across multiple independent sources (e.g., Meirelles 2000; ITDP 2018; BRT+ Centre of Excellence and EMBARQ 2020).

Brazil	BRA	UM	LAC	Juiz de Fora	1982	1998	1982	Hidalgo (2012) dates the BRT system in Juiz de Fora to 1982 (Table 4), citing a document by Brazil's National Public Transport Association (reference 36). Unfortunately, this source could not be verified since the link to the document was broken. Over an hour of desktop research, in addition to the research conducted under SPUR, did not yield any other results. Since there is clear evidence of an early BRT system in Juiz de Fora, and since Hidalgo (2012) is a credible source, I use 1982 as its adoption year in the analysis.
Brazil	BRA	UM	LAC	Recife	1982	2014	1982	The 2007 BRT Planning Guide (ITDP 2007) describes the system in Recife as a "lesser BRT system[-]" (p. 463), which indicates that the city had a BRT before 2014. Hidalgo (2012) dates Recife's BRT to 2007 (Table 4). However, Hidalgo's source could not be further cross-referenced since its link was broken. Meirelles (2000) documents three corridors with separated median busways, which indicates that Recife had a BRT-like system prior to 2007. Pina (2018), in turn, dates Recife's first exclusive bus lane to 1982, which falls into the period during which several other Brazilian cities began experimenting with priority bus systems. To ensure consistency across the approximations, I use 1982 as the adoption year of Recife's BRT.
Brazil	BRA	UM	LAC	Campinas	1986	1986	1986	
Brazil	BRA	UM	LAC	Criciúma	1996	1996	1996	
Brazil	BRA	UM	LAC	Uberlândia	2006	2006	2006	
Brazil	BRA	UM	LAC	Rio de Janeiro	2011	2012	2012	Rio's first BRT system, Transoeste, opened in June 2012 (Zottis 2013; Schlaikjer 2012). See Pereira (2019) for additional context.

Brazil	BRA	UM	LAC	Brasília	2011	2014	2015	The construction of Brasilia's first BRT system was completed in 2014 (BRTBrasil 2017). The system was inaugurated in June 2014 by Governor Agnelo Queiroz and President Dilma Rousseff (WRI Brasil 2014b). The system began its commercial operations in April 2015 (BRTBrasil 2017). To err on the side of caution, I use 2015 as the more conservative proxy for the systems adoption year.
Brazil	BRA	UM	LAC	Fortaleza	2012		2015	Hidalgo (2012) dates Fortaleza's BRT to 1994 (Table 4). However, his source could not be verified since the link was broken. News sources suggest that the city's BRT system opened in April 2015 (Lobo 2015; Fortalbus 2015), received 11 new stations in July 2015 (Lobo 2015; Redação O POVO Online 2015), and was expanded with a new corridor at the end of 2018 (Sampaio 2018). Several sources also suggest that the BRT was financed by the Inter-American Development Bank (Scholl et al. 2015, p. 62, footnote 24; Redação O POVO Online 2015; Sampaio 2018). Given this evidence, I use 2015 as Fortaleza's BRT adoption year.
Brazil	BRA	UM	LAC	Uberaba	2015	2016	2015	The BRT system in Uberaba began operations in 2015 (Neto 2018, p. 162).
Brazil	BRA	UM	LAC	Belém	2014	2017	2016	The BRT system in Belem was inaugurated in July 2016 by Governor Simão Jatene (Teixeira 2016; Agencia Belem 2016). Subsequently it was expanded in 2019 (Marques 2019).

Brazil	BRA	UM	LAC	Guarulhos	2013			BRTData notes that the system in Guarulhos is not a BRT, but rather a conventional bus service, citing a 2016 ITDP assessment. The ITDP assessment could not be verified, however, since no further reference or link is provided. Bazani (2012) suggests that Guarulhos received new conventional buses in 2012. The city's 2019 urban mobility plan indicates intentions to conduct studies on the impacts of a light rail or BRT system, implying that the city does not yet have a BRT (Secretaria de Transportes e Mobilidade Urbana 2019). Given this evidence, I exclude Guarulhos from the analysis.
Brazil	BRA	UM	LAC	Londrina	2010			The adoption year listed by BRTData is not backed by functioning sources. News sources indicate that Londrina's envisioned BRT was eventually turned into an express bus system (Associação Comercial e Industrial de Londrina n.d.; Bonde News 2014; WRI Brasil 2015). To err on the side of caution, I exclude Londrina from the analysis.
Brazil	BRA	UM	LAC	Natal	2008			Hidalgo (2012) dates Natal's BRT to 2001 (Table 4). The adoption year listed by BRTData is not backed by functioning sources. News sources indicate that Natal sought to implement a BRT project unsuccessfully (Nominuto 2009; França 2010; Nominuto 2011). To err on the side of caution, I exclude Natal from the analysis.

Brazil	BRA	UM	LAC	Niterói	2010			The source used by BRTData to back its adoption year, a blog article, is questionable (see Pellegrino 2010). mobilize (2012) and Barandier (2015) indicate that the city was planning to adopt a BRT or express bus system in the early 2010s. Moreover, BRTData notes that Niterói's Corredor Metropolitano Alameda São Boaventura, which was supposedly opened in 2010, is not a BRT, but a conventional bus service, citing a 2016 ITDP assessment. The ITDP assessment, however, could not be verified since no further reference is provided. GBNEWS (2019) and Pelegi (2019) suggests that TransOceânica, an express bus system, was inaugurated in Niteroi in April 2019. Both news sources label TransOceânica as a BHLS (Bus of High Level of Service) system, to differentiate it from BRT. To err on the side of caution, I exclude Niteroi from the analysis.
Brazil	BRA	UM	LAC	São Paulo - Corredor Metropolitano ABD	1988	1988		São Paulo has two BRT systems: SPTrans serves the city proper, and Corredor Metropolitano ABD serves parts of the metropolitan area. SPTrans is 135km long and has 12 corridors, while Corredor Metropolitano ABD is 45km long and has two corridors. Since this analysis is only interested in BRT adoption per city, and since SPTrans is both older and the city's main system, I exclude the Corredor Metropolitano ABD adoption date from the analysis. The adoption of the Corredor Metropolitano ABD system can be dated to 1988 (EMTU 2020).

Brazil	BRA	UM	LAC	Sumaré	2010			The adoption year listed by BRTData is not backed by functioning sources. Moreover, BRTData notes that the system in Sumaré is not a BRT, but a conventional bus service, citing a 2014 ITDP assessment. The ITDP assessment, however, could not be verified since no further reference is provided. Bazani (2017) provides further evidence that Sumaré is serviced by a bus system, not a BRT system. For these reasons, I exclude Sumaré from the analysis.
China	CHN	UM	EAP	Beijing	2004	2004	2004	
China	CHN	UM	EAP	Changde	2012	2012	2012	
China	CHN	UM	EAP	Changzhou	2008	2008	2008	
China	CHN	UM	EAP	Chengdu	2013	2013	2013	
China	CHN	UM	EAP	Chongqing	2008	2008	2008	The BRT system in Chongqing was demolished in 2012, the first system in China that was closed (Velasquez et al. 2017; Far East Mobility 2017a; Zeng 2013).
China	CHN	UM	EAP	Dalian	2008	2008	2008	
China	CHN	UM	EAP	Guangzhou	2010	2010	2010	
China	CHN	UM	EAP	Hangzhou	2006	2006	2006	
China	CHN	UM	EAP	Hefei	2010	2010	2010	
China	CHN	UM	EAP	Jinan	2008	2008	2008	
China	CHN	UM	EAP	Kunming	1999		1999	Kunming's BRT opened in April 1999 (Darido 2006, p. 11; Deng, Ma, and Wang 2013, p. 227; ESCI KSP 2012).
China	CHN	UM	EAP	Lanzhou	2013	2013	2013	
China	CHN	UM	EAP	Lianyungang	2012	2012	2012	
China	CHN	UM	EAP	Nanning		2017	2017	The BRT in Nanning commenced 25 January 2017 (Far East Mobility 2019).
China	CHN	UM	EAP	Urumqi	2011	2011	2011	
China	CHN	UM	EAP	Xiamen	2008	2008	2008	

China	CHN	UM	EAP	Yancheng	2010	2010	2010	
China	CHN	UM	EAP	Yichang	2015	2015	2015	
China	CHN	UM	EAP	Yinchuan	2012	2012	2012	
China	CHN	UM	EAP	Zaozhuang	2010	2010	2010	
China	CHN	UM	EAP	Zhengzhou	2009	2009	2009	
China	CHN	UM	EAP	Zhongshan		2014	2014	The BRT in Zhongshan commenced 27 January 2014 (Far East Mobility 2017b).
China	CHN	UM	EAP	Zhoushan		2013	2013	Verifying Zhoushan's BRT adoption was difficult. Neither Deng, Ma, and Wang (2013) nor Far East Mobility document the system's opening date. 40 minutes of desktop research by undergraduate researchers did not yield any results other than ITDP sources. Only ITDP China dates the system's commencement to 1 October 2013 (ITDP China 2014). Given the specificity of this date and the credibility of ITDP China, however, I include Zhoushan in the analysis and use 2013 as the system's adoption year.
Colombia	COL	UM	LAC	Barranquilla	2010	2010	2010	
Colombia	COL	UM	LAC	Bogotá	2000	2000	2000	
Colombia	COL	UM	LAC	Bucaramanga	2010	2010	2010	
Colombia	COL	UM	LAC	Cali	2008	2009	2009	Cali's BRT opened in 2009 (Turner, Kooshian, and Winkelman 2012, p. 12; Dario Hidalgo 2012, Table 4).
Colombia	COL	UM	LAC	Cartagena	2016	2016	2016	
Colombia	COL	UM	LAC	Medellín	2011	2011	2011	
Colombia	COL	UM	LAC	Pereira	2006	2007	2006	Hidalgo (2012, Table 4) lists 2007 at Pereira's BRT adoption date. However, Turner, Kooshian, and Winkelman (2012, p. 15) and Gómez-Lobo (2019, p. 7) and the system's official website (Megabus 2016) list 2006 as the system's opening year. I therefore use 2006 as the adoption date in the analysis.

Ecuador	ECU	UM	LAC	Guayaquil	2006	2006	2006	
Ecuador	ECU	UM	LAC	Quito	1995	1995	1995	
El Salvador	SLV	LM	LAC	Gran San Salvador	2013		2015	Gran San Salvador's first BRT line opened in January 2015 (Nevo, Granada, and Ortiz 2016, p. 9; CICPES 2015).
Guatemala	GTM	UM	LAC	Guatemala	2007	2007	2007	
India	IND	LM	SA	Ahmedabad	2009	2009	2009	
India	IND	LM	SA	Amritsar	2019	2016	2016	Sinha (2019) lists December 2016 as Amritsar's adoption date (Table 1-1, p. 3). Mahi (2019) states that the BRT project was launched in December 2015 and inaugurated in 2019. Teja (2019) states that the BRT system's first phase opened on 15 December 2016, and that the service was re-launched in January 2019. Because two sources list 2016 as the adoption date, and given that Teja (2019) appears to be a more credible source than Mahi (2019), I use 2016 as Amritsar's adoption year.
India	IND	LM	SA	Bhopal	2013		2013	The BRT in Bhopal opened on 27 September 2013 (Manish n.d.; Dave n.d.; Sinha 2019, Table 1-1, p. 3; Chaurasia 2014, p. 55; Srivastava 2016, p.1).
India	IND	LM	SA	Delhi		2008	2008	Delhi's BRT opened in April 2008 (Sinha 2019, Table 1-1, p. 3; Hidalgo 2012, Table 6; Singh 2018; Misra 2016). Demolition of the BRT system began on 19 February 2016 (The Hindu 2016; Misra 2016). See Balachandran (2015) for a simple timeline that led to the BRT's closure.

India	IND	LM	SA	Hubballi - Dharwad				Both Sinha (2019, Table 1-1, p. 3) and HDBRTS (n.d.), the system's official website, date the BRT's opening to October 2018. However, The Hindu (2020) reports that the system was officially inaugurated on 1 February 2020, after a one-year trial period. To err on the side of caution, I use 2020 as the more conservative proxy for the system's adoption date. Since 2020 falls beyond the time period of this study, I exclude the system from the analysis.
India	IND	LM	SA	Indore	2013	2013	2013	
India	IND	LM	SA	Jaipur	2010		2010	Jaipur's BRT opened in July 2010 (ZeeNews 2010; Sinha 2019, Tabke 1-1, p. 3; Hidalgo 2012).
India	IND	LM	SA	Kolkata				The BRT project in Kolkata was approved by the Ministry of Urban Development in March 2010 (Bhatt and Anadkat 2013, p. 74). However, the project consequently got delayed multiple times (Bandyopadhyay 2015). Sinha (2019) reports that the system was still under implementation as of April 2019 (Table 1-1, p. 3). Unfortunately, this claim could not be further verified or cross-referenced. To err on the side of caution, I therefore exclude the Kolkata BRT system from the analysis.
India	IND	LM	SA	Naya Raipur				The BRT project in Naya Raipur was kicked off by Prime Minister Modi on 2 November 2016 (Times of India 2016). Sinha (2019) reports that the system was still under implementation as of April 2019 (Table 1-1, p. 3). Unfortunately, like in the case of Kolkata, this claim could not be further verified or cross-referenced. To err on the side of caution, I therefore exclude the Naya Raipur BRT system from the analysis.
India	IND	LM	SA	Pune - Primpi-Chinchwad	2015	2015	2015	The BRT system connects two cities, Pune and Primpi. In June 2019, all vehicles were granted access to the BRT lanes in Pune (Hindustan Times 2019).

India	IND	LM	SA	Rajkot	2012	2013	2012	Sinha (2019) documents January 2012 as the opening date of Rajkot's BRT (Table 1-1, p. 3). Parmar (2012) and Express News Service (2012) date the system's commencement to 1 October 2012. I therefore use 2012 as the system's adoption date in the analysis.
India	IND	LM	SA	Surat	2014	2014	2014	
India	IND	LM	SA	Vijaywada			2013	Sinha (2019) dates Vijaywada's BRT adoption to 2013 (Table 1-1, p. 3). The Hindu (2012) dates the system's first trial run, with eight buses to service 3.5km, to December 2012. The trial followed significant delays (Times of India 2011). The New Indian Express (2018), in turn, notes that although the original plan foresaw 15.6km of BRT lanes (see also Bhatt and Anadkat 2013, p. 74), the system was never expanded beyond 3.5km. In other words, while the system was adopted, it never reached its envisioned size. Given this conflicting information, I use 2013 as a proxy for the system's adoption year, even though the original plan was never fully implemented.
India	IND	LM	SA	Vishakhapatnam				According to Sinha (2019), the BRT system in Vishakhapatnam was still under implementation as of April 2019 (Table 1-1, p. 3). While Potnuru (2020) notes that 2.5km of the BRT system have supposedly been completed, it is unclear whether the BRT is servicing the stretch. In the same article, Potnuru implies that the system has not yet commenced operations as of January 2020. These claims could unfortunately not be further verified or cross-referenced. To err on the side of caution, I therefore exclude the BRT system in Vishakhapatnam from the analysis.
Indonesia	IDN	LM	EAP	Jakarta	2004	2004	2004	

Iran	IRN	UM	MENA	Isfahan	2013	2012	2011	Phase 1 of Isfahan's first BRT corridor began operating in 2011 (Ghadirifaraz et al. 2016). No other date could be cross-referenced. Given the credibility of the source, which was presented at the 96th Annual Meeting of Transportation Research Board in Washington DC, I use 2011 as the system's adoption year in the analysis.
Iran	IRN	UM	MENA	Tabriz	2009	2009	2009	
Iran	IRN	UM	MENA	Tehran	2008	2007	2008	Hidalgo (2012) dates Teheran's BRT to 2007 (Table 6). However, Parvizi and Mohammadi (2011) note that the system was inaugurated on 14 January 2008 (p. 1887). I therefore use 2008 as the more conservative proxy for Teheran's BRT adoption date in the analysis.
Malaysia	MYS	UM	EAP	Subang Jaya	2015		2015	Malaysia's first BRT system began operations on 2 June 2015 (Ram 2015).
Mexico	MEX	UM	LAC	Acapulco	2016	2016	2016	
Mexico	MEX	UM	LAC	Chihuahua	2013	2013	2013	
Mexico	MEX	UM	LAC	Guadalajara	2009	2009	2009	
Mexico	MEX	UM	LAC	Guadalupe	2005			The system in Guadalupe, a city in the greater metro area of Monterrey, does not appear to be a full BRT (ITDP 2014). Twelve hours of research on the BRT in Monterrey by an undergraduate researcher through CNR's SPUR program in spring 2020 led to the same conclusion. To err on the side of caution, I therefore exclude the Guadalupe system from the analysis. Moreover, the later Ecovia adoption serves as a more conservative proxy for BRT adoption in the Monterrey metro area.
Mexico	MEX	UM	LAC	Juárez	2013	2013	2013	
Mexico	MEX	UM	LAC	León de los Aldama	2003	2003	2003	
Mexico	MEX	UM	LAC	Mexico City - Metrobus	2005	2005	2005	

Mexico	MEX	UM	LAC	Mexico City - Mexibus	2010	2010	2010	
Mexico	MEX	UM	LAC	Monterrey - Ecovia	2014	2014	2014	
Mexico	MEX	UM	LAC	Pachuca	2015	2015	2015	
Mexico	MEX	UM	LAC	Puebla	2013	2013	2013	
Mexico	MEX	UM	LAC	Tijuana		2015	2016	Tijuana's BRT opened in November 2016 (Reilly 2017).
Nigeria	NGA	LM	SSA	Lagos	2008		2008	Lagos' BRT opened in 2008 (Otunola, Kriticos, and Harman 2019, p. 3).
Pakistan	PAK	LM	SA	Islamabad - Rawalpindi	2015	2015	2015	
Pakistan	PAK	LM	SA	Lahore	2013	2013	2013	
Pakistan	PAK	LM	SA	Multan		2017	2017	Multan's BRT began operations in January 2017 (DawnNews 2017).
Peru	PER	UM	LAC	Lima	1972	2010	2010	Lima's Metropolitano BRT system was opened in mid-2010 (Scholl et al. 2018, p. 7; Dario Hidalgo 2012, Table 4).
South Africa	ZAF	UM	SSA	Cape Town	2011	2010	2011	Cape Town opened its BRT in May 2011 (Wood 2015, p. 573).
South Africa	ZAF	UM	SSA	Johannesburg	2009	2009	2009	
South Africa	ZAF	UM	SSA	Pretoria - City of Tshwane	2014	2014	2014	
Thailand	THA	UM	EAP	Bangkok	2010	2010	2010	
Turkey	TUR	UM	ECA	Istanbul	2007	2007	2007	
Venezuela	VEN	UM	LAC	Barquisimeto	2013	2013	2013	
Venezuela	VEN	UM	LAC	Caracas	2012	2012	2012	
Venezuela	VEN	UM	LAC	Merida	2007	2007	2007	

Vietnam	VNM	LM	EAP	Hanoi	2017	2016	2017	Hanoi opened its BRT on 31 December 2016 (Fjellstrom 2017), which could explain the incongruity between the BRTData and ITDP dates. For the analysis I set 2017 as the adoption date, which is the more conservative proxy.
Tanzania	TZA	L	SSA	Dar es Salaam	2016	2016	2016	The Dar es Salaam Bus Rapid Transit (Dart) system began operations on 10 May 2016 (The Citizen 2016).

Note. (a) World Bank (2020); (b) BRT+ Centre of Excellence and EMBARQ (2020); (c) ITDP (2018)

7.2.2. *Federalism*

Table 28: Federalism

Country[a]	Code	Income Group[b]	Federalism	Explanation
Mexico	MEX	UM	1917	While Mexico's 1917 constitution proclaimed Mexico as a federal state, federalism in Mexico was arguably not activated until 2000, when the *Partido Revolucionario Institucional* lost hegemonic power (Wuhs 2013).
Brazil	BRA	UM	1946	While Brazil has repeatedly reformed and amended its constitution, the basic structure of its modern political system can be traced to its 1946 Constitution (Souza 2013).
India	IND	LM	1950	After the federal scheme introduced by the 1935 Government of India Act could not be initiated, India's governmental structure, including its institutional distribution of competencies, was enacted by its 1950 Constitution (Saxena 2013).
Nigeria	NGA	LM	1954	Nigeria first became a "full-fledged federation" in 1954 (Suberu 2013).
Pakistan	PAK	LM	1956	Pakistan's federal system can be traced to its first Constitution, which was finalized in 1956 (Adeney 2007).
Venezuela	VEN	UM	1961	Venezuela's federal system can be dated to its 1961 Constitution, even though it remains contested whether the country has been governed federally under a centralized political system (Guerrero 2013).
Malaysia	MYS	UM	1963	For the analysis, federalism in Malaysia is dated to the formation of the Malayan Federation in 1963 (K. S. and Hui 2003).
Argentina	ARG	UM	1983	Argentina has been a constitutional federal democracy since 1983 (González 2013).
Sudan	SDN	LM	1991	For the analysis, Sudan's federalism is dated to 1991, when "[u]nder the fourth constitutional decree, the political system [of Sudan] is officially transformed into a federal system" (El-Battahani and Gadkarim 2017).
Russia	RUS	UM	1993	The first article of Russia's constitution from 12 December 1993 declares that "[t]he Federation-Russia is a federative rule-of-law state […]" (Sakwa 2013).
Ethiopia	ETH	L	1995	Ethiopia adopted federalism in 1995 (Vaughan 2013).
Bosnia and Herzegovina	BIH	UM	1995	For the analysis, federalism in Bosnia and Herzegovina is dated to Dayton Peace Agreement of 1995 (Keil 2016).
South Africa	ZAF	UM	1996	While South Africa's 1996 Constitution "makes no reference to a federation, and the South African government has assiduously avoided the federalism label" (Steytler 2013p. 442), Steytler, amongst other scholars, have identified South Africa as a federation.

Iraq	IRQ	UM	2005	Federalism in Iraq dates to its 2005 Constitution (Le Billon 2015).
Nepal	NPL	L	2015	After a turbulent political process (Lecours 2014), Nepal became a federation in 2015 (Shah 2019).
China	CHN	UM		Although China evidences some features of federalism, since "federalism has been officially rejected by the People's Government of China (PCR) government" (Henders 2013, p. 372), to err on the side of caution, China is not coded as federal.
Indonesia	IDN	LM		Although founded as a federal state in 1949, Indonesia became a unitary state in 1950 (Kingsbury 2013).
Lebanon	LBN	UM		While Lebanon evidences features of a federation (Kerr and Hamdan 2013), since it is not listed by the Forum of Federations, it is not coded as a federation for the analysis.
Australia	AUS	H		High-income economy and therefore excluded
Austria	AUT	H		High-income economy and therefore excluded
Belgium	BEL	H		High-income economy and therefore excluded
Canada	CAN	H		High-income economy and therefore excluded
Germany	DEU	H		High-income economy and therefore excluded
Spain	ESP	H		High-income economy and therefore excluded
Switzerland	CHE	H		High-income economy and therefore excluded
United Arab Emirates	ARE	H		High-income economy and therefore excluded
United States	USA	H		High-income economy and therefore excluded

Note. (a) Forum of Federations (2020); (b) World Bank (2020)

7.2.3. *International non-profit offices*

Table 29: International non-profit offices

NGO Office	New Name (if applicable)	City	Economy	Opening Year	Source(s)	Additional notes (if necessary)
EMBARQ Brazil	WRI Brasil Ross Center	Porto Alegre	Brazil	2005	WRI Brasil (n.d.) and Duduta et al. (2012, p. 83)	
ITDP Field Office Brazil		Rio de Janeiro	Brazil	2009	E-Mail Inquiry	
WRI Brazil		São Paulo	Brazil	2014	WRI Brasil (2014a, p. 5)	
ITDP Field Office China		Guangzhou	China	2004	ITDP China (n.d.)	
EMBARQ China	WRI China Ross Center	Beijing	China	2008	WRI China (n.d.) and Duduta et al. (2012, p. 83)	
WRI China		Beijing	China	2008	WRI China (n.d.)	
ITDP Field Office China		Beijing	China	2018	ITDP China (n.d.)	
WRI Africa		Addis Ababa	Ethiopia	2018	WRI (2018)	
EMBARQ India	WRI India Ross Center	Mumbai	India	2007	E-Mail Inquiry	
WRI India		Mumbai	India	2007	E-Mail Inquiry	
ITDP Regional Office India		Pune	India	2010	E-Mail Inquiry	
EMBARQ India	WRI India Ross Center	Bengaluru	India	2011	E-Mail Inquiry	
ITDP Field Office India	Urban Works Institute (ITDP network partner)	Chennai	India	2012	E-Mail Inquiry	
ITDP Regional Office India		Ranchi	India	2013	E-Mail Inquiry	
EMBARQ India	WRI India Ross Center	Delhi	India	Unclear	E-Mail Inquiry	The Delhi office was opened after the Mumbai office. I therefore use the opening year of the Mumbai office in the country-level analysis.

ITDP Field Office Indonesia		Jakarta	Indonesia	2004	E-Mail Inquiry	
WRI Indonesia		Jakarta	Indonesia	2014	WRI Indonesia (n.d.)	
ITDP Field Office Africa		Nairobi	Kenya	2017	ITDP (n.d.)	ITDP's website lists two opening dates for its office in Nairobi: 2016 and 2017. To err on the side of caution, I use 2017 as the more conservative proxy in the analysis.
EMBARQ Mexico	WRI Mexico Ross Center	Mexico City	Mexico	2002	EMBARQ Mexico (n.d.) and WRI (2002)	
ITDP Field Office Mexico		Mexico City	Mexico	2006	E-Mail Inquiry	
WRI Mexico		Mexico City	Mexico	2016	WRI Mexico (n.d.)	
WRI Europe		The Hague	Netherlands	NA	NA	High-income economy and therefore excluded
EMBARQ Andino		Arequipa	Peru	2008	EMBARQ Andino (n.d.), Duduta et al. (2012, p. 83), and E-Mail Inquiry	The office closed in 2014.
EMBARQ Turkey	WRI Turkey Ross Center	Istanbul	Turkey	2005	WRI Turkey (n.d.)	
WRI London		London	United Kingdom	NA	NA	High-income economy and therefore excluded
EMBARQ	WRI Ross Center	Washington, DC	United States	NA	NA	High-income economy and therefore excluded
ITDP Field Office United States		New York	United States	NA	NA	High-income economy and therefore excluded
ITDP Field Office Washington, DC		Washington, DC	United States	NA	NA	High-income economy and therefore excluded
ITDP Global HQ		New York	United States	NA	NA	High-income economy and therefore excluded
WRI Global HQ		Washington, DC	United States	NA	NA	High-income economy and therefore excluded

Note. Opening years of ENGO offices.