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OF LAND POLICY

Distributive Impacts and Support for Mass Transportation Projects: An Experimental Evaluation in Bogotá, Colombia

Working Paper WP18AH1

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December 2018

Abstract

Who supports mass infrastructure projects? Mass transportation infrastructure, such as metros and highways, is hugely expensive. But it also can deliver widespread benefits to users and windfall gains to nearby property owners and developers. This paper examines whether the uneven spatial incidence constrains infrastructure development in democracies using a new survey technique called Quadratic Voting. Surprisingly, I find little evidence that personal costs and benefits shape support for mass infrastructure. Proximity and public transit use do not predict support, and a survey experiment shows that different financing options have little impact on popular support. Rather, beliefs about whether mass infrastructure delivers benefits to the whole city, such as reducing traffic and improving pollution, are the primary determinants of support. The implications are that politicians and urban planners can build support for transportation projects by stressing shared benefits for the city and educating voters about alternative ways to finance transit infrastructure like value capture.

Keywords: Latin America and the Caribbean, transportation, infrastructure, public finance, value capture, property taxation

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Acknowledgements

The author acknowledges the generous financial support from the Lincoln Institute of Land Policy and Princeton University. Holland thanks Alvaro Pretel for his introduction to the Corredor Verde Project in Cali, Doug von Kohorn for assistance in programming the survey instrument, and Natalia Duarte for translation assistance. Matthew Amengual, Sean Ingham, Lindsay Mayka, Enrique Silva, Silvia Schor, Glen Weyl, and participants in the 2016 Latin American Studies Association Meeting, the American Political Science Association, and the Lincoln Institute of Land Policy Latin America and Caribbean Program conference provided valuable comments on previous versions of the paper. The project received ethics approvals from Harvard's IRB (#15-3150) and the design was pre-registered with EGAP before any data analysis began.

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Introduction

In much of the world, transportation infrastructure is sorely underprovided. Latin America, in particular, is a laggard in infrastructure provision. Many of the roads and railways were laid a century ago. The region would need to quadruple its investments in coming decades to close the infrastructure gap with economic competitors in East Asia (Perrotti and Sánchez 2011). Shortcomings in infrastructure provision, and especially urban transit projects, have deep implication for quality of life and social equality. While the average resident of Seoul, South Korea spends less than 45 minutes commuting each day, the average resident of Bogotá, Colombia spends more than two hours (Moovit 2014).[1] The poorest residents of Latin America's cities often travel several hours to get to work, wasting time and sacrificing many of the productivity gains that come with urbanization.

Who supports mass infrastructure projects? Do citizens want more mass transit projects and governments fail to deliver? Or has democracy aligned government and citizen priorities toward redistributive social expenditures rather than infrastructure investments? This paper uses a new approach to survey research called Quadratic Voting to understand who supports mass transit infrastructure, and how financing tools can alter the distribution of support.

Understanding the dynamics of infrastructure support requires dissecting how ordinary people think about project benefits, and especially how material interests, beliefs, and ideology shape attitudes. On the one hand, mass transit projects may present political challenges due to the uneven benefits across space. Only a subset of citizens lives near and thus can access transportation projects. Perhaps even more importantly, some of the biggest gains accrue to property owners who can see land prices skyrocket following major infrastructure investments. Others see concentrated harms, especially in case of residential displacement. Voters thus may determine their support for mass infrastructure depending on their *material interests* in a given project. If this theory holds, then governments can change popular support through their decisions about how to finance mass infrastructure projects, such as decisions about using debt, property taxes, or value capture mechanisms to make investments.

On the other hand, many mass transit projects produce diffuse and long-term benefits. Citizens may differ most in their *beliefs* about the effects of infrastructure on urban life. These may include beliefs about how investments will affect traffic, pollution, or economic activity. They also include ideological beliefs on the appropriate role of government or trust in elected officials in charge of overseeing expensive construction projects. If ideological beliefs drive popular support, then government choices about how to finance mass infrastructure projects should have

[1] "Seoulites commute to work for average 40 minutes," *National* 18 May 2011; Moovit, "The State of Public Transit Around the World," 2014.

a muted impact on project support. Instead, politicians primarily can alter popular support by convincing voters that projects will have shared benefits for the city.

This paper explores the role of material interests and social beliefs in shaping popular attitudes towards mass transit. To do so, I implemented an original public opinion survey with an embedded survey experiment in Bogotá, Colombia. Bogotá constitutes a useful case because the city has existing plans for a metro system but has not decided how to fund it. Colombia also is one of the few developing countries with extensive experience with both decentralized property tax collection and value-capture instruments to fund public works. This survey offers the first rigorous evaluation of how distributive benefits shape infrastructure support by sampling areas at varying distances from a proposed metro project. Additionally, I included an experiment within the survey to test how different financing options—namely, property taxation, value capture mechanisms, and pork spending—alter support.

Surprisingly, I find little evidence for the role of direct distributive interests in shaping support for infrastructure spending. Distance from a project, property ownership, and commuting patterns are all weak predictors of support for the metro. Instead, beliefs about the benefits produced by infrastructure projects (i.e. reducing traffic and pollution), support for the mayor, and to a lesser extent, the role of government are the main drivers of project support. Experimental treatments did little to affect project support. The only exception comes in property taxation, which substantially reduces support among property owners. The implication is that politicians may have leeway in choosing how to finance mass transit projects, if they can convince their voters that investments can deliver broad social benefits for the city. Politicians also need to do much more to communicate how alternative financing schemes like value capture work, particularly to those groups that do not pay them.

This study enriches studies of distributive politics by incorporating the specific characteristics of mass transit infrastructure and explicitly considering how distance from a project and property ownership affect support. It also makes a methodological contribution. Most public opinion surveys rely on some version of the Likert scale to gauge public opinion, despite many known problems with the survey methodology. Survey respondents answer a battery of questions with only limited incentives to consider the trade-offs across issue areas, and without clear ways to signal the issues that they care and know about. This paper relies on a new approach to the measurement of preferences that makes talk "less cheap" called quadratic voting (QV) (Lalley and Weyl 2016). This method is ideal to uncover the relative importance of an issue, and to measure how the intensity of preferences is affected by a change in parameters.

The next section discusses the distributive politics surrounding mass transportation projects. It emphasizes the long-standing debate over the role of property owners in funding public investments, and especially nearby property owners. The second section then introduces the case of the metro in Bogotá, Colombia. Third, I describe the way that I measure the intensity of citizen preferences and describe my survey and experiment. The fourth section presents the results and the fifth concludes.

The Distributive Politics of Mass Transportation

Much of the debate on infrastructure provision among political scientists has focused on whether the level of investment reflects majority preferences. Yet, most research fails to separate between consumer-facing infrastructure projects, such as subways and rapid-bus transit, and business-facing projects, such as ports or inter-city highways. It also fails to consider the spatial dynamics around mass transit in which urban residents near proposed routes, and especially property owners, have reasons to support infrastructure investments much more than those distant from investments and renters. In this section, I review the debate over support for mass transportation projects and generate hypotheses to distinguish between sources of support for mass transit. I also consider how governments can alter the distribution of popular support through their choices of how to fund infrastructure investments.

Support for Mass Transportation

What determines support for mass infrastructure? Existing scholarship is divided on this question. On one side are interest-based theories. The intuition is that individuals support infrastructure spending based on the direct benefits they receive from projects. The distributive politics literature generally conceives of these benefits at the district level. For instance, scholars—largely focused on the American case—emphasize that transportation policy is a distributive issue in which funds are allocated to specific districts to allow for credit claiming in Congress (Dilger 1998; Ferejohn 1974; Hauk 2007). Because legislators are elected from specific geographic constituencies, they are concerned about the incidence of policies on their district.

There also can be substantial differences in material interests within electoral districts. Road, subway, and highway projects involve a wide but rigid spatial extent. The geographic scope of benefits is often far broader than in other distributive projects (e.g. "point" projects like a power plant or a school) or through social welfare programs that circumscribe a class of individual beneficiaries (e.g. the unemployed or the poor). As Ferejohn (1974: 18) recognizes, "Among the greatest challenges is establishing the spatial scope of the effects of infrastructure projects: the construction of any project delivers benefits to some groups and imposes costs on others, sometimes even involving individuals in the same geographic area."

An interest-based theory of support for mass transit infrastructure predicts that support should come from two main groups: those who will benefit directly from using the project and those who benefit indirectly from increased property values. The first part is intuitive: the ability to use mass transit is a major part of the appeal. Intuitively, studies find that most of the changes in commuting patterns are concentrated in the areas surrounding mass transit projects (Baum-Snow and Kahn 2000). The strongest supporters should be those individuals who live near mass transit projects. Transportation use also varies with class. In the United States, low-income people use public transit disproportionately (Glaeser, Kahn, and Rappaport 2008; Taylor and Garrett 1999). Likewise, in developing countries, low-income groups are the main transit users. The middle class is more likely to own cars and growing fractions live in gated communities in surrounding suburbs (Caldeira 2000). If material interest theories hold, then low-income groups and those

who use public transit should be the strongest supporters, while the middle class and those who drive cars prioritize highway projects.

Second, nearby property owners form an overlooked group of beneficiaries from mass transit investments. Properties immediately adjacent to transit lines may be at risk of eviction or see decreases in property values due to negative externalities like construction, noise, crime, and homelessness around transit stations. But most studies find a large positive effect of transportation lines on commercial and residential property values in proximate areas, sometimes inducing land speculation even before projects are complete. Property value increases around a new Beijing subway line totaled $5.8 billion, or more than double the construction costs (Li et al. 2014). The extension of the Jubilee Line of the London Underground increased land values by $3.9 billion in nearby areas (Harrison 2006: 15). Transit infrastructure can produce an enormous transfer from taxpayers at large to a small number of property owners. Owners and renters therefore should have different preferences: new infrastructure can gentrify neighborhoods and raise property prices, benefitting owners, but it often pushes out renters unable to afford newly connected properties. Together, I expect:

H1a. Individuals living near public transit projects, and especially those who own property, are more supportive of expenditures than those who live far from projects and rent property.

H1b. Distance and property ownership should not affect support for national highway projects. Upper-income groups and car owners should be more supportive of highways than metros.

The possibility that motivations unrelated to current benefit expectations influence infrastructure preferences has received little attention in work on transportation. But the general idea that instrumental or sociotropic motivations matter has been at the heart of work on political behavior. For instance, fear of crime can lead the rich to support redistribution in high inequality settings (e.g., Rueda and Stegmueller 2016), and altruistic motivations are used to explain the rich's support for poverty relief (e.g., Dimick, Rueda, and Stegmueller 2016; Fowler and Kam 2007; Rueda and Pontusson 2010).

How does such an argument play out in the case of mass transit? One possibility is that individuals care about the long-run social implications of transportation investments. Kitschelt and Hellemans (1990) developed the concept of post-materialism to distinguish whether European voters cared about "materialist" issues, such as redistribution and inflation, or "post-materialist" issues, such as participation, the environment, and social values. The middle class has the luxury to focus on "quality of life" concerns, such as traffic, cleanliness, and air pollution. They also may care about the city's "brand" and "modern" infrastructure to encourage investment (Pasotti 2009). The poor, in contrast, are thought to be concerned about immediate consumption and focus on short-term material motivations, like schools, health care, and poverty relief. The key empirical prediction, in contrast to material interest theories, is that the middle class—and nontransit users more broadly—is more supportive of public transit investments than the poor.

Similar class predictions can arise from purely externality-based motivations about traffic and pollution. Politicians often support mass transit, especially metros, in the hopes of reducing road

congestion. One cross-national survey suggested that 41 percent of commuters believe that public transit reduces traffic.[2] Manville and Cummins (2015) find that support for public transit on referenda is high and growing in the United States, despite the fact that actual ridership is falling. They interpret this because voters want others to use public transit to reduce traffic but will not do so themselves. An externality-based rationale for transit support may be even stronger in developing countries due to the lack of regulation, both of weak emission standards for cars and trucks and informal bus providers (World Bank 2014). The case for highway construction in reducing traffic and pollution, in contrast, is less clear, at least among experts. A well-known paradox exists where highway construction actually increases traffic due to increases in driving by current residents and commercial traffic (Duranton and Turner 2011). The empirical implication is that individuals who are more concerned about traffic and pollution should be more supportive of public transit investments, but not highway construction.

H2a. Individuals who perceive social benefits from infrastructure investments, such as reduced pollution and traffic, will be most likely to support public investments.

H2b. Upper-income respondents, and especially those who care about the environment, should be more supportive of public transit.

Lastly, recent work has suggested that a major constraint on infrastructure spending is trust in government. Mass transportation projects tend to be enormously expensive "megaprojects" (Altshuler and Luberoff 2003). Looking at the United States, Jacobs and Matthews (2015) find that individuals with anti-government attitudes support less spending on highway infrastructure. Indeed, a classic idea in American politics is that conservative individuals "oppose [transportation] expenditures not on the merits of the service but on the demerits of the tax system" (Galbraith 1960: 195). Of course, things could cut the other way. Many Americans are hostile toward "government" in general but support specific government programs. As Kenworthy (2013: 151-53) puts it, people are "ideologically conservative but programmatically liberal" in that they like what government does and dislike the idea of government. In developing countries, concerns over corruption may be especially salient, and lead citizens to turn against even useful, personally beneficial infrastructure projects. If distrust of government and corruption shapes infrastructure support, then I expect:

H3. Individuals who voted against the current administration, support a smaller government, and expect substantial corruption in infrastructure projects will be less supportive.

Financial Instruments and Mass Transportation Support

How to fund infrastructure projects is a serious challenge, especially in low- and middle-income countries with limited capacity to borrow. As with most distributive goods, the assumption is that mass transit projects are funded through general tax revenues spread across the population, even though particular geographic areas enjoy concentrated benefits. But governments also can alter the distributive incidence of transit infrastructure through their choice of financing

[2] IBM Commuter Pain Survey, 2011, http://www-03.ibm.com/press/us/en/pressrelease/35359.wss.

instruments. If material interest theories prevail, then different financing schemes should have strong impacts on popular support.

It may seem like the most logical way to fund mass transit expenditures is through user fees. This always is part of the equation, but rarely makes much of a contribution to the capital costs of projects. For one, the marginal cost (i.e. fares and tolls) is far below the average cost (i.e. the fixed costs of building the infrastructure) for most transportation projects. These problems are exacerbated in developing countries where governments often regulate transit to keep bus, subway, and road fees down to prevent unrest (Gómez-Ibáñez 2009). Hotelling (1938: 248) most famously argued against the idea that public infrastructure investments should only be built when firms can recoup their fixed costs through user fees. As he explained, "Public works will frequently be of great social value even though there is no possible system of charging for their services that will meet the cost." When the social value of infrastructure surpasses the fixed cost of investment, government intervention to share the costs is warranted.

Once governments fund transit projects, they tend to rely on general taxes. But tax hikes can generate substantial backlash when transit projects deliver concentrated benefits to some geographic areas, but not others. Some governments therefore have institutions or informal rules intended to promote logrolling. The basic idea is that politicians compensate losing areas through other means, namely local public goods or "pork." Take the example of the Big Dig. Massachusetts taxpayers outside of Boston received a reprieve in highway tolls to balance out the concentrated benefits of the enormous urban infrastructure expense (Altshuler and Luberoff 2003). City governments likewise can compensate neighborhoods left out of transit infrastructure with additional investments in other goods, such as schools, hospitals, or parks.

A second way to distribute the uneven costs of infrastructure development is to raise property taxes. This solution asks those who benefit to pay more for infrastructure, given that these gains will be reflected in their property prices. In other words, if property assessments are conducted regularly, increases in market values resulting from government actions will show up in higher tax bills and these tax increases should be larger in places that benefit more from government interventions. The problem is that property taxes fall on buildings, not just the land, and therefore can deter homeowners and developers from making real estate improvements. In practical terms, many developing countries also collect little in property taxes or infrequently update their property assessments, thereby losing much of the potential revenue.

Third, an innovative way to fund infrastructure is based on the idea of capturing the value generated by public investments, or value-capture. In his seminal work, Henry George (1884) developed the idea of the "unearned increment" of land values. Take the example of a government that builds a road. If the road increases the value of an individual's land, the owner should compensate the government for some fraction of the increased value. Their actions played no part in changing the property value. Likewise, if the road is built distant from a second person's land, then that person pays nothing (or much less) for the project. Stiglitz (1977) formalized the "Henry George theorem" showing that beneficial investments in public goods will increase aggregate land rents by at least as much as the investment costs. Capturing land value increases therefore is efficient and necessary to finance productive public

investments.[3] Vickrey (1999) expanded on the point in the context of the mass transport systems of London and New York. He stressed that it is in the economic interests of landowners to pay the government a percentage of land value increases because otherwise infrastructure projects never get built, leaving both property owners and city residents worse off.

Several features are important to stress about value capture mechanisms. The first is that value capture is not a tax. The government produces the increase in land values, and therefore landowners simply repay the government for the public work and associated benefits. Sometimes these payments are called "special assessments," "betterment contributions," or "valorization" (in Spanish, *valorización*). Unlike taxes, these payments are charged on a one-time basis (or for a fixed period). Although technically not a tax, ordinary citizens often see value capture as another form of taxation, as I show below.

The second feature is that value capture applies to change in land values, not property values. For this reason, value capture mechanisms gain widespread support among economists because they do not distort decision-making like property taxes. They also have the potential to reduce rent-seeking speculation by allowing the government to capture the expected land value increases near public investments (for a review, see Dye and England 2010: ch. 2; Tideman et al. 2002). In practice, calculating the precise increase in land prices attributed to a public work is tricky. The lack of transparency in land value assessments, especially given that they are not linked to market sales data, can create a perception that they are arbitrary collections. Some governments declare entire zones beneficiaries of a project without accounting for heterogeneity in the impacts on land values, and even potential losses in value. Some governments get around these assessment issues by recovering the value of projects by selling or leasing land surrounding projects directly. I focus here on valorization paid by landowners.[4]

Third, value capture tools are designed to pay for a specific public works project. The government cannot use the funds for other purposes or collect more than the project is worth. When citizens contribute to the project varies by country. In most countries, charges are imposed on select landowners after the public work is complete, and usually run between 30 and 60 percent of the calculated increase in land values. In other countries, including Colombia, contributions are assessed prior to project construction based on features like distance and property type that are thought to correlate with land value changes. The government must return the collected funds if a project is not completed in a given time frame.

If material interests are the main drivers of infrastructure support, then each financing scheme should affect both the level and distribution of support for mass transit investments. Compared to general financing, logrolling should raise support for infrastructure expenditures in unaffected

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[3] In a similar spirit, Bergstrom (1979) shows that Lindahl taxes can result in an efficient level of public goods under majority rule. Pigou also made arguments for taxing windfall profits through a similar logic that accretions to an individual's property were unforeseen; however, unlike in the case of value capture, these could not be attributed to government actions (for a broader discussion of luck and taxation, see Scheve and Stasavage 2016: ch. 2).

[4] For additional discussion of these varying instruments, see Harrison 2006; Mathur 2014; Peterson 2009; Smolka 2012, 2013; Suzuki, Murakami, and Hong 2015.

areas. Second, property taxes should be associated with greater support from renters throughout the city and less support from property owners. Finally, my main interest is in the effects of value-capture mechanisms. Given that value capture is not framed as a tax and does not involve recurring payments, it should be associated with higher levels of popular support, especially compared to property taxes. It also should create a more even distribution of support, raising the support of unaffected areas and reducing the support of affected areas (especially among affected property owners). Thus, I expect:

H4: Value-capture mechanisms increase overall support for mass transit investments and reduce the variance in support between affected and unaffected zones.

Mass Transportation Infrastructure in Bogotá, Colombia

To explore the theoretical claims explained above, I focus on the case of a typical capital city in a middle-income country: Bogotá, Colombia. Bogotá is Colombia's capital and home to eight million people. Like many cities in Latin America, Bogotá has debated the construction of a metro for well over a decade (and some would say, since 1964).[5] But plans for the metro have been shelved multiple times. Traffic is among the worst in Latin America, and the commuting burden falls heavily on the poor who tend to live farther from the wealthier city center. Here I discuss how disagreement over the best form of mass transit and how to pay for it has undermined Bogotá's metro.

The "failure" to build a metro is praised by many observers as wise investment in a cheaper, more flexible alternative: bus-rapid transit (BRT) (e.g., Hidalgo et al. 2013). Bogotá introduced a BRT system called the Transmilenio with dedicated lanes and station-style stops in 2000. Then-mayor Enrique Peñalosa believed that Transmilenio had the capacity to serve the city's transportation needs at lower cost than a metro line.

At first, Transmilenio was hugely popular, but continued traffic jams and overcrowded buses revived debates over the metro. In 2007, Samuel Moreno beat Peñalosa in the mayoral election by promising to build a metro. Peñalosa again pointed out that Transmilenio was better value for money. Peñalosa's loss was widely attributed to his resistance to the metro. Even with Moreno's election, however, the city failed to begin a metro project or even to keep up with BRT line expansions. A scandal in which Moreno was found to have demanded kickbacks for public works related to Transmilenio further scarred the system's image and landed Moreno in jail.

The 2011 election once again centered on the metro and, in the wake of scandal, transparency. Gustavo Petro, an ally-turned-critic of Moreno, defeated Peñalosa. Petro once again promised to build a metro, while Peñalosa vacillated and focused on BRT improvements. Once in office, Petro commissioned a study of the metro, funded by the World Bank and Inter-American Development Bank. The proposed project involved a (mostly underground) system stretching 18-miles with 27 stops. President Juan Manuel Santos presented a symbolic check for $20

[5] "Llevamos 60 años haciendo estudios para el metro de Bogotá', dice Samuel Moreno," *El Tiempo* 24 June 2010.

billion, expressing the national government's commitment to the project. Mayors in Colombia cannot run for reelection, so Petro left office with the project plans in place and a national promise to co-finance the project.

Realizing his political error in opposing the metro, Peñalosa switched course and said he would build a metro in the 2015 mayoral campaign. He finally won. The City Council approved Peñalosa's development plan in June 2016. The document authorized the creation of a new agency to manage the metro, Empresa Metro. But uncertainty loomed over the metro project in part due to its financing and its relationship with the BRT system. The survey for this paper occurred in August 2016, when it still looked like Petro's proposed metro might be built and Peñalosa had not offered an alternative route for the metro.

Peñalosa opposed an underground metro due to the enormous expense. The proposed underground metro would be enormously expensive. At $7.5 billion or roughly $400 million per mile, it cost ten times more than a BRT line. According to the Petro administration, the benefits from the project in terms of times saved, air quality, and investments would be five times the cost.[6] Contrast this with the budget of social programs, such as Colombia's conditional cash transfer program Familias en Acción, which has a budget of just $583 million per year. Peñalosa repeatedly stressed that the money saved could be used to build numerous bus lines, health clinics, and schools. In Peñalosa's view, the middle class and rich merely wanted an underground metro to "avoid seeing the poor."[7]

Peñalosa also has a personal dislike for Petro that tainted the metro debate. For instance, Peñalosa made outrageous claims discrediting the studies commissioned—completed with international financing for $44 million—as something "done by a bureaucrat at the [planning institute] IDU as he brushed his teeth."[8] The thinking was that Peñalosa wanted to dedicate the metro money to expand the system that he started, Transmilenio, or at most, build a cheaper above-ground light rail system.

Fears about the costs of a metro are rooted in the history of Colombia's second-largest city, Medellín. Poor and hurried management of the contracting process made the Medellín metro the most expensive in the world on a per kilometer basis, and the most expensive public work in Colombian history. Although the initial project was estimated to cost the national government $656 million, the project ended up costing $1.9 billion, and accounting for 10 percent of Colombia's entire external debt (Alvear Sanin 2001).

The national government financed the lion's share of the Medellín metro, but the city was expected to contribute to the debt servicing and operating costs. The initial proposal to cover

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[6] Author interview with Sandra Gracio, IDU, January 7, 2015. The DNP disputed the methodology used.
[7] Los ricos quieren metros subterráneos para no ver a los pobres," Al Garete, 12 Jul 2016, http://app.idu.gov.co/seccion_metro_ASP/IntenasMain/Uandes.asp; https://www.youtube.com/watch?time_continue=2&v=qCZy-7zgaDM
[8] "Metro de Bogotá será casi todo elevado," *El Tiempo* 16 Dec 2015; "Bogotá perderá más de 130.000 millones de pesos si se desechan estudios del Metro: Distrito," *El Espectador,* 11 Nov 2015.

these costs included an important value-capture component.[9] Property owners whose land would rise in value due to the proximity to the metro line would pay a special assessment for the cost of the metro (Aristizabal 1994). The national government pushed heavily for the use of valorization to finance the metro, especially under President Virgilio Barco (1986-90). Barco's Minister of Public Works underscored the equity case for value capture in a speech in 1988:

> "The nation is not an abstraction; the nation is all of us and the funds come out of all of our pockets. Then the question is whether the totality of Colombian taxpayers should pay for a system that they will not benefit from, to resolve the problem of the most prosperous, richest city, where there is the highest economic level, and the most capacity to pay, so it doesn't seem like this proposal [of the central government funding the metro] is fair… The metro will bring an important change in the use of land with an increase of value, especially important in the area around the station, such that this increase in value generated will need to be captured in considerable part by the district government, to pay for the metro."[10]

Electoral politics killed the implementation of value capture. Medellín had proposed a highly progressive scheme of contributions. While 75 percent of property owners would pay less than $75 in contributions each year, the rest would pay heft sums over a ten-year period (with the highest contributions from developers totaling about $375,000 each year in those areas where land values increased the most). Project delays pushed back discussion of the value recovery. But in the week before the 1994 election, presidential candidate Ernesto Samper came to Medellín and promised to reduce valorization by fifty percent.[11] The city mayor reversed course under political pressure and said that the revenue would be found through other sources. "Instead the landowners captured huge increases in land value from the metro project," explained one bureaucrat who worked for the city government at the time.[12]

The central government tried to establish a standard formula to limit its financial commitments following the debacle of Medellín's metro. No more than 70 percent of project costs would come from national coffers. In the case of Bogotá's metro, even this threshold came up for debate given the high project costs and doubts about whether Bogotá could secure the rest of the funding to cover its share (plus near inevitable cost overruns).

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[9] Colombia is one of the few countries with extensive legislation and experience with value-capture tools to finance public projects (Smolka 2013: 47-52).
https://www.medellin.gov.co/irj/portal/ciudadanos?NavigationTarget=navurl://b1eee4b11fdaccc8b2d2ae8d523d3874.

[10] "Palabras del Señor Ministro de Obras Públicas y Transporte, Doctor Luis Fernando Jaramillo Correa, en el Centro de Convenciones de la Cámara de Comercio de Bogotá," 7 Oct 1988, Cámara de Comercio de Bogotá.

[11] "Inval definió tablas para cobro de la valorización del metro," *El Tiempo* 25 May 1995. http://www.eltiempo.com/archivo/documento/MAM-333183

[12] Author interview with Juan Guillermo Gómez Roldán, Fondoval, Medellín, Colombia, January 14, 2016.

The Bogotá city government has debated a combination of public debt, value capture, and property taxes to finance the metro.[13] The Petro administration commissioned relatively detailed studies on the potential revenue generated through land price changes around a metro project. Conservative estimates suggest that the metro would generate $683 million in additional land value near surrounding stations, which means that value capture could generate about half of the city's contribution to the metro.[14] But the change in political administration put property tax increases, rather than value capture, on the agenda. Peñalosa at times has opposed Bogotá's system of value capture and plus-value charges due to the high administrative costs. As he tweeted to his followers prior to taking office: "A higher property tax instead of betterment fees would be better, so that they don't spend all that is generated in bureaucracy and political tricks (*politiquería*) instead of public works."[15] Peñalosa wanted to reform the property tax system to fund infrastructure development.[16]

In short, Bogotá has made a concrete proposal to build a metro to serve its public transit needs. Ideas about how to fund the metro range from using public debt (from the national government and city utilities) to capturing land value increases near the metro or increasing property taxes. I now explain how I measure the effects of these proposals on public preferences.

Measuring Preference Intensity

Understanding the determinants of public support requires a way to gauge how much respondents care about an issue. But standard public opinion surveys tend to measure the direction of public sentiment, usually using a standard Likert scale that asks respondents to place their attitudes on a scale that runs from "strongly disagree" to "strongly agree." But there are several known problems with this approach.

First, researchers often hope to interpret "strong" responses at the extremes of the scale as indicating intense support or opposition. But survey answers tend to mix the "response style" of an individual with the actual intensity of his preferences (Greenleaf 1992). Some respondents always answer at the extremes of a Likert scale. More generally, talk is cheap on standard surveys so there is no cost to a respondent giving extreme answers, even on issues that he cares little about. Accordingly, survey data produced using a Likert scale often has a bimodal

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[13] "Mi afán es evitar riesgo que el metro no se haga," *El Tiempo* 1 June 2015. Around half of the funding will come from the public utility company's reserves and a commitment to put the next 22 years of profits of the company towards the project. Gasoline taxes also will provide some revenue for the project.
[14] Universidad Nacional de Colombia y la Universidad de los Andes. 2015. "Propuesta de Gestión del Suelo y Diseño Urbano en el Área de Influencia de la Primera Línea del Metro de Bogotá," available at http://app.idu.gov.co/seccion_metro_ASP/IntenasMain/GestionValor.asp.
[15] Twitter message from Enrique Peñalosa, 13 April 2013.
[16] "Las nuevas tarifas de predial que propone la administración," *El Tiempo* 11 Jul 2016. In Bogotá, property taxes historically have been calculated based on "stratifications" (strata) produced by statistical agencies at the block level. The strata system does not allow for heterogeneity within neighborhoods, and therefore can lead to situations where the tax burden is unequally distributed across households with very different income levels. Peñalosa proposed an alternative based on the commercial value of property.

response distribution, with clusters of responses at the extremes. Researchers have no way to know whether such polarization reflects the strength of underlying beliefs or quirks of the survey method.

A second problem arises with respondents with nonexistent or weak preferences. Surveys vary widely in regarding a non-committal option, such as a "neither-not" response category, is available. These response categories are often preferred by at least a quarter of respondents, but they are hard to interpret: do people reject the options? Or do they not care about an issue? Or do they care but have inadequate information? Similar problems arise with nonresponses. Researchers drop them from the analysis or impute them based on the answers to other questions (Honaker, King, and Blackwell 2011). But there are many scenarios where knowing whether people are neutral on an issue, uninformed, uninterested, or simply tired of taking a long survey leads to very different conclusions about politics.

This paper relies on a new approach to the measurement of preferences called quadratic voting (QV) (Lalley and Weyl 2016). The QV method captures how much respondents care about a given set of issues, the choice set hereafter, by asking them to "buy" votes in favor or against each issue. Respondents have a fixed budget to allocate across different issues, which means that expressing an extreme attitude has a cost. The price for each vote is quadratic so it becomes increasingly costly to acquire additional votes to express support or opposition to the same issue. As shown formally by Lalley and Weyl (2016), the quadratic price incents individuals to more accurately report not only the direction of their preferences (in favor or against), but also the intensity of their preferences with regards to a given issue (relative to other issues in the choice set). The survey respondents who values one issue twice as much is faced with having to pay twice as much to incrementally move the polls in his favor. To make this clear, Table 1 shows the costs of voting under QV, displaying both the total and marginal costs. The marginal cost—the additional amount that a voter must pay to cast an additional vote—is always (within 1 credit) proportionate to the number of votes purchased. So, it costs twice as much at the margin to cast 4 votes than to cast 2 votes (7 rather than 3 credits); twice as much to cast 8 votes than to cast 4 votes (15 rather than 7 credits); and so on.

Table 1: Total and Marginal Cost of Voting Under QV

Number of Votes	Total Cost	Marginal Costs
1	1	1
2	4	3
3	9	5
4	16	7
5	25	9

Source: Posner and Weyl (2015).

QV was designed as a means of arriving at efficient social decisions. This paper is not dedicated to studying the social choice problem of whether the metro should be built, but rather using the method to understand the intensity of individual support and how it responds to financing tools. Preliminary empirical results from the United States show that QV can be a promising alternative to Likert in survey research. QV achieves a much more normal distribution of responses and that it has greater power to predict actual behavior compared to traditional Likert scales (Quarfoot et

al. 2015). But there are several challenges of applying QV to survey research: it is not always clear how to define the choice set of issues to include. Additionally, as a social choice tool, respondents allocate votes based on whether they will be pivotal in changing the voting outcome. Surveys, in contrast, are merely expressive and respondents are unlikely to calculate their influence on a decision.

To define the choice set, I designed a module in which respondents evaluate a set of issues drawn from Colombia's National Development Plan. The left column of Table 2 lists the ten national policy issues that respondents evaluated. Colombia is relatively unique in that national development plans are binding documents that set out each presidential administration's agenda and therefore serves as a reasonable benchmark for the types of issues on the agenda. For instance, Colombia is making one of the largest investments in highway infrastructure in its history currently, known as the 4G (4th generation) highway projects. The national government also signed a historic peace accord to end a five-decade-long civil war, which was about to be subjected to a popular vote (by which it was narrowly rejected) when the survey was fielded.

Given the novelty of the QV method, I split the sample in half, asking half of the survey respondents to allocate 100 credits toward votes in favor and against the ten national propositions. The other half evaluated the same propositions on a standard 7-point Likert scale, expressing their support or opposition for each question. I therefore evaluate the results using both QV and Likert. The Appendix provides a screenshot of what the QV module looks like to survey respondents.

My second group of hypotheses suggests that support for the metro depends on the distribution of project costs. To test these hypotheses, I include an embedded survey experiment. QV is ideally suited to measure how an experimental treatment affects public attitudes because it captures the intensity of preferences, and not just their direction. After completing the round of QV about national issues, respondents heard one of four possible vignettes about the metro project in Bogotá:

> **Control (General revenue).** As you may have heard, the city has completed studies to build a metro in Bogotá. The project will be financed through the city's general revenue and national funds.
>
> **T1 (Value capture).** As you may have heard, the city has completed studies to build a metro in Bogotá. The project will be financed through the city's general revenue, national funds, **and valorization (*valorización*) in which those who live nearby will contribute more to the project than those who live far away**.
>
> **T2 (Property tax).** As you may have heard, the city has completed studies to build a metro in Bogotá. The project will be financed through the city's general revenue, national funds, **and a property tax in which property owners pay based on the commercial value of their property.**
>
> **T3 (Log rolling):** As you may have heard, the city has completed studies to build a metro in Bogotá. The project will be financed through the city's general revenue and national

funds, **and investments will be made in roads and parks in neighborhoods that have less access to the metro line.**

After hearing the vignette, respondents then did a second module of QV about city issues, shown in the right column of Table 2. The main dependent variable is the number of votes that the respondent put on the metro project (relative to other city priorities). The survey also included items to be used as covariates in my analysis, including a module on beliefs about the project (whether the metro will shorten their commute, reduce traffic, etc.), taxation and property ownership (what taxes they pay, whether they own their house or apartment, etc.), political ideology (past vote behavior, ideas about the role of government, etc.) and demographics (income, age, gender, etc.).

Table 2. National and City Policy Issues

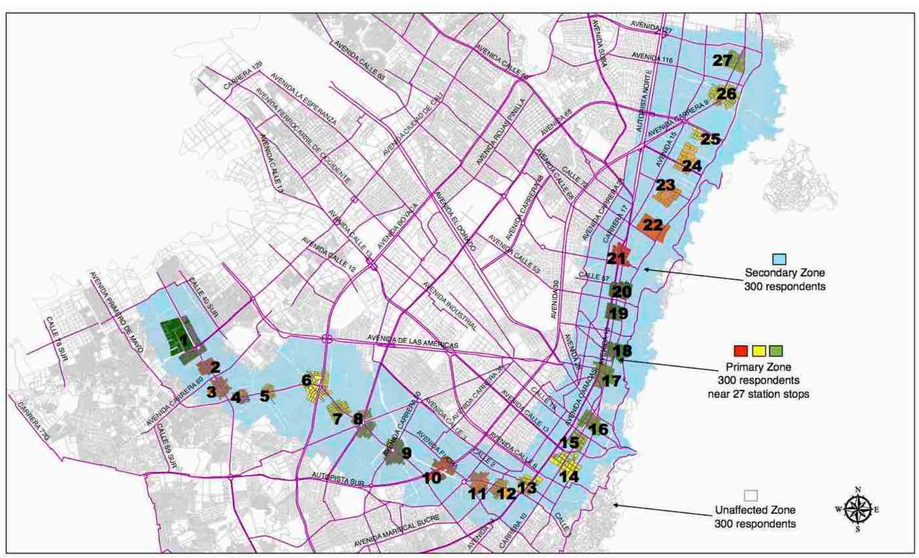
Module 1: National Issues	**Module 2: City Issues**
Metro. Build a metro in Bogotá.	Metro. Build a metro in Bogotá.
Corruption. Block elected officials who mismanage public resources from working in the public sector.	Corruption. Block elected officials who mismanage public resources from working in the public sector.
Highways. Build the network of 4G highway projects.	Roads. Expand and maintain roads and sidewalk infrastructure.
Taxes. Increase taxes on wealthy individuals and corporations.	Property Taxes. Increase taxes on property owners.
Social spending. Sharp increases in the coverage and generosity of cash transfer payments to poor families.	Social spending. Sharp increases in the coverage and generosity of transfer payments to poor families.
Rural development. Provide property titles, access roads, and crop assistance to farmers.	Public space. Regular operations to remove street vendors from public spaces.
Crime. Establish the death penalty and lifetime sentences for serious offenders.	Crime. Regular operations to break up criminal gangs and stop petty criminals.
Public services. Sharp increase in spending on public education and public hospitals.	Public services. Sharp increase in spending on public education and public hospitals.
Abortion. National ban on abortion in nearly all circumstances.	Environment. Conserve the city's ecosystem and restore degraded areas.
Peace. Sign the peace accord with the FARC.	Housing. Purchase of land and construction of social interest housing.

The survey was administered to 900 respondents living in Bogotá, Colombia in August to October 2016. This sample size is typical for representative public opinion surveys (such as the Latin America Public Opinion Project's AmericasBarometer). Given four experimental groups,

225 respondents received each control or treatment. I have statistical power to distinguish only relatively large heterogeneous treatment effects (i.e. different reactions to the experimental treatments between renters and owners, affected and unaffected areas). Costs prevented increasing the sample size.

Online platforms have been shown to provide high-quality samples for experimental evaluations, but were inappropriate here (Samuels and Zucco 2014). I piloted the survey with 30 respondents on Facebook who clicked on an ad asking if they lived in Bogotá. However, it proved very costly to recruit participants in Bogotá through this method and produced a sample that was clustered in central areas of the city. My theory depends on measuring variation in preferences across city space, so such an online sample would not provide a sufficiently large number of respondents living at various distances from the metro project.

Figure 1. Sampling Along Bogotá's Proposed Metro Line



Source: Author's Survey.

I instead used a stratified sample to guarantee an adequate sample size living within each geographic area. Following standard practice in urban planning, I divided the city into three zones shown in Figure 1: 1) a primary zone (500 m, or roughly 1/3 of a mile, the colored areas) around each station, 2) a secondary zone within walking distance (1000 m, slightly under one mile, shaded in blue) of a station, and 3) an unaffected zone (more than 1000m, no color) from a station. Each respondent saw a similar map (without the zones) of the proposed metro route at the beginning of the survey to make sure that there was a shared understanding of the project proposal.

I then stratified the sample using government-define class stratifications. Colombia divides households into six "strata," which often are grouped together with strata 1 and 2 as low-income households, strata 3 as lower-middle, and strata 4 and above as upper-middle class. Table 3 shows the division of class groups in the sample, and their relationship to Bogotá's population. Again, this method of respondent recruitment was preferable to an online convenience sample

because it covers the entire city and different class groups. Using a Facebook sample, I would have gotten a younger, wealthier, and more educated sample than possible through the direct recruitment in different neighborhoods.

Table 3: Sampling Procedure

Geographic Zone	**Lower Class** (Strata 1 and 2)	**Middle Class** (Strata 3)	**Upper Class** (Strata 4, 5 and 6)
Direct influence zone	130 (124)	130 (121)	40 (35)
Secondary influence zone	132 (123)	135 (127)	39 (35)
Unaffected zone	131 (121)	130 (112)	40 (30)
Total in Sample (907)	*393 (368)*	*395 (360)*	*119 (100)*
As Percent of Bogotá's population	48.8%	35.7%	13.8%

Notes: Software glitches meant that some QV responses were not recorded. The numbers indicate the completed surveys on demographic questions. The numbers in parentheses indicate the completed survey on both demographic and QV questions.

The QV instrument must be administered online, which created some logistical challenges in a middle-income country like Colombia. Not all areas of the city have reliable wireless connections. Security concerns also meant that enumerators were unwilling to carry portable electronic devices in all areas of the city. But Internet cafes are widespread. Rather than conduct a household survey, enumerators approached respondents in public spaces. They first verified that the respondent lived in the defined area around the metro project and their class stratification. They then recruited them to take the survey in an Internet café set up to administer the survey. Survey enumerators were trained to assist the respondents with any questions regarding the instructions and implementation of the survey. To encourage respondents to take the survey, they were offered a small gift for completing the survey.

Even using the Internet cafes to increase the chances of a reliable Internet connection, there were software problems recording the QV responses on the first module of the survey. The numbers in parentheses in Table 3 indicate the number of surveys with complete responses on the QV/Likert conditions and experiment. Luckily, there was no systematic missingness to induce bias into the survey responses. But the lost data reduce the power to detect significant effects, especially in the subgroup analyses.

The survey sample is quite like the Bogotá population, although slightly more likely to have access to the Internet (Appendix Table A.1). Of course, there may be unobservable differences between individuals who transit through public spaces and the population at large. This sampling technique is less likely to capture groups who stay at home more often, such as elderly

respondents, stay-at-home parents, or individuals who work from home. This bias is opposite that produced by household surveys, which tend to oversample those who are at home to answer the door. For a survey on transit, capturing more mobile populations seems critical, but care must be taken when making statement about the population at large.

Results

I now describe the results from the survey and experiment. Again, I examine public preferences in two ways, first considering who supports mass transit projects and then turning to the effects of different financing mechanisms on project support.

Determinants of Support

Before turning to the determinants of support, it is worth briefly discussing citizens' priorities. QV is a relative measure in which citizens allocate points across issues. The metro received substantial support when asked as part of a block of national and city priorities (see Appendix Table A.2 for details). For instance, increased spending on health and education generated the greatest and most uniform support, followed by investments in rural development and poverty alleviation programs. But the metro ranked fourth out of ten. The issues at the bottom of the list are those that divide the public, such as Colombia's peace deal and a prohibition on abortion. This suggests that the metro is an important public priority, at least among Bogotá residents.

My first set of hypotheses concerns which individuals support infrastructure projects. Given a relatively large number of ordinal categories, I use a standard OLS regression to analyze the two national proposals that related to infrastructure spending on the metro (*Metro*) and the highway network (*Highway*). For both metros and highways, I run the same models using three measurements of the dependent variable: support relative to other national priorities (*QV Nat)*, support on national issues using the costless Likert scale (*Likert*) and support relative to other city priorities (*QV City*).

To examine interest-based theories, I look at whether respondents who live near the proposed route (*Proximity*), own property *(Owner*), and take public transit (*Public Transit*) are more supportive of the metro. Proximity takes on a value of "0" if the person lives in the unaffected zone, "1" if they live in the secondary zone, and "2" if they live in the direct affectation zone. Owner takes on a value of "1" if the person owns the house or apartment where they live and "0" otherwise. Public transit users are defined as those who take the BRT or authorized city buses (SITP), which constitutes about half of those surveyed.[17] These direct stakes should shape support for the metro, but not for highway investments. I add controls for age, gender, and socioeconomic class to isolate the impact of direct material benefits.
Table 4 presents the results of the most basic interest-based models. Proximity is only significant in one specification, and property ownership does not predict support for the metro in any model. It is possible that only property owners near the metro have higher levels of support.

[17] One complication is that some bus/mini-buses are not authorized by the city. I consider their riders nonpublic transit users, because they might not expect to benefit from government transit investments.

However, I find no results analyzing the interaction between proximity and property ownership. The results thus provide little support for interest-based theories of infrastructure support. In the national issue-sample, I have statistical power to detect effects of 0.4 for owners (meaning that owning property is associated with 0.4 more votes on the metro—this drops to 0.3 in the city issue sample) and 0.2 for affected areas (meaning that a move one band closer to the metro is associated with 0.2 more votes). These effects correspond to roughly 1/10 of a standard deviation, which means that I can rule out property ownership and proximity having sizable effects.

Table 4. Interests and Support for Infrastructure

	Metro			Highway		
	(1) *QVNat*	(2) *Likert*	(3) *QVCity*	(1) *QVNat*	(2) *Likert*	(3) *QVCity*
Owner	0.084	0.057	0.043	0.114	0.119	0.076
	(0.21)	(0.17)	(0.15)	(0.17)	(0.16)	(0.11)
Proximity	0.037	-0.002	0.169*	-0.160	-0.101	-0.079
	(0.11)	(0.09)	(0.08)	(0.09)	(0.09)	(0.06)
Public	0.096	0.314	0.016	0.176	-0.055	0.340*
	(0.19)	(0.17)	(0.15)	(0.17)	(0.16)	(0.11)
Class	0.143*	0.140*	0.165*	0.172*	0.084	0.054
	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.04)
Age	0.154*	0.038	0.078	0.129*	0.061	0.071*
	(0.06)	(0.05)	(0.04)	(0.05)	(0.05)	(0.03)
Gender	-0.205	-0.150	-0.272*	-0.025	-0.329*	-0.093
	(0.18)	(0.15)	(0.14)	(0.15)	(0.14)	(0.10)
N	435	375	827	435	382	827
R^2	0.038	0.026	0.029	0.050	0.031	0.023

A belief-based theory predicts that upper-class respondents are more likely to support infrastructure, so the coefficient on class should be positive. I measure socio-economic status through government class stratification measures (*Class*). Other measures like household income and education are highly correlated with class (~0.4). I prefer to use the stratification measure due to missingness and misreporting in income data, as well as the fact that current monthly income may not reflect an individual's overall economic position. I expect the class coefficient to be particularly pronounced for metro projects that contribute to the quality of everyday urban life.

In addition to the class difference, I also include a series of questions that asked about expectations of benefits from the metro. The survey included questions about whether respondents thought that their commute would get shorter (*Shorter*) and whether traffic would improve (*Traffic*). Respondents who expect positive benefits from the project should be more supportive of its construction, so the coefficients should be positive. I also expect that respondents who care more about the environment, a core part of post-materialist values, should be more supportive of the metro. I measure concern about the environment based on the number of votes that the respondent placed on protecting the water system (*Environment*).

Finally, I consider the role that ideology plays in shaping support for infrastructure. I measure ideology in several ways: first, I consider trust in government by asking respondents how likely they think it is that the government will lose money to corruption in the metro project *(Corruption*) and, second, that the project will be started within five years (*Started*). Third, I look at whether the classic question about pro-government attitudes that asks the respondent to choose between "there are more things that the government should be doing" or "the less government, the better" (*Pro-Government*). Those who support a wider mandate for government should be more supportive of the metro. Lastly, I look at whether support for the current administration is associated with greater support for public infrastructure. I create an indicator variable that takes on a value of "1" for individuals who said that they voted for the current mayor, Peñalosa (*Mayor Vote*), and "0" for those who did not vote or supported another candidate. As noted above, Peñalosa has been critical of the metro project, and favors investments in Transmilenio. But he also is known as an efficient, clean mayor, who invests in city infrastructure. Therefore, his voters may be more enthusiastic about a major investment like the metro.

Table 5 presents the results of the models of beliefs and ideology in shaping support for the metro. Model 1 uses only class, gender, and age to predict support. Class is a robust predictor of support for the metro, but not for city highway spending.[18] This finding differentiates a beliefs-based theory from a material-interest one. Given that the rich are more likely to own cars and drive, it is plausible that they care more about urban roads than the poor. The results do not support this self-interested interpretation. Rather, upper-class respondents are more likely to support public transit and equally likely to support road projects. It is possible that the wealthy support public transit because they want others to take it and thereby reduce traffic and pollution that interferes with their quality of life.

[18] It is worth nothing that class does predict support for the 4G highway projects, but not for urban roads.

Table 5. Beliefs, Ideology, and Support for the Metro and Highway Projects

	Metro			Highway		
	(1)	(2)	(3)	(1)	(2)	(3)
Class	0.172*	0.154*	0.118*	0.023	0.010	0.020
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)
Age	0.085*	0.089*	0.057	0.078*	0.079*	0.074*
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Gender	-0.271*	-0.272*	-0.259	-0.060	-0.054	-0.099
	(0.13)	(0.13)	(0.13)	(0.10)	(0.10)	(0.10)
Shorter		0.344*			0.051	
		(0.09)			(0.06)	
Traffic		0.301*			0.029	
		(0.08)			(0.05)	
Environment		0.124*			0.153*	
		(0.05)			(0.05)	
Started			0.382*			-0.004
			(0.07)			(0.05)
Corruption			-0.046			-0.112
			(0.09)			(0.06)
Pro-Government			0.445*			0.174
			(0.18)			(0.13)
Mayor Vote			0.345*			0.011
			(0.16)			(0.13)
N	828	817	817	828	817	817
R^2	0.025	0.101	0.079	0.009	0.034	0.014

Model 2 looks more precisely at beliefs about the benefits of the metro. Respondents who believe that the project will reduce traffic and shorten commute times all express greater support for the metro. It is possible that these answers are just ad hoc rationalizations of metro support. So, perhaps most interestingly, respondents who are concerned about the environment also support more infrastructure construction. I interpret this as evidence that negative externalities or post-materialist concerns about the quality of urban life play a role in shaping infrastructure attitudes.[19] It is unlikely that support for environmental values is an ex-post rationalization of support for the metro.

Model 3 turns to views on the role of government and trust in its capacity. Respondents who believe that the metro project will begin soon, that the government should play a larger role, and that voted for the mayor all express greater support for the metro. Perhaps most surprisingly, expectations that the city will lose money to corruption have no relationship with support for the project. Although the combined model is not shown to save space, beliefs about the benefits that

[19] Interestingly, support for the environment is only weakly associated with class. Lower and upper-class respondents diverged little in their support for the environment.

the metro will produce for the city remain significant predictors of support even accounting for vote choices and general ideas about government's role.

Taken together, these results suggest that ideology and beliefs that the metro will result in benefits for the city at large are most predictive of support. Upper-income respondents seem more likely to support the metro, but this does not correspond to any measurable differences in material benefits, such as living closer to the project or taking public transit at present. Instead, it seems that wealthier individuals may weigh negative externalities caused by the lack of public transit, such as its effects on traffic and the environment, more heavily, or they may care more about post-materialist concerns.

The Effects of Financing Options on Mass Support

I now turn to the survey experiment. Respondents heard one of four statements about how the metro would be funded. I then evaluated their support for the metro looking at the mean votes placed on the metro using QV. I also checked whether respondents understood the treatments by asking whether they expected their tax burdens to change.

To check that the experiment randomly assigned treatment, I first check for balance on observable pre-treatment covariates, namely socio-economic class, distance from the metro project, gender, education, and property ownership. Balance tests confirm that observable covariates are statistically indistinguishable across the financing conditions, just as the random assignment of treatment implies.[20]

Figure 2 plots the estimated treatment effects. The top rows compare the treatment effects for the entire sample, meaning the difference in mean support for the metro project as a city priority under each financing condition compared to the control condition in which respondents were told that the project would be funded through a mix of "national and general city funds." Mean support appears to fall under each more specific financing treatment, although none of the effects reach statistical significance.

[20] Only the *p*-values for *Education* approach nominal significance levels for the betterment treatment, but a joint F-test is insignificant, and no differences are detected for *Strata* or *Income* levels. I conduct a regression analysis with covariates to account for any possible differences in observables.

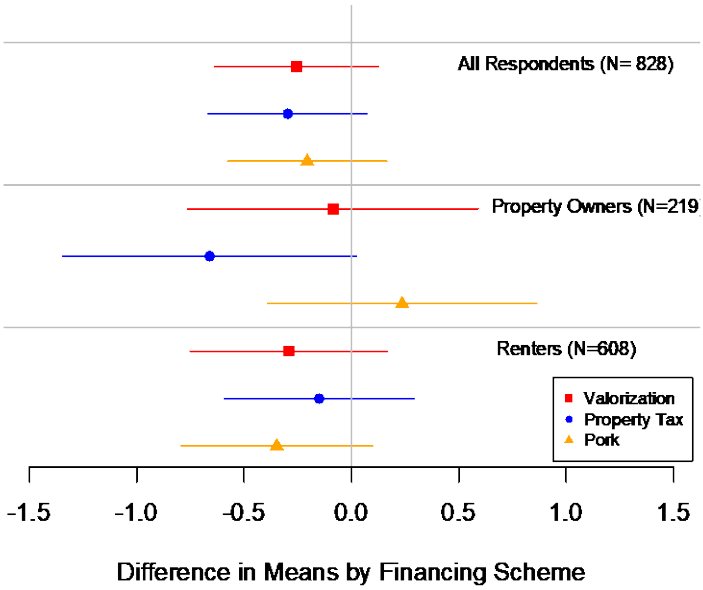


Figure 2. The Effects of Financing Options on Support for the Metro

Importantly, I also made predictions about how support would vary across subgroups, namely renters versus property owners, residents living in affected versus unaffected zones, and taxpayers and non-taxpayers. The bottom rows of Figure 2 show the differences in means for property owners and renters. As I expected, property owners are less supportive of the metro project when financed through property tax increases. What is surprising, however, is that renters are not more supportive of the metro when paid for by property owners.

The value-capture treatment did not have the hypothesized effects on property support. As Figure 2 suggests, there were no overall effects of project support using value capture. But more surprisingly, there were no differential effects between those who live in the affected and unaffected zones (not shown).

There are several possible explanations for the null effects, including the small sample size. Given four experimental groups, I could detect effects larger than 0.38, or roughly one fifth of a standard deviation. In other words, I can rule out that valorization increases project support by 0.38 votes compared to the control condition. Once I look at heterogeneous treatment effects, however, I sacrifice some statistical power. I can rule out with 95 percent confidence that valorization increases the support of renters by 0.48 votes compared to the support of property owners. This would be a sizable effect, about a quarter of a standard deviation. So, what the survey experiment tells us is that valorization is unlikely to have large effects on project support. There may be subtle differences that the experiment does not capture.

Additionally, the experiment may not have changed attitudes because respondents needed to read and understand the treatments. One way to see if this happened is to look at responses to a second evaluation question: "Do you think that you will pay more in taxes if the metro is built?" Looking at the basic control group, two-thirds of respondents believe that their taxes will increase if the metro is built. Most people thus expect to pay for the project. But what is most surprising is that the value capture treatment has the biggest impact on tax expectations. More

than 70 percent of respondents think that their taxes will go up when given information that the metro will involve value capture. As discussed previously, value capture technically is not a tax and these responses thus suggest substantial misunderstanding of the tool. Perhaps what is even more surprising is that individuals in unaffected zones are most likely to think that their taxes will go up with value capture. The gap is very substantial: whereas 82 percent of individuals in unaffected zones expect tax hikes with value capture, just 60 percent of those in areas surrounding the metro believe that taxes will go up with value capture. What this suggests is that respondents who live farther from the project are the least well informed about value capture and its potential impact on their tax bills. The hope is that value capture mechanisms, by recouping project costs from nearby land values, could reduce the need for additional taxes on residents living farther away from the project. The implication of the survey finding is that city officials could do more to educate city residents, and especially those who are least likely to pay valorization, about how it works and how it may reduce their taxes by capturing the benefits that infrastructure produces.

Table 6. Fraction that Expects to Pay More in Taxes by Treatment and Subgroup

	All	Renters	Owners	Unaffected	Secondary	Primary
Control	64.0	63.1	66.1	64.3	67.9	58.3
Valorization	70.3	69.4	72.3	82.3	69.8	60.0
Property Tax	61.2	60.1	63.8	66.7	66.2	50.7
Pork	60.3	58.7	64.8	55.7	66.7	59.2

aIn short, only raising property taxes seems to have affected popular support for the metro, and only among property owners. In theory, property taxation should increase support among renters because owners shoulder a greater fraction of the burden. This is not the case. In contrast, value capture mechanisms have no notable effects on popular support. This result likely reflects the limited popular understanding of the mechanism, especially among those who are least likely to make betterment contributions.

Conclusion

This paper provides the first rigorous evaluation of support for public infrastructure spending. I used a novel survey technique to understand support for infrastructure expenditures and sampled at varying distances from the proposed metro to understand how proximity shapes attitudes. Surprisingly, I find that material interests, such as distance from the metro project and property ownership, have little relationship to popular attitudes. Upper-income groups are more supportive of the metro than lower-income groups, even though they are less likely to ride public transit.

One interpretation of these results is that upper-income respondents care more about negative externalities, such as traffic and pollution, and therefore want to encourage others to use public transit. This could suggest a type of indirect material interests in public transit construction. Another interpretation is that individuals care about the broader social impact of infrastructure investments. I find that attitudes toward infrastructure spending are deeply shaped by

expectations of how projects affect overall quality of life. Respondents seem to be coming to evaluations about the metro based on their beliefs about how it will change the city, namely whether it will reduce traffic, make commutes shorter, and improve the environment, as well as their overall perceptions of the government's ability to implement the project. Middle-class respondents may care more about these social values, given that they have satisfied their immediate economic needs.

The other important finding of this paper is that the financial instruments used to fund the metro have little impact on project support. The only exception was the effect of property tax hikes among property owners. Owners did decrease their support for the metro when it was announced that increased property taxes would fund the project. These effects were not compensated for with increased support among renters, who might pay less for the project if owners foot the bill. More innovative value capture mechanisms, like infrastructure contributions (valorization), seem to have been poorly understood by the public. Respondents—and especially those far from the project—believed that their taxes would rise if the metro were funded through value capture, even though value capture is not a tax and can be used to offset tax increases.

These results were a surprise and have important implications for public policy. To be clear, I expected material variables like distance and commuting patterns to be the main determinants of support. The weak impact of these variables suggests politicians may follow a different tact in building support for transit infrastructure. Convincing citizens that projects will be completed and will bring broad benefits to residents may do the most to build popular support. Mayors may consider making a stronger case about how public transit affects traffic and pollution in the city at large and for middle-class taxpayers, rather than ridership. I also thought that value capture would be an important way to increase popular support for the metro. But value capture remains poorly understood by the public and did not budge attitudes toward the metro. A key challenge is to help citizens understand value capture. Individuals who do not live near infrastructure projects may be stronger supporters if they understood that the mechanism provided an alternative way to fund infrastructure development without raising property taxes.

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Appendix

Figure A.1 illustrates the QV module on the survey. Respondents vote in favor (thumbs up) or against (thumbs down) each proposition. Circles illustrate the number of votes purchased on a given proposition, while the small boxes below show the cost in credits and the counter at top shows the credits available for voting. Respondents can revise their answers as much as possible, and the software tracks their revision patterns, distinguishing how much attention the respondent paid to the exercise. A map of the proposed metro route and the affectation zone surrounding the metro stations is available here.

Figure A.1. Quadratic Voting Platform

Table A.1 provides additional descriptive statistics comparing the survey sample to the broader Bogotá population. The survey sample is very similar to the Bogotá population in terms of class stratification, poverty (operationalized by receipt of cash transfer payments and subsidized health access), gender, and household size. The survey sample is slightly more connected to the Internet, which may reflect the fact that respondents were comfortable and willing to use an Internet café. The survey sample also is slightly older than the Bogotá population, although this likely reflects the fact that I only surveyed adults over the age of 18.

Table A.1. Comparing the Survey Sample to the Bogotá Population

	Survey Sample				Population			
	Bottom	Middle	Top	Mean	Bottom	Middle	Top	Mean
Strata	33.3	33.3	33.3	3.1	48.8	35.7	13.8	2.6
CCT receipt	17.0	7.3	1.0	8.5				8.8
Subsidized health	47.0	25.6	3.0	25.2	33.6	14.3	1.7	23.9
Internet access	25.6	56.2	94.0	58.5	24.5	49.2	88.6	43.0
Female				49.0				53.0
Age				39.0				29.5
Household size				3.9				3.7

Notes: Bottom refers to Strata 1 and 2, middle is Strata 3, and top refers to Strata 4, 5, and 6. Survey means are unweighted. CCT receipt refers to Familías en Acción, which covered 198,500 families when the survey was administered. The higher average age reflects the fact that the survey was administered to adults over the age of 18. Source: Strata, gender, age, and household statistics come from the District Planning Secretary (Secretaría Distrital de Planeación), 2010; health coverage and internet access statistics come from the DANE-SDP, Encuesta Multipropósito para Bogotá 2011.

Table A.2 ranks the mean response across issues at the national and city level. It shows that the metro is a city priority regardless of the choice set or survey technique used. A striking feature is that the ordering produced by looking at mean responses is near identical under the Likert and the QV questionnaires. The main advantage of QV is to discern strong supporters and opponents of an issue even more precisely compared to Likert, but Likert does a relatively good job getting at the rank ordering of issues despite its top-coding.

Table A.2. Priorities of Residents on National and City Issues

	National Issues QV		**National Issues Likert**		**City Issues QV**	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Health and Education	2.89	0.08	2.43	0.07	2.96	0.05
Rural Development	2.53	0.07	2.34	0.07		
Poverty Alleviation	2.43	0.09	2.35	0.07		
Metro	2.38	0.09	2.18	0.08	2.45	0.07
Corruption	2.35	0.11	2.25	0.09	2.56	0.08
Highways	2.11	0.08	2.12	0.08		
Death Penalty	1.31	0.13	1.44	0.10		
Income Taxes	1.05	0.12	1.30	0.10		
Peace Agreement	0.58	0.15	0.83	0.11		
Abortion	0.23	0.13	0.81	0.11		
Crime					2.91	0.06
Environment					2.76	0.05
Roads					2.43	0.05
Housing					2.13	0.06
Remove Vendors					-0.42	0.09
Cut Poverty Programs					-0.67	0.09
Property Taxes					-1.09	0.08
Observations	**436**		**305**		**828**	