A Transport Justice Evaluation of Employer-Based Transit Subsidies

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Abstract

National statistics regarding subsidized commuting suggest that employer-based transit subsidies may be inaccessible to the vast majority of the working poor. My main purpose with this study is to increase our understanding of employer-based transit subsidies from a transport justice perspective. I apply the theory of transport justice developed by Karel Martens to evaluate whether the provision of transit subsidies varies significantly by income, and whether the subsidies are significantly associated with accessibility as measured by daily trip levels. I use worker-level data from household travel surveys for 10 of the 22 largest MPOs in the U.S., organized into 7 cases: 1) Atlanta; 2) Baltimore and Washington, DC; 3) Denver; 4) Los Angeles & San Diego; 5) New York and Newark; 6) Philadelphia; and 7) San Francisco. In each of the 7 cases, the odds of being offered a transit subsidy were significantly lower for workers in the 1st income quintile compared to workers in the 4th and 5th income quintiles, even after controlling for other relevant worker and employer characteristics. I found a lack of evidence, in most cases, that transit subsidies are significantly associated with accessibility, both in terms of daily trip levels for low-income workers and daily trip differentials between income groups. Given my finding that low-income workers are the least likely to have access to employer-based transit subsidies, policymakers may consider reform alternatives, such as commuter benefit ordinances, a refundable tax credit for commuting expenses, or alternatives such as income- and location-based subsidies for transit that may support all trip purposes. I hope this study will serve as a reference for policymakers deliberating commuter benefit reforms as well as strategies to support affordable access to opportunities for the working poor.

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General Audience Abstract

National statistics for subsidized commuting suggest employer-based transit subsidies are inaccessible to the majority of the working poor. Using a transport justice theoretical frame, this quantitative study used worker-level data from household travel surveys to evaluate whether employer-based transit subsidies vary by income, and whether the subsidies are associated with accessibility. The data were organized into 7 cases: 1) Atlanta; 2) Baltimore and Washington, DC; 3) Denver; 4) Los Angeles & San Diego; 5) New York and Newark; 6) Philadelphia; and 7) San Francisco. In each of the 7 cases, the odds of being offered a transit subsidy were significantly lower for workers in the 1st income quintile compared to workers in the 4th and 5th income quintiles, even after controlling for other relevant worker and employer characteristics. In most cases, I did not find a significant association between transit subsidies and accessibility. This study may serve as a reference for policymakers deliberating commuter benefit reforms as well as strategies to support affordable access to opportunities for the working poor.

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1. Introduction

"The promise of public transit as the great connector…must be renewed with a greater public commitment to ensuring transit fares remain affordable for the most economically disadvantaged families…Shouldn't we also offer discounts to those who need it most?" (Stolper and Rankin 2016, 2-3)

1.1. Problem Statement

Primarily framed as a tool for congestion mitigation, pollution reduction, and employee recruitment and retention, the transport justice[1] implications of employer-based subsidies for public transport commuting have received increasing attention in recent years – both in terms of access to the subsidies as well as their financial effects. According to the Bureau of Labor Statistics National Compensation Survey, 2% of civilian workers in the lowest wage quartile have subsidized commuting (for public transport and vanpooling) compared to 13% for workers in the highest wage quartile (Bureau of Labor Statistics 2016, Table 40). These national statistics have been highlighted in a series of advocacy reports on parking and transit commuter subsidies, which note that higher income workers are more likely to financially benefit from the tax exempt status of the subsidies as well (TransitCenter and Frontier Group 2014, 21, 28, 38, 2017, 25, 58). A recent advocacy report on transit affordability in New York City makes a similar point, arguing that low-income families face lower tax rates and are therefore less able to benefit from the current tax-preferred treatment for commuter benefits (Stolper and Rankin 2016, 19). Meanwhile, a recent Planetizen blog post critiquing employer-based commuter benefits notes that "under the current tax structure, higher-paid workers receive a greater discount" (Phillips 2014). Evidence to date therefore suggests that the federal tax expenditures for employer-based transit commuter subsidies, which result from foregone federal tax revenues and will sum to an

[1] In this study, I primarily use the term justice, intending to encompass notions of fairness, equity, and inclusion.

estimated $13.97 billion for fiscal years 2016-2026 (Office of Tax Analysis 2016),[2] may be inaccessible to the vast majority of the working poor and therefore regressive in nature.[3] My main purpose with this study is to increase our understanding of employer-based transit subsidies from a transport justice perspective. I apply the theory of transport justice developed by Karel Martens, and seek to contribute to our understanding of whether the provision of transit subsidies varies with income, and whether the subsidies have a significant impact on the accessibility experienced by the working poor.

Affordable access is of critical importance to the working poor, for whom transport costs represent a significant burden across many measures.[4] In 2003, the Bureau of Transportation Statistics devoted an issue brief to the commuting expenses of the working poor, which compiled and interpreted data from the Census Bureau's Survey of Income and Program Participation. At that time, the working poor spent almost 10% of their income on commuting, compared to 4% for the population as a whole (Bureau of Transportation Statistics 2003). Similarly, working poor transit commuters devoted 13% of their income to commuting expenses, compared to the median share of 3% across all transit commuters (Bureau of Transportation Statistics 2003). Nevertheless, public transport commuting demands a smaller share of income than driving; those working poor who commuted by car spent 21% of their income on commuting expenses,

[2] At the time of this writing, tax reform legislation with the potential to impact these tax expenditures is under consideration in the U.S. Congress.

[3] In their text on policy analysis, Weimer and Vining describe tax expenditures as "notorious for their inequitable distributional consequences" due to the fact that they do not benefit lower-income individuals, who have little or no income tax liability (Weimer and Vining 1999, 221).

[4] In the Mineta Transportation Institute's 2011 report, "Getting Around When You're Just Getting By: The Travel Behavior and Transportation Expenditures of Low-Income Adults," the authors note that affordable transport has received much less attention than other challenges faced by the poor, such as affordable housing, and call for more focused attention on transport affordability (Agrawal et al. 2011, 7). Jeekel and Martens (2017, 8-9) argue that the domain of transport should join health, education, and housing as a pillar of a developed welfare state.

compared to 5% across all driving commuters (Bureau of Transportation Statistics 2003). The working poor are less likely to drive to work and more likely to use commute alternatives than the population as a whole; figures for 2014 indicate 64.3% of workers below the poverty level drive to work, compared to 76.8% for the overall workforce (Bureau of Transportation Statistics 2016, 50). This could be due to the significant financial burden vehicle ownership represents for the working poor (Deka 2004, 339, Tomer 2011, 2, 8). Car-related debt has an especially significant impact on working poor access to home ownership, and therefore wealth accumulation (Sanchez et al. 2007, 38, 40, Agrawal et al. 2011, 13). Meanwhile, public transport can serve as "an effective money-saving tool," with transport expenditures significantly lower in regions with large-scale rail services compared to bus-only and small-rail systems (Ferrell 2015, 17-18, see also Litman 2017a, 11).

Travel costs more generally represent an "overwhelming constraint" (Clifton and Lucas 2004, 25) and "heavy financial burden" (Agrawal et al. 2011, 7) for those with low incomes, impacting the type and extent of daily travel as well as opportunities for social mobility (Bouchard 2015, Stolper and Rankin 2016, 13). The poor tend to own fewer vehicles, make fewer trips, travel shorter distances, and use slower and less expensive forms of public transport (Bureau of Transportation Statistics 2016, 50, Santos et al. 2011, 18, Clifton and Lucas 2004, 20, Sanchez et al. 2007, 43-44, Agrawal et al. 2011, 12, Tomer 2011, 3, American Public Transportation Association 2017b, 36). For example, the Bureau of Transportation Statistics estimates that households with incomes below $25,000 are eight times more likely to be zero-vehicle households than households with incomes above that level (Bureau of Transportation Statistics 2016, 50). Low-income households have also experienced increases in transport costs. Households in the lowest income quintile experienced a 1% increase in their transport-

expenditure burden between 1988 and 2008, while across all households there was a 14% decrease (Agrawal et al. 2011, 11). Similarly, transport expenditures increased by 4% among households in the lowest income quintile between 1993 and 2003, while those in the highest income quintile experienced an 11% decline (Sanchez et al. 2007, 37-38, see also Deka 338-339). Meanwhile, between 1990 and 2015, the cost of public transport increased faster than the cost of a personal vehicle (index values of 227.6 versus 163.0, respectively) (Bureau of Transportation Statistics 2016, Figure 5-22). Indeed, transit fare affordability was the largest problem cited by low-income New Yorkers in a recent advocacy-based survey about the subway system (Stolper and Rankin 2016, 10). Because vehicle ownership and operation is significantly more expensive than public transport ridership, some studies have actually shown less price-sensitivity in public transport ridership among the poor than among those with more resources (Agrawal et al. 2011, 15). This low price-elasticity of demand speaks to the critical role that public transport plays in the lives of those with low incomes, as well as the need to devote greater resources and attention to understanding tools to ensure its affordability (Agrawal et al. 2011, 53-54, Tomer 2011, 8).

1.2. Motivations

As a private college graduate from a background of modest means, I made the strategic decision to begin my life as a young professional in Washington, DC. Having completed an internship in nearby Takoma Park during my third year of undergraduate study, I had a sense that the region could be a place that would allow me to focus on student loans, rather than car payments. That turned out to be a feasible strategy; I was able to live without a car for the entire period between my undergraduate and graduate studies, while paying down my student loans ahead of schedule.

For most of this period, I combined transit and bicycle commuting, and took advantage of commuter subsidies as a federal employee that covered the full cost of my transit fares.

The fact that I received no employer-based subsidies for bicycle commuting during my three years as a full-time federal employee did not occur to me until after I had departed to begin graduate study. But ever since, commuter subsidies have fascinated me. In my first year of graduate study in Virginia Tech's applied economics program, I became aware that bicycling had been added as a qualified form of transportation for the purposes of employer-based fringe benefits under the federal tax code. During my internship at the U.S. Department of Transportation the following summer, I devoted my individual research project – "The Impact of the Bicycle Commuter Act: A Proposed Analysis of Financial Incentives" – to this change in the federal tax code. My focus at that time, and for several years following that internship, was on the potential for commuter benefits to impact the travel behavior (especially mode choice) of the workers who received them; I did not focus on access to commuter benefits themselves.

But, I do now. Harkening back to my experience as a fully subsidized transit commuter, I feel a compelling sense of responsibility to give more attention to the workers – especially the working poor – who shared those transit trips with me, while paying full fares. I seek to understand the policy context and factors that allowed me to benefit so significantly while others, especially those with even greater financial constraints, did not. This has shifted my focus from the relationship between commuter benefits and travel behavior, to the potential for commuter benefits to serve as an important mechanism for affordable access, and has led me to the theory and literature surrounding the concept of transport justice.

With this study, I seek to shed light on access to employer-based transit subsidies, with an appreciation for their potential to contribute to affordable access to opportunities. I hope that this research will make a timely contribution to informed policy deliberations, especially given the dynamic policy landscape surrounding commuter benefits (see, e.g., Baker, Judd, and Oram 2010, 5, American Public Transportation Association 2017a, 11, TransitCenter and Frontier Group 2017). In the past decade, proposals have emerged to allow bikesharing expenses to be included as part of the tax-exempt transit benefit, create a multimodal commuter benefit, or simply eliminate or significantly reduce the tax-exempt status of commuter car parking (see, e.g., Joint Committee on Taxation 2014, TransitCenter and Frontier Group 2014, 2017, American Public Transportation Association 2017a, 11). After many years of advocacy and temporary provisions, parity was achieved between transit and car parking in terms of maximum allowable tax-exempt amounts (for the first time in 2009 and made permanent for tax-year 2015) (Baker, Judd, and Oram 2010, 5, 9, Lieber 2011, TransitCenter and Frontier Group 2014, 4-5, 9, 23, Wolter Kluwer 2016, American Public Transportation Association 2017a, 10-12). Of particular relevance to this study is the increasing policy interest in local ordinances for commuter benefits (Baker, Judd, and Oram 2010, 18, TransitCenter 2010, 2, American Public Transportation Association 2017a, 11, TransitCenter and Frontier Group 2017, 40-46).[5] In the past decade, several major cities, including San Francisco, CA, Washington, DC, and New York, NY, have implemented ordinances requiring some employers to offer commuter benefits (American Public Transportation Association 2017a, 11-12, TransitCenter and Frontier Group 2017, 40-46). Building upon these local efforts, the Association for Commuter Transportation commenced a campaign to encourage transit benefit ordinances in 25 cities by 2020 (2017a). Meanwhile, the

[5] At the same time, resistance to employer requirements has also emerged; lawmakers in South Carolina recently passed legislation prohibiting local governments from enacting requirements for employer-based benefits (Association for Commuter Transportation 2017b).

Federal Highway Administration has conducted a study[6] (forthcoming) of local parking cash-out ordinances, while a bill requiring employers to offer parking cash-out was recently introduced to the Washington, DC, city council (Lazo 2017). In this study, I focus on disparate access to employer-based transit subsidies across income groups, and the findings may hold relevance for policy deliberations regarding commuter benefit or parking cash-out ordinances, which have typically not emphasized affordable access for the working poor.

Beyond commuter benefits, this study holds relevance for those concerned with transport justice. Employer-based transit subsidies are only one potential mechanism for reducing the monetary burden of public transport fares for the most vulnerable among us. TransitCenter & Frontier Group recently called for the creation of a commuter income tax deduction for those without access to employer-based transit benefits (2017, 62-63). Another mechanism could be direct federal subsidies for transit passes, which could be used across all trip purposes and remove employer control over their provision (Phillips 2014). Indeed, support has been growing in New York, Boston, and Denver for income-based programs similar to those already in place in Seattle and San Francisco (Stolper and Rankin 2016, 23, Mondon 2015, Dungca 2016). Table 1 provides a sample overview of policy tools for reducing transit fares, using employers, income, and location as the basis for the subsidy. Income- and location-based programs have the potential advantage of providing support across all trip types, but may be difficult to implement in regions with financially-strained transit systems. Meanwhile, employer-based subsidies have the regressive tax implications noted above.

[6] I was a member of an external advisory group for the FHWA parking cash-out study.

Table 1. Program Alternatives to Reduce Public Transport Fares for Users

Locations	Program Name	Basis	Trip Type	Funder
New York, NY; Washington, DC; San Francisco, CA	NYC Transit Ordinance; DC Transit Ordinance; San Francisco Commuter Benefits Ordinance	Employer	Commuting	Employers; Federal Govt. *(via tax exemption)*
Seattle, WA; San Francisco, CA;	ORCA Lift; Muni Lifeline;	Income	All	Transit Providers
New York, NY	Freedom Ticket *(proposed pilot)*	Location	All	Transit Providers

Sources: (Worland 2015, New York City Transit Riders Council 2015, Lindblom 2015, Lazo 2015, San Francisco Department of the Environment 2017, Fitzsimmons 2016, Stolper and Rankin 2016, 22, King County Department of Transportation 2017, New York City Department of Consumer Affairs 2017, San Francisco Municipal Transportation Agency 2017).

Policymakers therefore have a choice when it comes to the design of transit subsidies. These subsidies are themselves only one type of support policymakers could consider in seeking to "mitigate the high costs and low quality of transportation experienced by the poor" (Agrawal et al. 2011, 53, see 53-61 for a detailed menu of strategies). This study therefore seeks to shed light on one policy piece of the complex challenge of affordable access and just transport.

1.3. Overview

This dissertation is divided into five chapters. In this first chapter, I discuss the justice implications of employer-based transit subsidies, especially in the context of the significant financial challenges that transport poses for the working poor. I share the overall purpose of my study, which is to improve our understanding of the factors associated with the provision of transit subsidies. In the second chapter, I trace the development of Karel Martens' theory of transport justice as presented in his published work spanning the previous decade. The basis for his theory is rooted in a critique of the traditional approach to transport planning, and I connect this critique to a shift in U.S. transport policy and planning. Martens draws upon the social justice theorists Walzer, Rawls, and Dworkin, as well as the capability approach developed by

Sen and Nussbaum, to argue for an entitlement to sufficient accessibility. I then discuss the application of the theory to the topic of commuter benefits, which leads to a focus on entitlement to the benefits as well as their impact on accessibility. I conclude the chapter by reviewing the justice aspects of the commuter benefits literature. My study contributes to this literature with a novel application of the Martensian theory of transport justice, as well as the use of disaggregate worker data to identify factors associated with transit benefit offerings.

In the third chapter, I describe my main research questions, which focus attention on access to employer-based transit benefits as well as the association between the benefits and accessibility. My main hypothesis, informed by the transport justice theoretical framework as well as the commuter benefits literature, is that low-income workers will have significantly lower odds of being offered employer-based transit benefits than workers with higher incomes. I also hypothesize that transit benefits will be positively associated with daily trips among workers in the 1st income quintile, and a reduced differential in daily trips between workers in the 1st and 2nd-5th income quintiles. My study uses data from household travel surveys for 10 of the largest Metropolitan Planning Organizations in the U.S., which I group into seven cases. I use single-equation binary logistic regression to estimate the likelihood of being offered an employer-based transit subsidy, and negative binomial regression to evaluate accessibility as measured by total daily trips. I conclude by discussing expectations regarding the explanatory variables included in the models based on prior research. To the best of my knowledge, this is the first study to use worker-level data to systematically focus on access to transit benefits and the first study to evaluate transit subsidies in relation to a person-level accessibility measure.

I devote the fourth chapter to the presentation of the results of my empirical analysis. After controlling for factors such as employer-based car parking subsidies, schedule type, employer location and type, and occupation, I find that workers in the 4th and 5th income quintiles have significantly higher odds of being offered an employer-based transit subsidy than workers in the 1st income quintile in each of the seven regional models, while workers in the 2nd and 3rd income quintiles have significantly higher odds in three and six of the models, respectively. In each of the seven models, the predicted probability of being offered a transit subsidy by an employer is lowest for workers in the 1st income quintile. I found a lack of evidence, in most cases, that transit subsidies are significantly associated with accessibility, both in terms of daily trip levels for low-income workers and daily trip differentials between income groups. Among workers in the 1st income quintile, a transit subsidy was positively associated with daily trips in two out of seven cases; in the remaining five cases, the transit benefit offering was not significantly associated with daily trips. Meanwhile, among workers without a transit subsidy, there were two cases where having an income in the 2nd-5th quintile was positively associated with daily trips, but also two cases where the association was negative. Among workers with a transit subsidy, having an income in the 2nd-5th quintile was not significantly associated with daily trips in any of the seven cases.

In the final chapter, I interpret the results of my analysis in relation to the transport justice theoretical frame as well as prior commuter benefits research. My empirical study of access to employer-based transit subsidies suggests that they remain unavailable for most of the working poor. In light of these findings, I discuss policy reform alternatives, including commuter benefit ordinances, a refundable tax credit for commute expenses, or a shift away from subsidies for commute trips and toward transit subsidies for all trip purposes. I conclude by sharing reflections

on limitations and outstanding questions for future research. I hope that these findings will serve as a reference for policymakers deliberating commuter benefit reforms and strategies to support affordable access to opportunities for the working poor.

2. Theory and Literature Review

In this dissertation, I primarily rely upon Karel Martens' theory of transport justice, as developed over the preceding decade (2006, 2011, Martens and Hurvitz 2011, Martens, Golub, and Robinson 2012, 2012, 2015, 2016a) and most recently in *Transport Justice: Designing Fair Transportation Systems* (2017b). This chapter is divided into four sections. In the first section, I summarize the Martensian critique of the traditional approach to transport planning. Martens argues that traditional transport planning fails to fully address concerns of justice, and makes the case for an approach based on needs, accessibility, and people, rather than demand, mobility, and system performance. I then connect this discussion to a shift in U.S. transport policy, especially in relation to regional planning for equity and environmental justice. The second section introduces the main philosophies of social justice that Martens relies upon to develop his theory of transport justice, including Walzer's spheres of justice, Rawls' theory of justice, Dworkin's theory of equality of resources, and the capability approach developed by Sen and Nussbaum. I introduce the theoretical constructs developed by Martens for conceptualizing transport justice. His earlier work utilizes a maximax criterion to prioritize constrained ranges between the least- and most-advantaged groups in society, while his later work focuses on the concept of sufficient accessibility. In the third section, I discuss the application of the Martensian theory of transport justice to the evaluation of commuter benefits. This leads to a focus on entitlement to commuter benefits, as well as their impact on accessibility. From the Martensian perspective, a double injustice may arise if those with sufficient income are offered commuter benefits while those with insufficient income are not. In the final section, I review the academic literature on commuter benefits from a transport justice perspective. The potential for bias across modal as well as income groups has long been recognized by researchers working in this area. This study

may help to fill a gap in the literature through its unique application of transport justice theory and its focus on access to commuter benefits.

2.1. Critique of the Traditional Approach to Transport Planning

Martens is motivated to develop a theory of transport justice due to the problematic notions of fairness and justice implied in traditional transport planning (Martens 2006, Martens and Hurvitz 2011, Martens, Golub, and Robinson 2012, Martens 2017b). He describes the traditional approach as based on a conceptualization of equality rooted in the demand for travel (2017b, 25, 30). From this perspective, the primary challenge for transport planners is sufficient system capacity, which in turn necessitates that mobility-based concepts such as speed and congestion remain dominant (Martens, Golub, and Robinson 2012, 689, 2017b, 22, 25). Martens argues that this leads to transport planning that is regressive and likely to reinforce or worsen existing inequalities (Martens, Golub, and Robinson 2012, 690, 2017b, 31) such that those without cars experience "real hardships" (2017b, 31-32).

Martens identifies two problematic components of traditional transport planning: 1) demand forecasting; and 2) cost-benefit analysis (Martens 2006, 2017b, 22, 24-25, 28, 32). Travel demand modeling is primarily oriented toward the distribution of infrastructure, rather than the distribution of accessibility (Martens and Hurvitz 2011, 183), and is inherently flawed in its assumption that existing travel behavior is the result of free choice, rather than reflective of any kind of constraint (Martens 2006, 5, Martens and Hurvitz 2011, 185, Martens 2017b, 28).[7]

[7] Similarly, Morris and colleagues argued that using measures of actual behavior to evaluate the transport/land-use system entangles the influence of choices and constraints (Morris, Dumble, and Wigan 1979, 95). Wachs and Kumagai describe the use of actual travel volumes as indicators of travel demand as a mechanism "to propagate rather than alleviate differences in accessibility," and argue that, "today's low levels of travel might become self-fulfilling prophecies for the future" if they are used to guide transport investments (1973, 441-442). They go on to argue that opportunity-based accessibility indicators offer greater consistency with transport and social policy than observed travel behavior (1973, 442). Likewise, Pirie describes how "extant travel patterns are not a reliable indicator of the accessibility which people prefer to have to certain places" (1979, 304).

Indeed, while current travel patterns are typically thought to "represent 'the best possible set of actions that individuals could take given their preferences and the spatial structure of the city,'" they result as much from household constraints and service availability as choice (Martens and Hurvitz 2011, 185, citing Sheppard 1995). Transport planning based on demand in the economic sense (a want *and* ability to pay) negates the need to consider latent demand and the potential for poor transport service to impact household trip rates, and thereby absolves transport planners from the duty to critically review travel disparities (2011, 185). In developing a prescriptive theory to aid the normative assessment of transport systems (Martens 2017b, 9), Martens emphasizes that fairness requires the measurement of possible, rather than actual, activity (2017b, 136). Indeed, "the fact that a person has learned to live under harsh conditions, and to smile courageously in the face of it, should not nullify his claim to a better life" (Martens 2016c, citing Cohen 1993).

As a result, travel models that forecast demand based on existing travel patterns tend to predict growth in travel for those already experiencing the least constraints, and stagnant travel for those experiencing the most constraints (Martens and Hurvitz 2011, 185, Martens 2017b, 28). This in turn leads to recommendations for projects that support those with the most resources and least constraints, and reinforce differences between modal user groups (Martens 2006, 5-7, Martens and Hurvitz 2011, 185-186, Martens 2017b, 28-29).[8] Cost-benefit analysis is also problematic in

[8] This point is consistent with a wide body of literature critiquing the traditional approach to transport planning. For example, Deka argues that travel demand forecasting has inhibited efforts to increase social justice and perpetuated existing travel patterns, regardless of "true" travel needs (2004, 335). Fainstein describes how traditional planning uses procedures that favor upper- and middle-class interests, and argues that the assumption that "past experience will simply repeat itself" is faulty (2010, 59-61). Lucas critiques the tendency of traditional transport planning to cater to demand through infrastructure extensions and focus on speed over access, and argues that this generates the most benefits for those with the most resources (2004b, 11-12). She describes how the effect of "travel poverty" experienced by low-income persons "is to significantly reduce their life chances because of a reduced opportunity to access" important services; as a result, "the inequalities that are already evident" tend to be "reinforced" (2004d, 291). Similarly, Sanchez and Brenman acknowledge the role transport policies have played in limiting life chances

the way it links the benefits of a transport project to total number of trips (Martens 2006, 10, 2011, 967-968, 2017b, 30). This valuation approach tends to bias the prioritization of planning projects in a way that benefits those with more resources, especially in terms of car ownership (2006, 10, 2017b, 30). Failure to account for the distribution of mobility-enhancing benefits may lead, he argues, to inequities in the ability to take advantage of essential services and opportunities (2011, 971).

Martens contrasts the traditional approach to transport planning, with its emphasis on demand, mobility, and system performance, with an approach that focuses on need, accessibility, and people. If everyone deserves a "life of choice and value" (2006, 7, quoting H. Frankfurt 1987) then need, rather than demand, should be the principle of justice upon which transport planning is based (2006, 7).[9] The need criterion shifts the focus of transport planning from mobility to accessibility, by seeking to "secure a minimal level of accessibility for all" (2006, 8). This goal implies greater attention to the distribution of planning projects and the "fair treatment of

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of minorities by preventing access to opportunities and generating significant "indirect negative social and economic effects" (2007, 1-2).

[9] The connection between human dignity and choice is further developed by Martens in his discussion of the capability approach of Sen and Nussbaum (2017b, 136). This aligns with the description by Weimer and Vining of the "freedom to choose how one lives" as central to dignity (1999, 142), and the notion by Wachs that "the ability to access places and activities provides choices that are the essence of human freedom" (2004, 141). Sanchez and Brenman also affirm that "transportation mobility is a hallmark of full membership in American society" (2007, 3). Lucas emphasizes transport's connection to welfare, "both as an enabler of access to goods and services and in terms of the negative social and health impacts it can have on people's lives" (2004a, 2). She argues that "transport is becoming a basic human necessity" such that "ensuring that everyone has adequate access to it is a valid area of concern for public policy" (2004b, 10). Martens describes accessibility's role in the "fundamental constitutive interest" people have in their actual, as well as potential, circumstances (2017b, 135). From this perspective, people derive an action's value based not only on its characteristics, but also the range of possible actions from which it was drawn (Martens 2016c, 2017b, 135). The assessment of fairness should primarily focus on capabilities, which reflect "a person's freedom to choose between different ways of living" (2017b, 136). Martens emphasizes that a justice-oriented perspective therefore requires the measurement of possible, rather than actual, activity (2017b, 136), and that the capability approach contributes to an appreciation of people as "agents of change" (2016a).

persons" (2006, 7, 2017b, 11).[10] Shifting to the need criterion and the goal of accessibility for all has significant implications for the use of cost-benefit analysis to evaluate transport investments. Based upon the principle of diminishing returns, the marginal value assigned to accessibility gains should be inversely related to existing accessibility levels; as a result, the expected gain from a marginal increase in accessibility should be higher among those with the most constrained existing choice sets (2006, 11-12).

This discussion by Martens is consistent with a shift in U.S. transport policy in recent decades toward a broader set of planning goals and evaluation measures, beyond system performance and congestion (Cervero 1996, Johnston 2004, Wachs 2004, Handy 2008, Levine 2011, Litman 2012, Venter 2016). One of the most impactful policy shifts occurred with passage of the 1991 Intermodal Surface Transportation Efficiency Act ("ISTEA") (Vuchic 1999, 107-112, Gifford 2003, 73, Hanson 2004, 24, Venter 2016, 18), which "construed the transportation problem far more broadly than had previous policies" (Hanson 2004, 24) and gave regional planning entities more influence over spending through greater fund allocation flexibility (Wachs 2004, 148).[11] ISTEA was followed in 1994 by Executive Order 12898 and in 1997 by U.S. Department of Transportation Order 5610.2, which together clarified the requirements for transportation under Title VI of the Civil Rights Act of 1964, and formalized the goal of achieving environmental

[10] Martens argues that a focus on accessibility "places people at the heart of transportation planning" (2017b, 18-19). This is consistent with a trend in planning scholarship to emphasize the importance of ensuring people remain the focus of the planning process (see, e.g., Lucas 2004c, Deka 2004, Sanchez et al. 2007, Soja 2010, Fainstein 2010). For example, Wickstrom (1971, 337) reflects that failures to improve urban transport may be explained by the tendency to define goals and standards for individual modes rather than the system as a whole. Lucas describes the manner in which past transport theories and models were more concerned with system efficiency than the accessibility needs of users, while more recent efforts sought to intertwine transport and socioeconomic welfare (2004d, 291). Sanchez and Brenman describe how transport equity and related concepts "represent an evolution in [the appreciation of] how civil rights and transportation are interrelated" (2007, 7-8).

[11] Additional legislative examples include the 1988 California Regulation XV and 1990 Clean Air Act Amendments (Vuchic 1999, 322, Giuliano and Handy 2004, 385, Johnston 2004, 119, Banister 2005, 153).

justice (Sanchez et al. 2007, 73-75, Handy 2008, 115, Williams and Golub 2017, 5, 7-11). Environmental justice is "fundamentally about fairness toward the disadvantaged" and among the most important aspects of contemporary transportation policymaking (Wachs 2004, 151). Several recent studies have assessed regional transportation plans with regard to their success in developing and implementing a broader set of policy goals, especially regarding environmental justice, equity, and accessibility (Handy 2008, Karner and Niemeier 2013, Golub and Martens 2014, Manaugh, Badami, and El-Geneidy 2015, Boisjoly and El-Geneidy 2017, Williams and Golub 2017).[12] In general, these studies have found incorporation of a broader set of goals in regional plans, but lagging development of associated indicators and performance measures to support meaningful implementation. The National Institute for Transportation and Communities recently developed guidance for Metropolitan Planning Organizations to aid their efforts to evaluate distributional equity, in light of broad evidence that their efforts to achieve equity goals are hampered by a lack of federal guidance on measures and standards (Williams and Golub 2017, see also Sanchez et al. 2007, 76). In their overview of best practices for equity analysis, they include measures for affordability as well as accessibility to places, infrastructure, and transit (Williams and Golub 2017, 61-67).

Having reviewed the critique by Martens of the traditional approach to transport planning and contextualized it in relation to shifts in U.S. transport policy and planning, I turn next to a review of the philosophical development of his theory of transport justice.

2.2. The Philosophical Development of the Martensian Theory of Transport Justice

Across several works, Martens seeks to learn about fairness in the realm of transport and develop principles that may support policymaking and planning based on transport justice (Martens,

[12] See 3.2 below for a discussion of the integration of accessibility and equity in the regional plans for the Metropolitan Planning Organizations included in the empirical portion of this study.

Golub, and Robinson 2012, 2012, 2015, 2016a, 2017b). His overall goal is to identify the distributive principle that should guide transport planning (Martens 2012, 1035, 2017b, 43). Martens primarily relies upon: 1) Walzer's spheres of justice; 2) Rawls' theory of justice; and 3) Dworkin's theory of equality of resources. He also draws upon the capability approach of Sen and Nussbaum to develop the concept of sufficient accessibility.

Martens uses the Walzerian theory of distributive spheres to argue that a distributive approach to transport is necessary (2012, Martens, Golub, and Robinson 2012, 2017b). To do this, Martens examines the "social meaning" of transport as well as whether a "separate sphere" is justified based upon that social meaning (2012, 1036, Martens, Golub, and Robinson 2012, 685, 2017b, 43-44, 47-56). As summarized by Martens, Walzer argues that the meaning of goods is socially constructed such that no single distributive criterion (i.e., free exchange or need) is applicable to all goods (Martens 2012, 1037, 2017b, 48). As a result, the social meaning of a good becomes the basis for determining its fair distribution, and goods with distinct social meanings should be recognized as deserving of their own distributive sphere (2012, 1037, Martens, Golub, and Robinson 2012, 685, 2017b, 48). A separate sphere enables the distribution of a good to be explicitly guided by appropriate distributive principles; common examples of goods deserving of separate spheres include health and education (Martens, Golub, and Robinson 2012, 685, Martens 2012, 1037, 2017b, 44, 48).[13] Removing goods with distinct social meanings from the sphere of free exchange ensures that their distribution is not determined by resources such as money and power; this in turn prevents the compounding of inequalities across different goods or spheres (Martens 2012, 1037, Martens, Golub, and Robinson 2012, 685, 2017b, 48).

[13] See the recent discussion by Jeekel and Martens of healthcare, education, and housing as pillars of a developed welfare state (2017).

Martens uses Walzer's notion of distinct spheres to make the case for a distributive approach to transport (Martens 2012, 1038, Martens, Golub, and Robinson 2012, 686-687, 2017b, 49). To do this, he describes "the transport good" as comprised of two distinct social meanings, potential mobility and accessibility (Martens 2012, 1038-1039, Martens, Golub, and Robinson 2012, 686-687, 2017b, 50-51). Potential mobility may be understood as the capacity to overcome distance, while accessibility may be appreciated as the capacity to access opportunities (Martens 2012, 1039-1040, Martens, Golub, and Robinson 2012, 686, 2017b, 51). Martens acknowledges the contested nature of the social construction of the transport good's social meaning (Martens, Golub, and Robinson 2012, 686, 2017b, 52),[14] but ultimately argues that accessibility is most reflective of its social meaning as accessibility better represents notions of "choice, possibilities for experience, and freedom" (Martens 2012, 1041-1042, Martens, Golub, and Robinson 2012, 686, 2017b, 53-54, see also Jeekel and Martens 2017, 12).[15]

Martens then builds upon accessibility as the social meaning of the transport good to make the case that its distribution deserves to be removed from the sphere of free exchange (Martens 2012, 1042-1045, Martens, Golub, and Robinson 2012, 686-687, 2017b, 54-56). Accessibility has an "enabling character" relevant to "the special moral interest of persons to determine their own path of life" (Martens, Golub, and Robinson 2012, 686, 2017b, 82), and important impacts on the possibility to accumulate wealth in the economic and social realms (Martens 2012, 1045, 2017b,

[14] This contested nature has been recognized for several decades. For example, Morris and colleagues noted the ongoing "debate on whether accessibility or mobility should be the objective in transport planning" (Morris, Dumble, and Wigan 1979). Recently, Bertolini described the "ambivalent position of accessibility in the policy agenda" and the continued focus on facilitating mobility perceived by practitioners (2017, 179, 222, see also Venter 2016, 6-7).

[15] Handy makes a similar point in discussing mobility and accessibility in relation to automobile dependence, explaining that "choice is an important element of accessibility: more choices in both destinations and modes of travel mean greater accessibility by most definitions" (2002).

55-56).[16] Indeed, transport is crucial to the management of daily life, given its unique capacity to shape life opportunities in the "structuring dimension of social life" (Martens 2012, 1044, 2017b, 55). Martens summarizes that transport is "an indispensable resource shaping one's life path" that has a social meaning sufficiently distinct to warrant a separate distributive sphere (Martens 2012, 1045, 2017b, 56).[17]

Having established the need for a separate distributive sphere, Martens considers potential distributive criteria for the transport good, first focusing on the Rawlsian perspective (2012, Martens, Golub, and Robinson 2012) and then most recently on Dworkin's theory of equality of resources (2017b). In his earlier works, Martens critically reviews the distributive criteria of equality, merit, need, and the four principles introduced by Rawls in *A Theory of Justice* (2012, 1046-1048, Martens, Golub, and Robinson 2012, 687-689). While the equality principle fails to take into account the inevitable differences across space (2012, 1046, Martens, Golub, and Robinson 2012, 687), and the needs principle can be paternalistic in distinguishing wants from needs, Martens finds several aspects of the Rawlsian theory of justice to be instructive for identifying a distributive criterion for transport. Specifically, Martens emphasizes the latter two principles introduced by Rawls: 1) maximizing average accessibility with a minimum floor constraint; and 2) maximizing average accessibility with a range constraint between the least- and most-advantaged members of society (2012, 1048, Martens, Golub, and Robinson 2012, 687-688). Martens finds the second of these, known as the maximax criterion, the most compelling, as the range constraint makes it robust to changing levels of access (2012, 1048, Martens, Golub, and Robinson 2012, 688).

[16] See the discussion of human dignity and choice in section 2.1 above.

[17] Martens later argues that the Rawlsian perspective also supports the notion that the distribution of transport should be based on principles of justice, as accessibility is a benefit of social cooperation (2017b, 81).

Applied to the transport good, the maximax criterion seeks to maximize average accessibility while limiting the accessibility gap between the worst-off and the best-off (see an example application depicted in Figure 3 in Martens 2012, 1048-1049). Martens envisions how application of the maximax criterion to transport planning would support the shift from a focus on system performance to accessibility gaps (2012, 1048) and enable "a most just distribution" of the transport good that would leave no area or neighborhood behind (Martens, Golub, and Robinson 2012, 687-688). Given existing accessibility gaps, application of the maximax criterion could mean that transport investments that disproportionately benefit the least-advantaged could be considered fair (Martens, Golub, and Robinson 2012, 689).[18]

In subsequent work, Martens highlights the important contribution of the Rawlsian emphasis on the least-advantaged in society (2017b, 82) but continues formal philosophical explorations by engaging with Dworkin's theory of equality of resources. As summarized by Martens, from the Dworkian perspective a society is just "if an equal amount of resources is devoted to each person's life" because then "people decide what sorts of lives to pursue against a background of information about the actual cost their choices impose on other people" (2017b, 84-85, citing Dworkin 2000). Dworkin uses auctions as a mechanism for obtaining resource bundles that align with preferences, and insurance schemes as a way to deliberately manage risk and mitigate the effects of bad luck, lack of skills, and impairments (2017b, 86-88). In the Dworkian framework, insurance ensures equality in the *ex ante* risk of bad luck, but not necessarily in the *ex post* outcomes (2017b, 89). As a result, insurance helps to define a minimum distribution based on compensation owed to those experiencing bad luck or impairments, while allowing for

[18] This may be thought of as a "restorative approach" to understanding the distribution of transportation benefits, which goes beyond a "proportionality approach" in order to distribute transportation investments in a way that "favors underserved communities and reduces inequalities over time" (Martens and Golub 2014, as cited in Williams and Golub 2017, 19).

differences in resources above the minimum (2017b, 89). Martens acknowledges that both the Rawlsian original position and the Dworkian case of bad luck are instructive in developing principles of just distribution; they both provide insight into the principles a rational agent would use when making decisions about the fair distribution of resources (2017b, 89, 91). Ultimately, however, Martens finds the Dworkian approach to justice more compelling due to its acknowledgement of the manner in which equality has "a price that a rational agent is only willing to pay to a limited extent" (2017b, 89).

The Dworkian framework serves as the basis for the subsequent theoretical extensions developed by Martens for the transport good. Martens extends Dworkin's fictive island construct to eight hypothetical scenarios that incorporate variations in residential location, transportation services, travel-related impairments, income, and insurance schemes (2017b, 90-122). For the purposes of this study, I highlight here two conclusions. First, Martens finds that "justice *requires* transportation subsidies" for those with insufficient income to limit their income shortfalls, providing the "moral underpinnings" for the real-world subsidization of public transport (2017b, 114, italics in original). Second, Martens argues that insurance should be available to protect against risks associated with travel-related impairments, travel costs, and residential location (2017b, 121-124). Especially relevant for this dissertation are travel cost risks. Martens maintains that only those with insufficient income are entitled to travel cost subsidies, while those with sufficient income should pay their full travel costs (2017b, 124). He reiterates that "any form of subsidy to lower the costs of using the transportation system for [those with sufficient income] is at odds with the demands of justice" (2017b, 124). In a webinar for the Institute for Transportation and Development Policy, Martens described as questionable the

value of a blunt subsidy that could lead to "subsidizing many people who could actually afford the full price" of their transport (Martens 2016b, 48:10 of recording).

Overall, Martens argues that accessibility insurance schemes "should be seen as the practical manifestation of [the] classical government duty" to "protect citizens from exclusion" and other forces that "may infringe a person's freedom" (2017b, 125-126). Martens concludes his discussion of the scenarios by introducing four principles of justice-based transport planning:

> 1) the experience of insufficient accessibility is unjust;
> 2) everyone is entitled to insure against the risk of insufficient accessibility;
> 3) accessibility for all requires that insurance proceeds be used to reduce accessibility insufficiencies; and
> 4) interventions are just if they do not increase the number of people experiencing insufficient accessibility or further reduce the accessibility levels of those already experiencing insufficient accessibility (2017b, 126).

This prompts him to explore the concept of sufficient accessibility. Before turning attention to that concept, I provide a distillation in Table 2 of the development of the Martensian perspective on criteria for just transport planning.[19]

Table 2. Refinement of the Martensian Criterion for Transport Justice

Need improves upon the traditional transport planning criterion of *demand*, but suffers from challenges in distinguishing wants versus needs and may therefore be overly invasive or paternalistic in practice (2006)
The ***maximax criterion*** improves upon the simpler concept of *need* and formalizes concern for the least advantaged in society, but suffers from lack of attention to inevitable tradeoffs faced by planners and does not necessarily ensure sufficient accessibility (2012, Martens, Golub, and Robinson 2012)
The ***sufficiency principle*** improves upon the *maximax criterion* by more explicitly recognizing tradeoffs and ensuring sufficiency, but does not incorporate inequality considerations and may be complex to translate into practical settings (2015, 2017b)

[19] Martens arrived at the maximax criterion through a process of elimination, while his theory of transport justice based on the sufficiency principle resulted from systematic reasoning (Martens 2017a). This study is informed and motivated by both criteria.

Having developed "a conditional right to sufficient accessibility,"[20] Martens devotes attention to developing the notion of sufficient accessibility as well as guidance for determining a sufficiency standard (2017b, 128-129). Building upon the social exclusion literature, Martens describes how a lack of accessibility can become a barrier to achieving a sufficient level of benefits from activity participation (2017b, 134). Insufficient accessibility may therefore be understood to occur when "accessibility levels are so low that they directly limit the possibility of a person to participate in a normal range of activities" (2017b, 133). That is, insufficient accessibility does not provide ample activity participation choices (2017b, 140-141). This conceptualization of insufficient accessibility reflects Martens' earlier connection of accessibility with human dignity and choice, and he reinforces that diminishing marginal returns suggest accessibility improvements will have the greatest impact for those with low accessibility (2017b, 132-133).

Martens holds that insufficient accessibility represents "the domain of justice" where people are "entitled to corrective measures to improve their accessibility" (2017b, 142). Such corrective measures should be financed by the entire society, and justifiably sourced from "general taxation" (2017b, 142). Echoing the earlier discussion of mitigating travel cost risks, Martens notes that, from a justice perspective, general taxation should be reserved and only used "for financing measures that reduce" insufficient accessibility (2017b, 142).[21] Concomitantly, those experiencing sufficient accessibility are "not entitled to accessibility improvements financed through" general taxation, but instead may improve their situation through self-financing as long

[20] In a recent comparison of equity in healthcare, education, housing, and transport, Jeekel and Martens (2017, 10-11) argue for consideration of a right to adequate transport. Additional recent works in planning also discuss a fundamental right to transport and inclusion (Deka 2004, Lucas 2004c, Sanchez et al. 2007). The Leadership Conference on Civil and Human Rights also describes transport equity as "a civil and human rights priority" (2017).
[21] Aligned with this argument for general taxation to support subsidies for those with insufficient accessibility, Block-Schachter discussed the potential for a transit pass program funded by property taxes to enable the poor to pay less for transit and "decrease costs most for those people who are least well off" (2009, 177-178).

as it does not impinge on the accessibility of the least-advantaged (2017b, 142-143). Martens describes the utility of a sufficiency standard for transport justice: "the range below the threshold belongs to the domain of justice; here, improvements in accessibility are *required* and should be financed by *a faire scheme of taxation*" while "the range above the threshold belongs to the domain of free exchange" (2017b, 144, emphasis in original).[22]

Martens introduces a coordinate system to aid in conceptualizing the role of transport planning in addressing insufficient accessibility and promoting a fair transport system (see Figure 8.1 in Martens 2017b, 155-157). In this coordinate system, the horizontal axis represents potential mobility and the vertical axis represents accessibility; interactions between these measures generate domains with distinct meanings.[23] Each axis represents the average of its respective measure, such that the sufficiency level for accessibility is likely to fall below the horizontal axis (2017b, 156). Martens envisions the role of transport planning as constrained to the two quadrants to the left of the vertical axis. In these quadrants, individuals experience below-average potential mobility due to relatively poor service by the transportation system (2017b, 156). Critically, not everyone to the left of the vertical axis is entitled to support for improvements; rather, such a "domain of justice" is reserved for those in the lower-left quadrant, labeled Quadrant I, who experience both insufficient accessibility and below-average potential mobility (2017b, 156-157). The role of transport planning based on justice is "first and foremost, [to] address the plight of these [Quadrant I] population groups" whose insufficient accessibility is largely due to "a poorly functioning transportation system" (2017b, 157). Meanwhile,

[22] The importance of "critical or 'threshold' accessibility levels" has long been recognized (Pirie 1979, 299, quoting Anderson 1971).

[23] This framework aligns with the reasoning developed by Wachs and Kumagai, who remarked that "both location and access to an automobile or transit system must be considered jointly in determining the household's accessibility to opportunities" (1973, 443).

population groups to the left of the vertical axis but above the accessibility sufficiency threshold are in what Martens calls the “domain of free exchange” where individuals are responsible for improving their situation through market exchange (2017b, 157). Those to the right of the vertical axis are well-served by the transport system and therefore outside of the purview of transport planning; adjustments to their circumstances may be made via free exchange.

Martens devotes attention to several additional issues, including the measurement of accessibility, the role of transport planning in the experience of sufficient accessibility, the identification of groups experiencing insufficient accessibility due to a poor transport system, and the setting of priorities (2017b, 149, 157-172). For the purposes of this study, I highlight two of them. First, Martens acknowledges that measuring accessibility is a complex task and therefore refrains from detailing an exact method for its measurement (2017b, 151, 153-154). Accessibility measures may be relatively simple, and should aim to offer an indication of accessibility deficits and the risk of “participation poverty” (2017b, 153). Second, Martens compares the valuation of accessibility improvements across utilitarianism, sufficientarianism, and prioritarianism. Martens finds prioritarianism to be the most compelling; it has a depreciating priority slope, where the value attached to accessibility gains is inversely related to the initial accessibility levels experienced by a population group (Martens 2017b, 171-172). As a result, groups contributing the most to the regional accessibility deficiencies are the most deserving of improvements to their accessibility levels (Martens 2017b, 160-162). This relates to his earlier use of the principle of diminishing marginal utility, which suggests gains for marginal increases in accessibility should be valued higher among those with the smallest initial choice sets (Martens 2006, 11, 2017b, 171-172). Having reviewed the development of the Martensian

theory of transport justice, I am now ready to turn to the application of the theory to the topic of this study, commuter benefits.

2.3. Application of the Martensian Theory of Transport Justice to Commuter Benefits

Martens developed his theory of transport justice with the intent to address "the *physical* design of the transportation system – the set of infrastructures, facilities and services that enable movement and thus provide persons with accessibility and the possibility of participating in out-of-home activities" (2017b, 150). However, I also find it to be a compelling foundation for an analysis of commuter benefits.[24] Recall that in his discussion of unfair income differentials, Martens avers that, from a justice perspective, those with insufficient income are entitled to transport subsidies to limit their income shortfalls (2017b, 114). Concomitantly, those with sufficient income should pay the full cost of their transport and are not entitled to transport subsidies; this is the case for the majority of the population in most developed societies (2017b, 124, 48:10 of recording, 2016b, 2017a). Importantly, Martens opines that, from a justice perspective, "commuter benefits are no longer needed for the majority of [the] population" and make possible a "double injustice" *if those with sufficient income receive commuter benefits while those with insufficient income do not* (2017a, emphasis my own).[25] In an ideal case, most people would pay the full cost of their travel, and only a small share of the population with insufficient income would receive any "person-linked subsidy on travel" (2017a).

I recognize that a focus on commuter benefits and the working population does not address the accessibility challenges of those outside the workforce (Martens 2017a), who are often among

[24] The following discussion is guided by email correspondence with Dr. Karel Martens in May 2017 regarding his theory as it relates to the topic of commuter benefits.

[25] Martens acknowledges there may be other rationales for commuter benefits, such as incentivizing sustainable transport (2017a), as do I.

society's most vulnerable. There is a rich area of research devoted to the role of transport in employment outcomes, and most studies find that access to automobiles and public transport tends to have a positive impact on employment.[26] Meanwhile, a "lack of reliable and convenient transportation has remained a significant obstacle to families trying to pull themselves off welfare and out of poverty" (Sanchez et al. 2007, 10) and can have the effect of "limiting earnings and upward mobility for the most economically disadvantaged families" (Stolper and Rankin 2016, 13). Acknowledging that some of society's most vulnerable citizens are outside of the workforce, I proceed with a focus on employer-based commuter benefits to give more attention to current conditions in relation to transport justice, especially for the most vulnerable among the working population.

There are two key issues to consider in applying the Martensian theory of transport justice to commuter benefits: 1) entitlement to the benefits; and 2) their impact on accessibility (2017a). In identifying those entitled to commuter benefits, there are two dimensions of accessibility costs to consider: time and money (2017a). Martens envisions four scenarios:

1) sufficiency in both monetary and temporal dimensions;
2) sufficiency in monetary dimension/insufficiency in temporal dimension;
3) insufficiency in monetary dimension/sufficiency in temporal dimension; and
4) insufficiency in both monetary and temporal dimensions (2017a).

Commuter benefits are not justified in the first scenario, which would typically be the case for those with access to automobiles and sufficient income (2017a). However, commuter benefits may be a justified strategy in the other three scenarios, depending on the availability of transport alternatives. In the second scenario, characterized by sufficiency in the monetary but not

[26] Todd Litman's report "Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning" reviews many studies in this area (Litman 2017b, see also, e.g., Sanchez 1999, Raphael et al. 2001, Cervero, Sandoval, and Landis 2002, Sanchez, Shen, and Peng 2004, Sanchez et al. 2007, 53-57, Sanchez 2008, Thakuriah 2011, Thakuriah et al. 2013, Tyndall 2017, Center for Transportation Studies 2017).

temporal dimension, commuter benefits would be one strategy to consider if an alternative transport option that would provide sufficient accessibility in the temporal dimension were available. However, if no such alternative exists, the transport system would need to be improved, and commuter benefits would not be an appropriate strategy (2017a). In the third scenario, where there is sufficiency in the temporal but not monetary dimension, commuter benefits may be an appropriate strategy if a transport alternative is not available which offers sufficiency in both dimensions. Finally, in the fourth scenario, where there are insufficiencies in both the monetary and temporal dimensions of accessibility, commuter benefits are justified if an alternative transport option exists that would provide sufficiency across both dimensions. If no such alternative exists, the transport system itself would need to be improved, as in the second scenario (2017a).

This study is especially guided by the Martensian emphasis that individuals are entitled to commuter benefits if they experience insufficient accessibility. As described further in the following chapter, I focus in particular on access to employer-based transit subsidies among workers with the lowest incomes, who may be the most likely to experience insufficiency in either or both of the monetary and temporal dimensions of accessibility. I also apply the theory by evaluating whether the subsidies are significantly associated with accessibility levels, including differentials between income groups. In this way, I seek to build upon the maximax criterion focus on accessibility gaps.

2.4. The Discussion of Justice in the Commuter Benefits Literature

Having introduced an application of the Martensian theory of transport justice to the topic of commuter benefits, I now turn to discussing the concept of justice in the academic literature on commuter benefits. While congestion and environmental effects have been a primary focus,

transport justice implications have been recognized in the academic literature on commuter benefits for nearly half-a-century. On the whole, this literature has suggested that commuter benefits have significant relevance to distributional concerns.

Segelhorst and Kirkus (1973) provide an early example of research devoted to understanding the impact of car parking subsidies on travel behavior, and explicitly address equity implications. Using microeconomic theory to frame their discussion, the authors identify the problematic likelihood for parking subsidies to bias commuters away from choosing public transport. They note that parking subsidies lead to disproportionate congestion costs for transit riders and disproportionate benefits for those most likely (typically high income workers, among others) to have regular access to an automobile (1973, 61). In this way, congestion and equity effects interact: high income auto commuters are subsidized for increasing congestion while low-income transit commuters incur the added congestion costs, leading to an outcome where "net incomes become more unequally distributed" (1973, 61-62). Segelhorst and Kirkus identify the removal of parking subsidies in urban areas as "the most direct and economically efficient solution" to address the problems they generate, but recognize that treating commuter benefits as taxable income may be challenging (1973, 62-63).[27] They describe the subsidization of both public transport and car parking as a "second best" solution[28] that would remove bias against transit[29]

[27] This call to eliminate or significantly modify the tax-preferred status of employer-based car parking subsidies has continued within the academic literature (see, e.g., Vuchic 1999, Shoup 2005b, Wall 2007) as well as the advocacy community (TransitCenter and Frontier Group 2014, 2017).

[28] In their review of the 30-year history of tax-free transit benefits in the U.S., Baker and colleagues echo this description of transit subsidies as a "second best" solution and "free parking offset" (Baker, Judd, and Oram 2010, 1, 3, 18). Similarly, the American Public Transportation Association recently argued that transit benefits are a way to "fairly balance incentives for auto use such as free or reduced-rate parking" (2017a, 17).

[29] The issue of bias in commuter subsidies across modal user groups was recognized as early as 1973, when a representative of the U.S. General Accounting Office replied to a query regarding equal treatment of federal employees in relation to commuting by stating that "the Government should not assume a share of its employees' commuting expense by providing free or subsidized parking for a select group of employees when others who pay

and encourage some efficiency and equity gains,[30] but nevertheless still "not discourage general over-utilisation of resources for urban transport" (1973, 63).[31] This description of the tendency for subsidies to benefit those with the most resources is consistent with the critique by Martens of the traditional approach to transport planning. In addition, their observation that subsidies of both modes would result in waste through the encouragement of transport over-utilization relates to the emphasis Martens places on reserving subsidies for those experiencing insufficient accessibility.

A large body of scholarship by Donald Shoup and Richard Willson over several decades has focused on the relationship between employer subsidies for car parking and commuter travel behavior (Shoup and Pickrell 1980, Willson and Shoup 1990, Willson 1992, Shoup and Willson 1992, Shoup 1997, 2005a, b). Alongside discussions of congestion, air pollution, and energy use, these authors have also highlighted the tendency for car parking subsidies to benefit higher income groups (Willson and Shoup 1990, 145). Shoup's framing of "parking cash out" as a way

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for commercial parking or use public transportation do not receive a similar benefit" (Moore 1973). While this issue has often focused on transit fare versus car parking subsidies, another example comes from a U.S. Department of Transportation report on bicycling from 1980, which discussed incentives to provide "bicyclists at least the same level of benefits enjoyed by automobile commuters" (U.S. Department of Transportation 1980, 17, 35-36). More recently, Gates argues in a Master's thesis on incentives to reduce SOV commuting that, "from an equity perspective, bicyclists and walkers should receive the same subsidy as their driving or transit-riding co-workers" (2015, 65, 82). Disparities in the tax treatment of commuter benefits have existed since prior to 1984 (when an allowance for tax-free transit benefits was enacted), and persists to the present. In most years since 1984, the maximum allowable amount for transit was significantly lower than the amount for car parking; parity between car parking and transit maximum allowable amounts (currently $255 per month) was not made permanent until tax-year 2015. Meanwhile, bicycling was added in 2009, but at a monthly maximum of $20.

[30] Since the publication of this article, many studies have acknowledged the potential for public transport subsidies to offer equity gains in terms of support for low-income workers, who tend to ride public transport at higher rates than others. For example, Root described how "existing bus users would benefit from service enhancements" spurred by the greater transit patronage likely to result from subsidies for transit (2001, 112). Tony Dutzik, Senior Policy Analyst at Frontier Group, identified for me the elimination of restrictions on federal transit subsidies for transit operations as a policy reform that could enable lower transit fares or support service provision and ultimately benefit low-income riders (2017).

[31] Vuchic makes a similar point, arguing that simultaneous incentives for public transport and car use tend to result in greater overall costs, and cites the federal tax treatment of employer-based car parking subsidies as one example (1999, xxiii).

of "subsidizing people, not parking" (Shoup 1997, 201, 215) aligns with the emphasis by Martens to place people at the center of transport planning. In *Parking Cash Out* (2005b, 76-79), Shoup devotes attention to the ways in which this mechanism[32] may benefit traditionally disadvantaged groups, such as low-income workers, who tend to commute to work in single occupancy vehicles at lower rates. He describes parking cash out as a way to promote "both tax equity and transportation justice" and argues that "avoiding bias in transportation policy is simple transportation justice" (Shoup 2005b, 78).

While the literature has found a tendency for car parking subsidies to benefit higher income groups, there is also recognition that the removal of these subsidies may negatively impact lower income workers in certain circumstances. For example, Kuppam and colleagues cautioned in a study of stated responses to parking pricing for the Washington, DC, area that pricing levels should aim to achieve "desired transportation impacts…without causing hardship to lower income populations" (Kuppam, Pendyala, and Gollakoti 1998, 45). Similarly, when studying transportation demand management strategies in Portland, OR, Bianco described the challenge of effectively influencing workers who can afford to pay increased parking prices without reaching such high levels that "the resulting inequity for lower-income groups [would outweigh] the societal gain of the mode shift" (Bianco 2000, 52). In a study of road and parking pricing impacts on commuter mode choice in Vancouver, BC, Washbrook and colleagues found price elasticities of demand peaking in middle income ranges; they attributed the relative lack of price sensitivity of low-income workers to their limited choice sets, and cautioned that these workers could be pressured to either pay the charges or shift to (potentially low quality) public transport

[32] Parking cash out refers to offering employees the cash equivalent of use of a car parking space.

(Washbrook, Haider, and Jaccard 2006, 634-636).[33] These findings are consistent with the argument by Martens that those with sufficient income should pay the full cost of their travel, while those with insufficient income should receive subsidies to achieve sufficient accessibility. In addition, they relate to the tradeoff of forgoing consumption to maintain sufficient accessibility or forgoing accessibility to maintain consumption often faced by individuals with insufficient income (2017b, 220).[34] Martens argues that taxation should cover subsidies for those with insufficient accessibility to mitigate the tradeoff between consumption and accessibility poverty, and transport system upgrades in recognition of circumstances in which insufficient accessibility may not be adequately addressed through a monetary subsidy (2017b, 218-223). These reflections suggest commuter benefits may have a role to play in supporting sufficient accessibility, but should be considered in relation to the quality of the transport system offerings. With this study, I seek to contribute to the consideration of justice in the commuter benefits literature, through a novel theoretical application of the Martensian theory of transport justice and a focus on factors associated with commuter subsidy offerings.[35] In the following chapter, I discuss in detail the methods I used to study commuter benefits from a Martensian perspective.

[33] This reflects the monetary and temporal dimensions of accessibility outlined by Martens (see 2.3 above).

[34] This consumption versus accessibility poverty tradeoff has been recognized in both the academic and advocacy communities. A 2004 study relying on the Consumer Expenditure Survey attributed the finding that the poorest households spent the smallest share of income on transport to potential differences in time costs, service quality, and consumer expenditures (Sanchez et al. 2007, 35, citing Rice 2004). Agrawal and colleagues describe how low-income individuals use reductions in non-transport spending as a strategy to manage household resources in relation to transport costs (2011, 35). Deka notes that increases in transport expenditures by low-income households may be accompanied by reduced consumption of other goods and services (Deka, 339). Meanwhile, an advocacy report on transportation equity argues that automobile-oriented investments either lead to isolation, or "force low-income people to overspend on transportation and forego other necessities" (The Leadership Conference Education Fund 2011, 6, 8). Another advocacy report about transit affordability in New York City describes how "many of the most vulnerable families must choose between spending on basic necessities or important trips that connect them to the workforce and social supports" (Stolper and Rankin 2016, 7, 12).

[35] See 5.3 below for reflections on the Martensian perspective, including discussion of an alternative perspective on social justice and its implications for the study of commuter benefits.

3. Empirical Strategy

This study's first chapter reviewed affordable access challenges facing the working poor and the aggregate evidence suggesting employer-based transit subsidies may remain largely out of their reach. In the second chapter, I adopted a Martensian theoretical perspective on transport justice and described my contribution to the commuter benefits literature. With this foundation in place, I now turn attention to providing an overview of the empirical strategy employed in this study. In this chapter's first section, I present the principle research questions evaluated in the empirical portion of this dissertation, as well as the corresponding hypotheses. In the second section, I describe the study sample and data, and include a review of planning efforts by the regions in the study sample to integrate accessibility and equity planning. In the third section, I discuss the methods employed to analyze the data, and discuss expectations regarding the explanatory variables included in the modeling.[36]

3.1. Research Questions

Eligibility for commuter benefits and their effects on accessibility are critical issues to consider when evaluating commuter benefits from a transport justice perspective (Martens 2017a). In particular, society should devote accessibility support to those with the greatest accessibility deficits, typically those with insufficient income. I present the following research question to assess whether the pattern of existing commuter benefit offerings follows a just pattern:

> ***Does the likelihood of being offered an employer-based transit subsidy vary across income groups?***

While aggregate data sources such as the National Compensation Survey suggest disparities exist in subsidized commuting across income groups, this is the first study to investigate the subject with disaggregate data and control for additional worker and employer characteristics. With this

[36] See 5.3 below for reflections on the empirical strategy, including discussion of rationales and acknowledgment of limitations.

question, I seek to evaluate existing patterns of commuter benefit offerings in relation to the Martensian notion that those with the least resources should receive the most support. While the focus of the empirical section is on transit subsidy offerings, I also conduct a preliminary assessment of commuter benefit impacts on accessibility with the following research question:

> ***Are employer-based transit subsidies associated with accessibility levels, as measured by total daily trips, both in terms of averages among low-income workers as well as differences between low-income workers and those with higher incomes?*** [37]

This question especially takes inspiration from the maximax criterion's consideration of accessibility gaps. I offer the following hypotheses for these research questions:

> *First, income is positively associated with the likelihood of being offered an employer-based transit subsidy, even after controlling for factors such as car parking subsidies, employer type, employer location, occupation, and work schedule. Second, the offer of employer-based transit subsidies is positively associated with daily trip-making among low-income workers. Third, accessibility differentials between low- and high-income earners are reduced by the presence of employer-based transit subsidies.*

As a result, I anticipate that low-income workers will be less likely to have access to employer-based transit subsidies than workers in higher income categories. Further, I anticipate that low-income workers with employer-based transit subsidies will make more daily trips than low-income workers without the subsidies, and that differentials between low-income workers and those in higher income groups will be lower among workers with the subsidies than among those without them. These hypotheses suggest that employer-based transit subsidies in their current form may be a worthy policy area for reform, especially for policymakers interested in increasing affordable access to opportunities and promoting transport justice.

[37] I follow Ralph in using total daily trips, described "as a proxy for respondent's access to opportunities," as a person-level accessibility measure (2015, 36). Martens offers guidance that the measurement of accessibility should support the assessment of the risk of "participation poverty" (2017b, 153), and this is an active area of research (see, e.g., Handy and Niemeier 1997, Geurs and van Wee 2004, Martens 2016c). I recognize that analyzing current trip-making may be problematic from a transport justice perspective, and reserve for future research a more in-depth treatment of the relationship between commuter benefits and sufficient accessibility.

3.2. Study Sample & Data

This study focuses on employer-based transit benefits in large U.S. metropolitan areas, which tend to offer diverse transport systems and services for daily travel and are more likely to have significant numbers of employers offering commuter benefits for public transport. In addition, large metropolitan areas are likely to have Metropolitan Planning Organizations ("MPOs") with the resources to conduct and compile regional household travel surveys, which offer the best regionally representative disaggregate passenger travel data currently available.[38] The U.S. Department of Transportation's Metropolitan Planning Organization Database lists 22 MPOs with residential populations greater than 2.5 million; I was able to obtain a recent household travel survey with information about employer-based transit benefits for a total of 10 of them.[39] Table 3 presents the 10 U.S. MPOs included in this study, along with their associated major cities, residential populations, and travel survey collection years. Figure 1 presents a map of all 22 large MPOs, revealing a geographic skew in the sample. This study used regional household travel surveys, except for those MPOs located in California. For the Los Angeles, San Diego, and San Francisco MPOs, I used the state's 2010-2012 California Household Travel Survey and a unique MPO identifier ("MPO Sample") to isolate workers in each of these regions. In general, household travel surveys collect information at the household and individual levels, and also include information about individual trips based on a 24-hour travel diary for each household member.

[38] The nationally representative 2001 and 2009 National Household Travel Surveys did not collect information about employer-based transit benefits.

[39] Appendix A provides information about the process I used to obtain the travel survey data files for the MPOs included in the study. Appendix B lists the 12 large MPOs I was not able to include; most of the large MPOs excluded from the study did not collect information about employer-based transit benefits in their most recent household travel surveys.

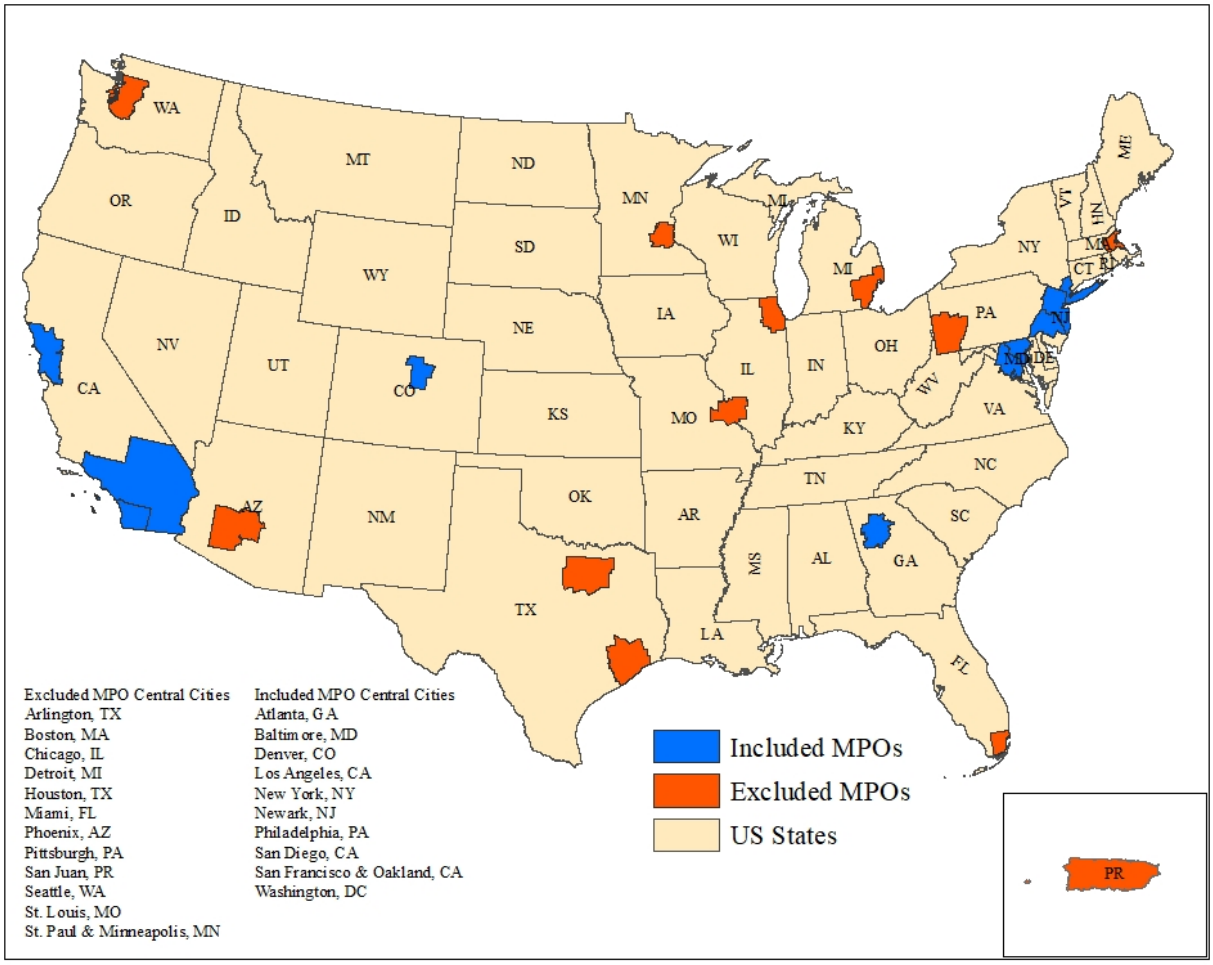
Table 3. List of the MPOs and Corresponding Travel Surveys Included in the Study

MPO	Major City	2010 Population	Survey Year/Type
Atlanta Regional Commission	Atlanta, GA	4,818,052	2011/Regional
Baltimore Regional Transportation Board	Baltimore, MD	2,684,661	2007-2008/Regional
Delaware Valley Regional Planning Commission	Philadelphia, PA	5,626,318	2012-2013/Regional
Denver Regional Council of Governments	Denver, CO	2,827,082	2009-2010/Regional
Metropolitan Transportation Commission	San Francisco, CA	7,150,828	2010-2012/State
National Capital Region Transportation Planning Board	Washington, DC	5,068,737	2007-2008/Regional
New York Metropolitan Transportation Council	New York, NY	12,367,508	2010-2011/Regional
North Jersey Transportation Planning Authority	Newark, NJ	6,579,801	2010-2011/Regional
San Diego Association of Governments	San Diego, CA	3,095,271	2010-2012/State
Southern California Association of Governments	Los Angeles, CA	18,051,203	2010-2012/State

Note: Compiled using the U.S. Department of Transportation's Metropolitan Planning Organization Database (2017a).

Jurisdictions in three of the MPOs included in the study (San Francisco and Berkeley in the Bay Area, Washington, DC, and New York, NY) have passed transit benefit ordinances over the past decade. The California survey used for the San Francisco MPO was conducted *after* implementation of transit benefit ordinances in that region, while the surveys for Washington, DC, and New York, NY, were both conducted *before* implementation of transit benefit ordinances in those cities. Thus, the study mainly looks at employer-based transit benefit offerings in the absence of transit benefit ordinances, with the exception of the findings for the San Francisco sample. This study may therefore have some relevance for cities or regions contemplating commuter benefit ordinances.

Figure 1. Map of All U.S. Metropolitan Planning Organizations With Populations Over 2.5 Million



Note: I created this map using data from the U.S. Department of Transportation's National Transportation Atlas Database and Metropolitan Planning Organization Database (2017a, b), and the USA Contiguous Albers Equal Area Conic projection; Puerto Rico is not to scale.

Across the 10 MPOs, I worked with six different survey formats.[40] To account for survey format variation and enable the use of appropriate survey weights, I maintained seven datasets[41] based on the following MPO groupings: 1) Atlanta; 2) Baltimore and Washington, DC; 3) Denver; 4)

[40] The Washington, DC, and Baltimore, MD, MPOs collaborated on their 2007-2008 surveys, while the Newark, NJ, and New York, NY, MPOs jointly administered their 2010-2011 survey, and the California MPO samples were derived from the same 2010-2012 statewide survey.

[41] Tian recently completed a dissertation on travel behavior and the built environment which pooled data from 23 regional travel surveys, with the principle rationale for pooling described as increased explanatory power and external validity (2017, 16, 69). See 5.3 below for discussion of my choice to forgo pooling the data.

Los Angeles & San Diego; 5) Newark and New York; 6) Philadelphia; and 7) San Francisco. These groupings are based on MPOs that share a geographic border and travel survey format.

I conducted a targeted review of the regional transportation plans for the 10 MPOs included in my study to examine patterns in their efforts to integrate accessibility and equity, especially regarding their stated goals and performance measures (see 2.1 above for general discussion). Appendix C summarizes my findings regarding the integration of accessibility and equity in the plans. Based on the overview by Williams and Golub (2017, 61-67), I especially noted emphases on affordability as well as access to places, infrastructure, and transit. In general, I found strong integration of the concept of accessibility into equity planning. Several of the plans reflected an appreciation of a fundamental connection between accessibility and equity. For example, the Los Angeles regional plan noted the temporal and monetary dimensions of accessibility (like Martens), and described how both accessibility and equity are improved by lowering travel costs and increasing choices (Southern California Association of Governments 2016, 169). This recognition by the MPOs of the role that choice places in accessibility and equity is consistent with the emphasis by Martens on the connections among accessibility, choice, and human dignity. With specific relevance to this study's focus on transit affordability for the working poor, the Philadelphia regional plan lists expansion of access to discounted transit passes for low-income residents as a strategy to promote equitable access (Delaware Valley Regional Planning Commission 2017a, 89). While essentially all of the MPOs in the sample included goals relating to accessibility and equity, there was variation in the degree to which accessibility-based performance measures have been integrated into equity analyses; this is consistent with the finding by Williams and Golub that equity goals are more developed than performance measures (2017). In a few cases, none were readily available, while in several other cases one or two such

measures were included. The most detailed and complex accessibility-based environmental justice performance measures were from the three MPOs located in California (Los Angeles, San Diego, and San Francisco). This could reflect the impact of California's 2008 Sustainable Communities and Climate Protection Act (SB 375), which requires regional transportation plans to include "measures of equity and accessibility" in the form of access to transit and job access by transit across income groups (as accessed via the California Air Resources Board 2017). Overall, this review of the regional transportation plans for the MPOs included in the study helps to contextualize my study of employer-based transit benefits.[42]

3.3. Modeling Strategy & Expectations

In this study, I employ statistical and econometric techniques to model the relationship between dependent and independent variables based on non-experimental (observational) data. I use two forms of maximum likelihood estimation. To model the likelihood of being offered an employer-based transit subsidy, I use binary logistic regression, and to assess the relationship between employer-based transit subsidies and total daily trips, I use negative binomial regression. For both modeling efforts, I use standard errors robust to clusters at the household level. I relied upon the Stata and Excel software packages to conduct the analysis and compile the results.

In general, multiple regression analysis builds upon binary tabulations and bivariate correlations. It models the relationship between a dependent variable and two or more independent variables, which we expect are associated with the dependent variable.[43] This gives us a degree of

[42] Review of the regional transportation plans for the 12 large MPOs excluded from the study was beyond the scope of my efforts, but such a review could inform an assessment of the degree to which the study sample is representative of all large MPOs in terms of patterns in planning efforts to integrate accessibility into equity planning. Such a review could also inform whether the geographic skew of the sample toward coastal regions and away from interior regions has any significance with respect to transport policy and planning.

[43] Because my analysis of the association between transit subsidies and accessibility is preliminary, I use the simple form of negative binomial regression, which contains a dependent variable and a single independent variable.

confidence that the effect we are attributing to a given independent variable is not, in reality, due to the effect another independent variable is having on the dependent variable. Maximum likelihood estimation is a probability-based technique, of which binary logistic regression and negative binomial regression are both examples. Logistic regression is appropriate for a limited dependent variable that takes on only two values (i.e., present/absent), while negative binomial regression is appropriate for over-dispersed count outcomes (Cameron and Trivedi 2010, 462, 577).[44] Below, I operationalize my hypotheses and present the modeled relationships between employer-based transit subsidies and income, as well as total daily trips and transit subsidies.

1) Pr(employer-based transit subsidy=1) = $\Theta(\beta_0 + \beta_1$ employee income + β_2 car parking subsidy + β_3 employer location + β_4 employer type + β_5 schedule type + β_6 occupation + $\varepsilon)$
   Sample: all workers
2) Pr(total daily trips=h|x) = $\Theta(\beta_0 + \beta_1$ transit subsidy + $\varepsilon)$
   Sample: workers in 1st income quintile
3) Pr(total daily trips=h|x) = $\Theta(\beta_0 + \beta_1$ income in 2nd-5th quintile + $\varepsilon)$
   Two samples: workers with and without a transit subsidy offering

Appendix D provides information about how I prepared data for each of the variables included in the models; I sought as much modeling consistency across the seven datasets as possible.[45]

In the final portion of this chapter, I discuss prior research that informs my expectations regarding variables included in the study. This the first study to evaluate factors associated with the provision of employer-based transit subsidies using disaggregate data for workers, and the first study to evaluate transit subsidies in relation to a person-level accessibility measure.[46] According to the National Compensation Survey (discussed in Chapter 1), subsidized commuting

[44] In my datasets, the variance/mean ratio for daily trips ranges from 1.2 to 3.0 across the seven cases. Negative binomial regression is therefore more appropriate than Poisson, in which the mean and variance are equal.

[45] The six survey formats varied in the availability and categorization of information about factors of interest. I therefore highlight patterns across the cases in the sign and significance of the coefficients, but not their magnitude.

[46] TransitCenter studied commuter benefit offerings using a survey of employers based in Chicago, New York, and/or San Francisco (2010), but did not break down the offerings across income groups.

varies with income, with only 1% of workers in the lowest decile of income subsidized compared to 19% of workers in the highest decile (Bureau of Labor Statistics 2016, Table 40a). In addition, The Pew Charitable Trusts (2016) recently stated that "jobs with higher pay generally also come with more extensive and expensive benefit packages." As a result, I expect the likelihood of being offered a transit subsidy from an employer to increase with income. The National Compensation survey also suggests that part-time workers receive subsidized commuting at a lower rate than full-time workers, and that workers in service occupations are subsidized at below-average rates while those in public administration and management are subsidized at above-average rates (Bureau of Labor Statistics 2016, Table 40a). Employer size has also been found to be associated with benefit offerings, with large- and medium-sized employers more likely to offer transit benefits than small businesses (TransitCenter 2010, 11, Metropolitan Washington Council of Governments 2016, 105-106); unfortunately, I could not include employer size due to lack of data in the travel surveys. There is also evidence that commuter benefits vary by employer type. For example, the 2016 State of the Commute regional survey for Washington, DC, found that federal workers were offered a transit or vanpooling incentive from employers at higher rates (73%) than those who work in the private (22%) or nonprofit (42%) sectors or those who work for state or local agencies (25%) (Metropolitan Washington Council of Governments 2016, 105).[47] This aligns with a large body of scholarship that suggests fringe benefits are a strategy for closing public-private sector wage gaps (Thom and Reilly 2015, 342). As a result, it would be reasonable to expect the provision of employer-based transit subsidies to be positively associated with public sector (and especially federal) employment.

[47] The relatively high rate of transit benefit offerings among federal workers may relate to the longstanding support for federal agencies to participate in transit benefit programs, dating back to the Treasury, Postal Service and General Government Appropriations Act of 1991 (U.S. General Accounting Office 1993).

I also expect the provision of employer-based transit subsidies to vary by employer location, due to the spatial character of transit service. TransitCenter found the share of employers offering commuter benefits to be twice as high in CBDs compared to locations outside of CBDs (TransitCenter 2010, 3, 13). Likewise, the 2016 State of the Commute regional survey for Washington, DC, found that the share of workers offered transit incentives from employers declined as distance from the regional center increased, from 57% in the region's inner core, to 25% in the middle ring, and 10% in the outer ring (Metropolitan Washington Council of Governments 2016, 106). It seems reasonable to expect, in general, that employers located in central areas with higher levels of transit service will be more likely to offer incentives for its use. Although I am not aware of prior research specifically examining this issue, I expect that a car parking subsidy offering may reduce the chance of being offered a transit subsidy, if they are considered substitutes from an employee benefit package perspective. Finally, with regard to my second outcome variable, total daily trips, prior research (discussed in Chapter 1) suggests daily travel is positively associated with income. National surveys from 1983-2009 indicate that households with the highest incomes make approximately 2.5 times as many annual person trips as the lowest income households (Santos et al. 2011, 18). To my knowledge, no prior research has examined daily trips in relation to transit subsidies, either within or between income groups. This review of prior research informs my interpretation of the results, which are presented in the following chapter.

4. Results

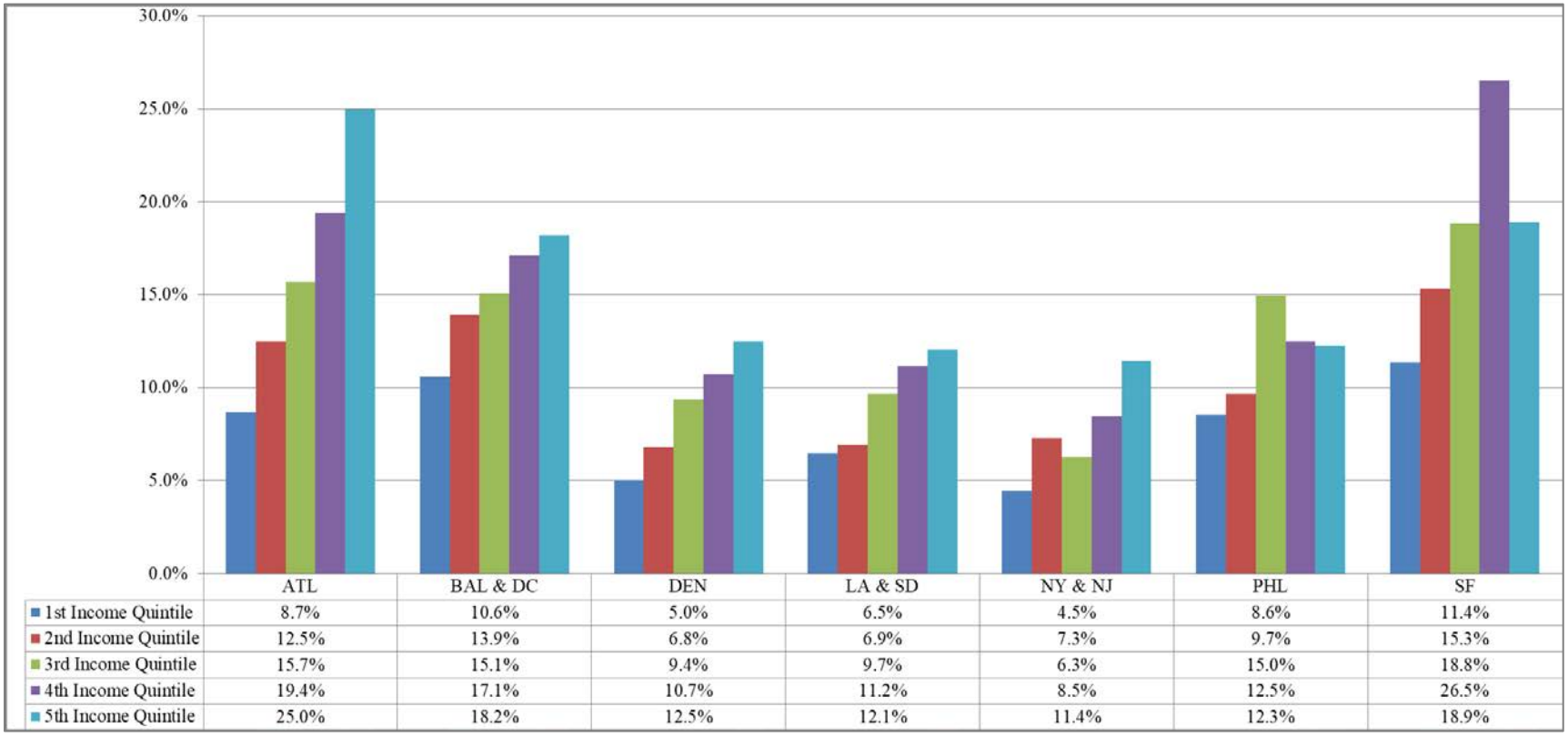
This chapter presents the results of the empirical strategy described in the preceding chapter. In brief review, ***my principle research questions investigate whether the likelihood of an employer-based transit subsidy offering varies by income, and whether these transit subsidies are associated with accessibility levels, as measured by total daily trips***. My study area incorporates data for 10 MPOs organized into seven cases: 1) Atlanta ("ATL"); 2) Baltimore and Washington, DC ("BAL & DC"); 3) Denver ("DEN"); 4) Los Angeles & San Diego ("LA & SD"); 5) New York and Newark ("NY & NJ"); 6) Philadelphia ("PHL"); and 7) San Francisco ("SF"). I assess the outcomes of interest, employer-based transit subsidies along with total daily trips, at the level of individual workers. In the first section, I present binary tabulations for the transit benefit offering across income groups. Next, I provide an overview of patterns across the study area in the binary logistic regression results. Appendices E-K present correlation coefficients, summary statistics, and logistic regression results for each of the seven cases. I present predicted probabilities across income groups in the third section. In the final section, I present results for the evaluation of transit benefit offerings in relation to total daily trips.

4.1. Binary Tabulations (Employer-Based Transit Benefits & Income)

In this section, I present binary tabulations between employer-based transit subsidies and income, and focus on identifying patterns across the seven sets of results. Figure 2 presents the binary tabulations between the share of workers offered an employer-based transit subsidy and household income as categorized by income quintiles. In each of the seven cases, the share of workers offered an employer-based transit subsidy is lowest for workers in the lowest income quintile. The share increases sequentially between the 1st and 5th income quintiles in 4 cases (ATL, BAL & DC, DEN, & LA & SD). Meanwhile, in NY & NJ, the 2nd quintile has a higher

share than the 3rd quintile, in PHL, the 3rd quintile has the highest overall share, and in SF the 4th quintile has the highest share. 1-sided difference-in-means t-tests suggest that the mean for the 1st income quintile is significantly less than the mean for the 2nd-5th quintiles (p-values <0.01) in each of the seven cases. The binary distributions presented in Figure 2 allow for other factors that may be significantly associated with employer-based transit subsidy offerings to simultaneously vary with income. I turn next to statistical techniques that enable an evaluation of the relationship between transit subsidy offerings and income while controlling for other potentially relevant factors.

Figure 2. Share of Workers Offered an Employer-Based Transit Subsidy by Income Quintile



	ATL	BAL & DC	DEN	LA & SD	NY & NJ	PHL	SF
1st Income Quintile	8.7%	10.6%	5.0%	6.5%	4.5%	8.6%	11.4%
2nd Income Quintile	12.5%	13.9%	6.8%	6.9%	7.3%	9.7%	15.3%
3rd Income Quintile	15.7%	15.1%	9.4%	9.7%	6.3%	15.0%	18.8%
4th Income Quintile	19.4%	17.1%	10.7%	11.2%	8.5%	12.5%	26.5%
5th Income Quintile	25.0%	18.2%	12.5%	12.1%	11.4%	12.3%	18.9%

4.2. Logistic Regression Results (Likelihood of Employer-Based Transit Subsidy)

In this section, I present a summary of the odds ratios generated by seven individual logistic regression models for the likelihood of being offered an employer-based transit subsidy. I direct the reader to review Appendices E-K, which contain correlation coefficients, summary statistics, and full logistic regression results for each of the seven cases.[48] The odds ratios presented in this section for each of the seven cases are identical to the odds ratios presented in the full logistic regression result tables contained in the appendices; they are presented alongside each other in this section for compactness. I note here patterns in the direction and significance for each explanatory variable.

Table 4 summarizes sample sizes as well as several measures of goodness-of-fit for the seven individual logistic regression models used to estimate the likelihood of an employer-based transit subsidy offer.[49] Three of the samples have 3,000-5,000 observations (LA & SD, PHL, and SF),

[48] Appendix E contains results for ATL, with full logistic regression results on page 91; Appendix F contains results for BAL & DC, with full logistic regression results on page 94; Appendix G contains results for DEN, with full logistic regression results on page 97; Appendix H contains results for LA & SD, with full logistic regression results on page 100; Appendix I contains results for NY & NJ, with full logistic regression results on page 103; Appendix J contains results for PHL, with full logistic regression results on page 106; and Appendix K contains results for SF, with full logistic regression results on page 109.

[49] McFadden's pseudo-R^2 mimics the R^2 measure of linear regression, but is not a measure of the proportion of variance of the dependent variable explained by the model (Cameron and Trivedi 2010, 471). Instead, it represents one minus the ratio of the maximized log-likelihood value over the intercept-only log likelihood. For models with binary outcomes, pseudo-R^2 is bounded between zero and one. The Hosmer-Lemeshow goodness-of-fit test generates a test statistic for the chi-squared distribution using the average predicted probability and sample frequency in groups generated based on predicted probabilities (Cameron and Trivedi 2010, 472). When the number of covariate patterns is large, using 10 groups is an appropriate default. Rejection of the null hypothesis indicates model misspecification. The Link test is appropriate after any single-equation model, and evaluates model specification by regressing y on y-hat and y-hat^2 while omitting the original model regressors (Cameron and Trivedi 2010, 100). Rejecting the null hypothesis of a coefficient of zero for y-hat^2 indicates model misspecification. Classification statistics provide a measure of predictive capacity and are sensitive to the relative size of groups, with classification into the larger group favored. Sensitivity represents the fraction of observations with y=1 that are correctly specified, while specificity represents the fraction of observations with y=0 that are correctly classified (Cameron and Trivedi 2010, 473-474). The proportional reduction in error measures the reduction in prediction error for the outcome variable, while the concordance statistic uses the area under the Receiver Operating Characteristic curve to measure predictive accuracy.

while two of the samples have 7,000-10,000 observations (ATL, DEN). The two largest samples are for BAL & DC (14,413) and NY & NJ (20,009). Pseudo-R^2 values range across the seven models from 0.048 (SF) to 0.258 (BAL & DC). The Hosmer-Lemeshow goodness-of-fit test indicates there is evidence for model misspecification in four of the models (ATL, BAL & DC, DEN, and NY & NJ). The Link test suggests model misspecification in five of the models (ATL, DEN, LA & SD, NY & NJ, and PHL). SF is the only case where both the Hosmer-Lemeshow and Link tests do not indicate evidence of model misspecification.

Table 4. Sample Size and Measures of Explanatory Power and Model Fit Across the Study Sample (Employer-Based Transit Subsidy Offering)

	Sample Size	***pseudo-R^2***	***Hosmer-Lemeshow GOF p-value***	***Link Test squared-term p-value***	***Sensitivity***	***Specificity***	***PRE***	***Concordance Statistic***
ATL	7,784	0.070	0.075	<0.01	0.5%	99.9%	0.0%	0.686
BAL & DC	14,413	0.258	0.015	0.343	37.5%	95.7%	16.9%	0.839
DEN	7,409	0.174	0.028	0.036	11.8%	99.3%	6.5%	0.783
LA & SD	3,811	0.062	0.618	0.010	0.0%	100.0%	0.0%	0.675
NY & NJ	20,009	0.193	0.001	<0.01	0.0%	100.0%	0.0%	0.824
PHL	4,830	0.122	0.312	0.042	0.0%	100.0%	0.0%	0.752
SF	3,449	0.048	0.642	0.505	0.5%	99.9%	0.0%	0.654

Note: The pseudo-R^2 value measures goodness of fit, with values constrained to the 0-1 range for a binary outcome and higher values indicating a better fit. The Hosmer-Lemeshow goodness-of-fit and Link tests are two additional measures of model fit, and p-values under 0.10 generally indicate evidence of model misspecification. The Hosmer-Lemeshow tests each used 10 groups. Sensitivity, specificity, and proportional reduction in error ("PRE") are classification statistics, with higher values representing greater predictive capacity. The concordance statistic measures goodness of fit; a value of 0.5 means a model does not improve upon random chance in predicting an outcome, while a value of 0.7 or higher is generally considered indicative of a good model.

A review of classification statistics indicates that five of the models have essentially no sensitivity (i.e., the ability to correctly classify positive outcomes); BAL & DC (37.5%) and DEN (11.8%) are the two exceptions. Meanwhile, specificity (i.e., the ability to correctly classify negative outcomes) is high in all seven cases. The related PRE measure indicates only two cases (BAL & DC, and DEN) reduce errors in the prediction of the outcome. As positive outcomes were relatively rare (ATL: 13%; BAL & DC: 16%; DEN: 11%; LA & SD: 13%; NY & NJ: 8%;

PHL: 11%; SF: 18%),[50] the low sensitivity of the models is somewhat expected. All of the models have concordance statistics above 0.5, which suggest they improve upon random chance, and four (BAL & DC, DEN, NY & NJ, and PHL) have values above 0.7.

Table 5 and Figure 3 summarize the odds ratios and significance levels for income, the primary explanatory variable of interest, generated in each of the seven binary logistic regression models to estimate the likelihood of being offered an employer-based transit subsidy. The sign for each income quintile is consistent across the seven cases – all of the odds ratios for the 2nd-5th income quintiles are above the 1.0 level for the 1st income quintile base category. Using a p-value threshold of 0.10, the odds of being offered an employer-based transit subsidy are significantly higher for those in the 2nd income quintile in three out of seven models (BAL & DC, NY & NJ, and SF). Meanwhile, the odds are significantly higher for those in the 3rd income quintile in all but one model (DEN), and higher for those in the 4th and 5th income quintiles in all of the cases.

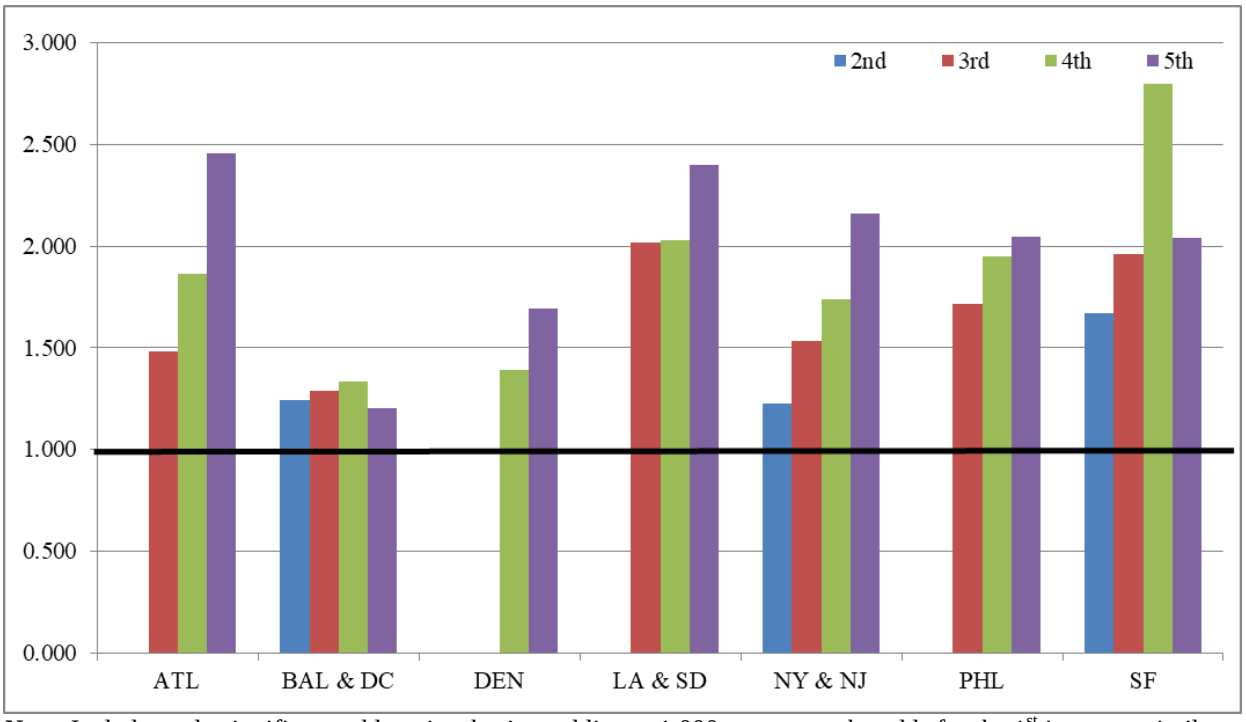
Table 5. Odds Ratios for Income (Likelihood of Employer-Based Transit Subsidy Offering)

	Income Quintile								
	1st (O.R.; Base)	2nd (O.R)	p-value	3rd (O.R)	p-value	4th (O.R)	p-value	5th (O.R)	p-value
ATL	1.000	1.160	0.405	**1.482**	**0.021**	**1.863**	**0.000**	**2.456**	**0.000**
BAL & DC		**1.243**	**0.030**	**1.288**	**0.012**	**1.336**	**0.003**	**1.206**	**0.040**
DEN		1.139	0.554	1.219	0.298	**1.391**	**0.090**	**1.696**	**0.008**
LA & SD		1.272	0.287	**2.015**	**0.000**	**2.032**	**0.000**	**2.399**	**0.000**
NY & NJ		**1.226**	**0.085**	**1.535**	**0.000**	**1.740**	**0.000**	**2.158**	**0.000**
PHL		1.356	0.140	**1.714**	**0.006**	**1.951**	**0.000**	**2.045**	**0.000**
SF		**1.671**	**0.014**	**1.960**	**0.000**	**2.798**	**0.000**	**2.043**	**0.000**

Note: Bold text indicates significance at the 10% level.

[50] These percentages represent the summary statistics for the transit subsidy offering in Appendices E-K. The share of workers offered an employer-based transit subsidy was higher in this study's sample of large MPOs than the national figures reported for subsidized commuting by the Bureau of Labor Statistics (as cited in Chapter 1). This finding of above-average rates in my study area is reasonable, as I focused on the nation's largest MPOs, which tend to have above-average transit service. While the national statistics for subsidized commuting indicate that 2% of low-income workers (in both the bottom quartile and decile) have subsidized commuting, the rate of transit benefit offerings for workers in the 1st income quintile in my study sample ranged from 4.5% (NY & NJ) to 11.4% (SF) (see Figure 2).

Figure 3. Odds Ratios for Income Quintiles (Likelihood of Employer-Based Transit Subsidy Offering)



Note: Includes only significant odds ratios; horizontal line at 1.000 represents the odds for the 1st income quintile (base) category.

In three models (BAL & DC, NY & NJ, and SF), the odds of being offered an employer-based transit subsidy are significantly higher for workers across the 2nd-5th income quintiles, compared to workers in the 1st income quintile. In Denver, only the odds for workers in the 4th and 5th income quintiles differ significantly from the odds for workers in the 1st income quintile. I hypothesized that low-income workers would be less likely to have access to employer-based transit subsidies than workers in higher income groups, even after controlling for other relevant worker and employer characteristics. These results largely confirm this hypothesis, based upon a relatively consistent pattern across the seven cases.

Next, I summarize the results regarding the additional explanatory factors included in each of the seven binary logistic regression models. Table 6 summarizes pairwise correlation coefficients and odds ratios for the offer of employer-based car parking. For each case in which the variable

could be included, the offer of a parking subsidy had a significantly negative pairwise correlation with the offer of a transit subsidy. Likewise, the odds of being offered a transit subsidy were significantly lower for workers offered a parking subsidy in all but one of the models. PHL is the exceptional case, with a significantly negative pairwise correlation but significantly higher odds in the logistic regression. My expectation was for car parking to be negatively associated with a transit benefit offering. These results provide some evidence to support the notion that the benefits may be considered substitutes, but further study could help to explain cases where the two benefits are more likely to be offered together. It could also be the case that the model is attributing to the car parking variable land use characteristics associated with free parking not otherwise captured in the model through the employer location variable.

Table 6. Odds Ratios for Employer-Based Parking Subsidy (Likelihood of Employer-Based Transit Subsidy Offering)

	Corr. Coeff.	p-value	Odds Ratio	p-value
ATL	**-0.100**	**0.000**	**0.571**	**0.000**
BAL & DC	**-0.171**	**0.000**	**0.577**	**0.000**
DEN	**-0.242**	**0.000**	**0.275**	**0.000**
LA & SD	NA			
NY & NJ	**-0.074**	**0.000**	**0.249**	**0.000**
PHL	**-0.039**	**0.005**	**1.617**	**0.000**
SF	NA			

Note: Pairwise correlation with employer-based transit subsidy offering; odds ratio for logistic regression of likelihood of employer-based transit subsidy offering. Bold text indicates significance at the 10% level.

Table 7 summarizes the results for employer type, which could be included in three of seven models. In BAL & DC, federal and state/local government employers are categorized separately, while ATL and NY & NJ provide a single government category. Across the three models, government employment was associated with significantly higher odds of receiving an employer-based transit subsidy. This is consistent with prior research that suggests fringe benefits may serve as a mechanism to compensate for wage gaps between the public and private

sectors. In BAL & DC, federal and state/local public service were separated, and the odds ratio for federal workers (5.323, p-value<0.01) was over four times the odds ratio for state/local workers (1.224, p-value=0.031). This is consistent with the State of the Commute regional study conducted by the DC MPO, which found much higher rates of transit and vanpooling incentives among federal workers (73%) than state or local government workers (25%). In two of the models, non-profit employment was associated with significantly higher odds as well, but in ATL the odds did not significantly differ from for-profit businesses, the base category. This might be due to an approach similar to the one described for the public sector, where fringe benefits are used to compensate for income gaps compared to the private sector.

Table 7. Odds Ratios for Employer Type (Likelihood of Employer-Based Transit Subsidy Offering)

	Government		Federal Government		State/Local Govern.		Non Profit		Self-Employed		Other Type		Foreign/Intern.	
	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value
ATL	**1.566**	**0.000**					1.127	0.338	**0.708**	**0.085**	1.578	0.457		
BAL & DC			**5.323**	**0.000**	**1.224**	**0.031**	**1.303**	**0.001**					0.784	0.368
DEN	NA													
LA & SD	NA													
NY & NJ	**1.182**	**0.049**					**1.620**	**0.000**	**0.203**	**0.000**	1.308	0.189		
PHL	NA													
SF	NA													

Note: Odds ratio for logistic regression of likelihood of employer-based transit subsidy offering. Bold text indicates significance at the 10% level.

As presented in Appendices E-K, employer locations in large cities and regional centers tended to be significantly associated with the likelihood of being offered an employer-based transit subsidy. In ATL, the odds of being offered an employer-based transit subsidy were significantly higher for workers with employers located in DeKalb (ORs: 2.406, p-value<0.01) and Fulton (OR: 2.473, p-value<0.01) Counties, which each contain portions of Atlanta. In the model for BAL & DC, the odds of being offered an employer-based transit subsidy were significantly higher for workers in Arlington County (OR: 7.969, p-value<0.01), Baltimore City (OR: 3.631, p-value<0.01), and Washington DC (OR: 11.149, p-value<0.01), among additional jurisdictions.

In DEN, the odds were significantly higher for workers with employers in Boulder (OR: 11.007, p-value<0.01) and Denver (OR: 2.542, p-value<0.01). In PHL, a Philadelphia worker had significantly higher odds as well (OR: 4.224, p-value<0.01). In the NY & NJ sample, workers in New York City (OR: 9.365, p-value<0.01), Jersey City (5.263, p-value<0.01), and Newark (3.146, p-value<0.01) all had significantly higher odds of being offered a transit subsidy than workers outside of those cities. Among the California cities, the odds of receiving an employer-based transit subsidy were higher for workers in Glendale, Los Angeles, Orange, San Bernardino, and San Diego for the LA & SD sample, and higher in Oakland, Palo Alto, San Francisco, and San Jose for the SF sample. Overall, these findings are consistent with prior research that has found that transit benefit offerings are most common in CBDs and near regional centers. However, the finding of no significant difference in the odds for workers in Berkeley was unexpected (OR: 1.130, p=0.653), especially since that jurisdiction had a transit benefit ordinance in place at the time of the household travel survey.

The final two control variable categories were for work schedule type, and occupation category. ATL, LA & SD, NY & NJ, and SF measured work schedules based on days of work per week. In ATL (OR: 1.223, p-value=0.015) & SF (OR: 1.217; p-value=0.061), those working five days per week had significantly higher odds, while those working six-seven days per week did not have significantly differing odds from the base of one-four days per week. In LA & SD, the odds did not significantly vary across the three categories (one-four days, five days, and six-seven days). Meanwhile, in NY & NJ, those working five days per week (OR: 2.054; p-value<0.01) and six-seven days per week (OR: 1.842; p-value<0.01) had significantly higher odds of being offered a transit subsidy compared to those working one-four days per week. In BAL & DC, work schedule was categorized based on combinations of weekdays versus weekends, and workers

whose schedules included weekends had significantly lower odds of a transit subsidy offer compared to those working only weekdays. In DEN, work schedule was organized by hours per week, and compared to those working part-time (1-29 hours per week), all other workers had significantly higher odds of being offered an employer-based transit subsidy. In Philadelphia, the binary variable capturing a Monday-Friday work schedule was not associated with significantly differing odds of being offered a transit subsidy. Overall, the results for work schedule were mixed, but when significant tended to suggest that those with typical full-time weekday work schedules had a higher likelihood of being offered an employer-based transit subsidy. This is consistent with the expectation that part-time workers are less likely to be offered subsidized commuting. In general, benefits are often limited or unavailable for part-time workers, so these findings are reasonable.

Finally, occupation categories were collected for all regions but BAL & DC. Table 8 summarizes the odds ratios for occupation categories across the study sample. The most consistent trend was for workers in the support services category, who had significantly lower odds of being offered an employer-based transit subsidy compared to the base of management and finance workers in every model for which occupation data were available. This is consistent with the below-average national rate of 5% for subsidized commuting reported for service sector employees by the Bureau of Labor Statistics. In all regions but DEN, those in professional services also had significantly lower odds compared to the base category. In DEN, NY & NJ, and PHL, science & health professionals had significantly higher odds of being offered a transit subsidy, while in ATL, DEN, and LA & SD, production/extraction/military workers had significantly lower odds.

Table 8. Odds Ratios for Occupation Category (Likelihood of Employer-Based Transit Subsidy Offering)

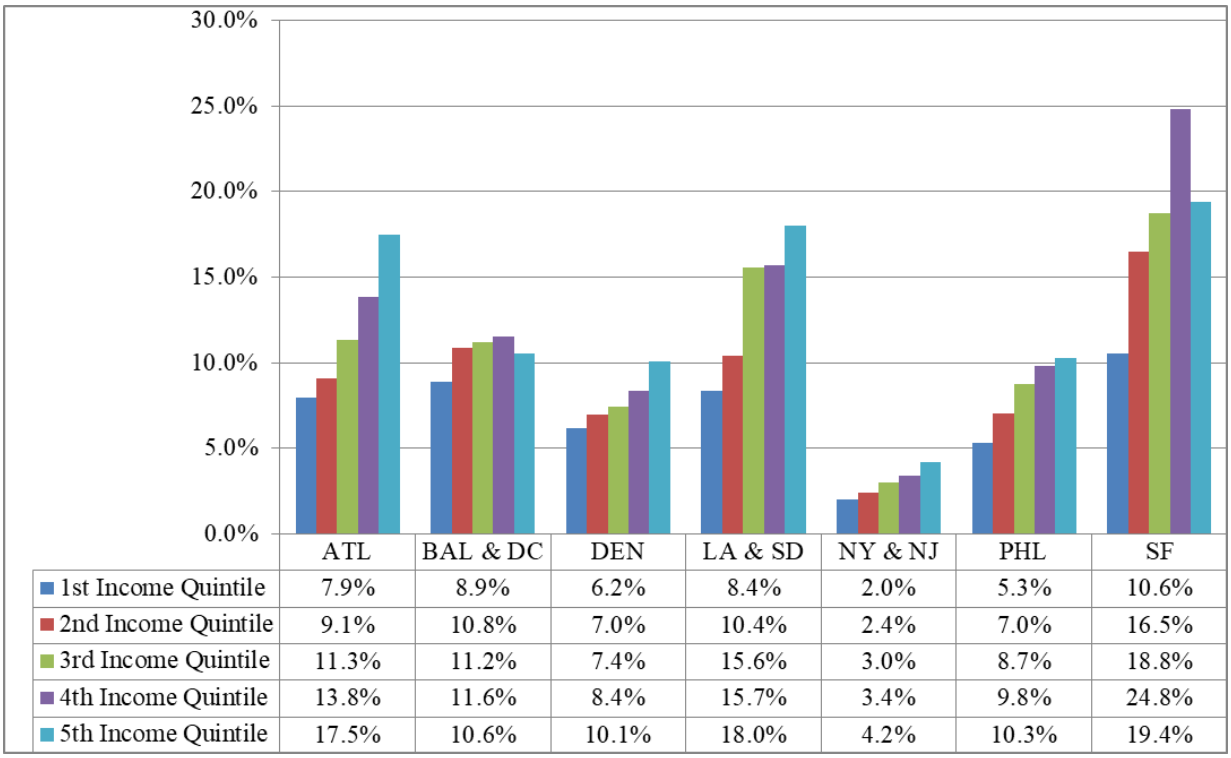
	Management & Finances (Base)	Science & Health Professionals		Professional Services		Support Services		Production, Extraction, Military		Other	
	Odds Ratio	*Odds Ratio*	*p-value*	*Odds Ratio*	*p-value*	*Odds Ratio*	*p-value*	*Odds Ratio*	*p-value*	*Odds Ratio*	*p-value*
ATL	1.000	0.878	0.265	**0.516**	**0.000**	**0.615**	**0.000**	**0.718**	**0.020**	**0.540**	**0.013**
BAL & DC	NA										
DEN	1.000	**1.228**	**0.051**	0.912	0.391	**0.557**	**0.000**	**0.641**	**0.013**	**0.383**	**0.084**
LA & SD		0.867	0.326	**0.663**	**0.004**	**0.574**	**0.000**	**0.467**	**0.000**	0.819	0.456
NY & NJ		**1.319**	**0.007**	**0.667**	**0.000**	**0.761**	**0.002**	0.821	0.157	0.761	0.247
PHL		**1.375**	**0.027**	**0.684**	**0.003**	**0.679**	**0.013**	0.808	0.350	1.349	0.280
SF		1.091	0.500	**0.518**	**0.000**	**0.515**	**0.000**	0.786	0.224	1.168	0.513

Note: Odds ratio for logistic regression of likelihood of employer-based transit subsidy offering. Bold text indicates significance at the 10% level.

4.3. Predicted Probabilities (Employer-Based Transit Subsidy Offering)

The seven binary logistic regression models presented in Appendices E-K may also be used to generate predicted probabilities, which are based on assigning values to the explanatory variables. Figure 4 presents the predicted probabilities for the employer-based transit benefit offering across income quintile, while all other explanatory variables included in the logistic regression are held at their mean sample values. In each case, the probability of being offered a transit subsidy by an employer is lowest for workers in the first income quintile. The probability is highest for workers in the 5th income quintile in five cases (ATL, DEN, LA & SD, NY & NJ, and PHL), and highest for workers in the 4th income quintile in two cases (BAL & DC, and SF). To assess each model's predictive capacity, Table 9 presents the difference between the predicted probability of being offered a transit subsidy and the observed share as listed in the summary statistics for each income quintile. Consistent with the earlier presentation of classification statistics for sensitivity and specificity, most of the models under-predict the occurrence of a transit subsidy offering. In four cases (ATL, BAL & DC, NY & NJ, and PHL), the transit subsidy offering is under-predicted across all five income quintiles. Meanwhile, only one model (LA & SD) over-predicts the transit subsidy offering across all quintiles.

Figure 4. Predicted Probabilities for Employer-Based Transit Benefit Offering Based on Income Quintile (Holding Other Variables at Mean Values)



	ATL	BAL & DC	DEN	LA & SD	NY & NJ	PHL	SF
1st Income Quintile	7.9%	8.9%	6.2%	8.4%	2.0%	5.3%	10.6%
2nd Income Quintile	9.1%	10.8%	7.0%	10.4%	2.4%	7.0%	16.5%
3rd Income Quintile	11.3%	11.2%	7.4%	15.6%	3.0%	8.7%	18.8%
4th Income Quintile	13.8%	11.6%	8.4%	15.7%	3.4%	9.8%	24.8%
5th Income Quintile	17.5%	10.6%	10.1%	18.0%	4.2%	10.3%	19.4%

Table 9. Difference Between Predicted Probabilities and Observed Shares by Income Quintile

	ATL	BAL & DC	DEN	LA & SD	NY & NJ	PHL	SF
1st	-0.8%	-1.7%	1.2%	1.9%	-2.5%	-3.3%	-0.8%
2nd	-3.4%	-3.1%	0.2%	3.5%	-4.9%	-2.6%	1.1%
3rd	-4.4%	-3.9%	-2.0%	5.9%	-3.2%	-6.2%	-0.1%
4th	-5.6%	-5.6%	-2.3%	4.5%	-5.0%	-2.7%	-1.7%
5th	-7.5%	-7.7%	-2.5%	5.9%	-7.2%	-2.0%	0.5%

Given that the transit benefit offering is relatively rare, under-prediction of the transit subsidy offering in the models is to be expected. This concludes the presentation of results regarding modeling the likelihood of being offered an employer-based transit subsidy. The next section turns to the second research question, regarding whether these subsidies are significantly associated with accessibility levels.

4.4. Binary Tabulations and Simple Negative Binomial Regression (Total Daily Trips)

In this final section of the chapter, I present results for the evaluation of accessibility levels, as measured by total daily trips, in relation to the transit benefit offering. I hypothesized that transit subsidy offerings would be positively associated with daily trips among low-income workers, and reduced accessibility differentials between low- and high-income workers. Figure 5 presents binary tabulations for total daily trips among workers in the 1st income quintile (first two columns) as well as the 2nd-5th income quintiles (last two columns), by transit subsidy offering status. Table 10 presents the coefficients and p-values for three separate negative binomial regressions; the outcome in each of the three models is the sum of daily trips. In the first, the transit subsidy offering is the independent variable and the sample is limited to workers in the 1st income quintile. In the second, a binary measure for whether a worker is in the 2nd-5th income quintile is the independent variable and the sample is limited to workers without a transit subsidy. The third uses the binary measure for whether a worker is in the 2nd-5th income quintile as the independent variable, and limits the sample to workers with a transit subsidy.

First, with regard to whether transit subsidy offerings would be positively associated with daily trips among low-income workers, a comparison of the first two columns in Figure 5 indicates mean daily trip values are higher among workers offered an employer-based transit subsidy compared to their counterparts not offered a subsidy in six of the seven cases (with DEN the exception). The first set of negative binomial regression results in Table 10 indicates that a transit subsidy offering was positively associated with daily trips in each of the seven cases; however, the relationship was significant in only two cases (BAL & DC, and NY & NJ). My hypothesis that transit subsidies would be positively associated with daily trips among low-

income workers is therefore supported in only two cases; in the remaining five cases, the subsidies are not associated with significantly differing accessibility levels.

Figure 5. Binary Tabulations for Daily Trips Across Income Quintiles by Transit Subsidy Offering

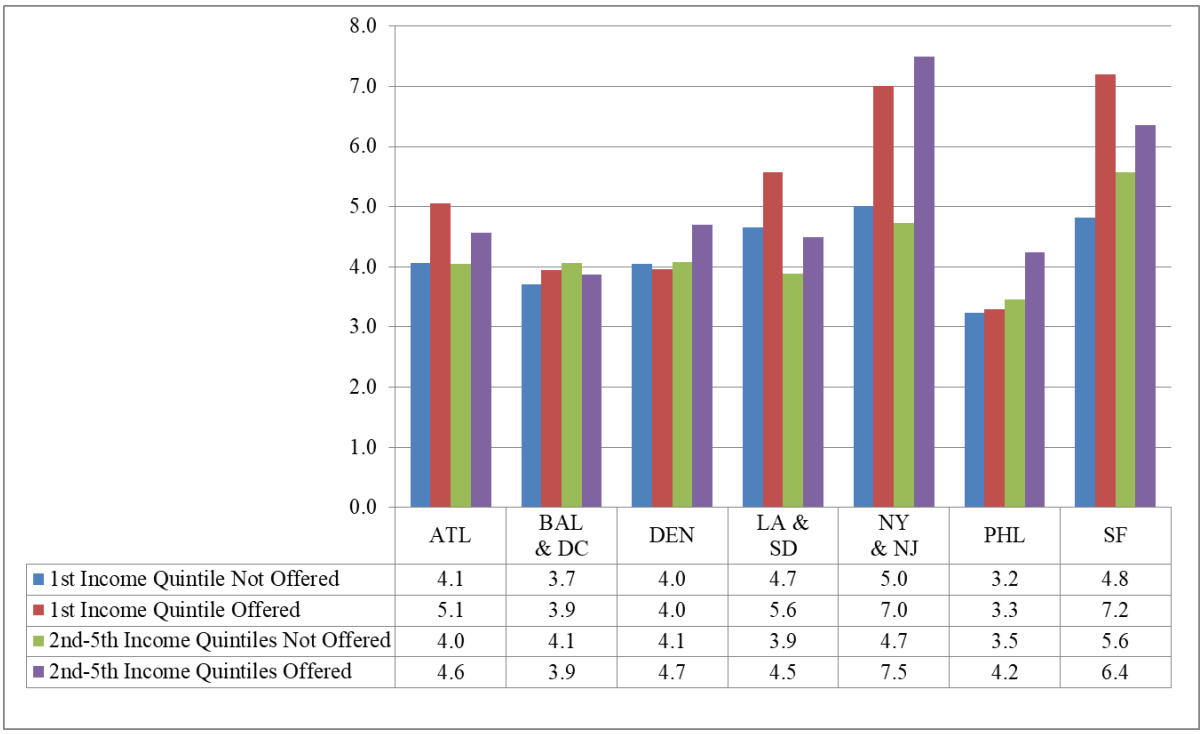


Table 10. Negative Binomial Regression Results (Total Daily Trips)

Sample	1st Income Quintile		Transit Subsidy=0		Transit Subsidy=1	
Variable	Transit Subsidy		High Income		High Income	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
ATL	0.134	0.124	0.011	0.648	-0.039	0.612
BAL & DC	**0.074**	**0.046**	**0.094**	**0.000**	-0.018	0.601
DEN	0.051	0.668	0.013	0.685	0.146	0.188
LA & SD	0.174	0.275	**-0.159**	**0.005**	-0.159	0.306
NY & NJ	**0.487**	**0.000**	**-0.089**	**0.000**	-0.058	0.405
PHL	0.087	0.333	0.030	0.276	0.028	0.741
SF	0.216	0.336	**0.141**	**0.019**	0.017	0.922

Note: Bold text indicates significance at the 10% level.

Second, with regard to whether accessibility differentials between low- and high-income workers are lower in the presence of transit subsidies, two sets of comparisons (between the first and third

columns, and second and fourth columns in Figure 5) indicate mixed results. Among workers not offered a transit benefit, the average number of daily trips is lower for workers in the 1st income quintile in four cases (BAL & DC, DEN, PHL, and SF), but higher in the remaining three cases (ATL, LA & SD, and NY & NJ). The second set of negative binomial regression results in Table 10 indicates that, among workers not offered a transit subsidy, income was significantly positively associated with daily trips in two cases (BAL & DC, and SF), but unexpectedly significantly negatively associated in two cases (LA & SD, and NY & NJ). Meanwhile, Figure 5 indicates that, among workers offered a transit subsidy, daily trip averages are lower for workers in the 1st income quintile in three cases (DEN, NY & NJ, PHL), but even or higher in the remaining four cases (ATL, BAL & DC, LA & SD, and SF). The third set of negative binomial regression results in Table 10 indicates that the income measure was not significantly associated with daily trips among workers offered a transit subsidy in any of the seven cases.

One pattern indicative of an association between transit subsidies and reduced accessibility differentials between income groups would be a significant association between income and daily trips in the absence of a subsidy and an insignificant association in the presence of a subsidy. This pattern was observed from the expected direction (positive coefficient for income) in only two cases (BAL & DC, and SF), but observed from the unexpected direction (negative coefficient for income) in two additional cases (LA & SD, NY & NJ). In total, the results presented in Figure 5 and Table 10 indicate a lack of evidence, in most cases, that transit subsidies are significantly associated with accessibility, both in terms of accessibility levels for low-income workers and accessibility differentials between income groups. The following chapter provides a discussion of these results as well as concluding remarks.

5. Conclusion

This study has explored employer-based transit benefits from a transport justice perspective, motivated by the challenges experienced by the working poor to affordably access opportunities. The Martensian theory of transport justice establishes a philosophical basis for an entitlement to sufficient accessibility and emphasizes that resources to improve accessibility should be devoted to those experiencing the greatest deficits. With this theoretical frame, I evaluated the likelihood of being offered employer-based transit subsidies across income groups, as well as the relationship between these subsidies and accessibility. My study analyzed these questions at the worker-level utilizing household travel survey data for 10 of the 22 largest MPOs in the U.S., organized into seven cases: 1) Atlanta; 2) Baltimore and Washington, DC; 3) Denver; 4) Los Angeles & San Diego; 5) New York and Newark; 6) Philadelphia; and 7) San Francisco. In this final chapter, I interpret the main results of my empirical analysis, describe implications for theory and policy, and reflect on limitations and outstanding questions for future research.

5.1. Interpretation of the Main Results

In each of the seven binary logistic regression models, the odds of being offered a transit subsidy are significantly higher for workers in the 4th and 5th income quintiles compared to the odds for workers in the 1st income quintile (see Table 5 and Figure 3), and the predicted probability of being offered a transit subsidy by an employer is lowest for workers in the 1st income quintile compared to workers in the 2nd-5th income quintiles (see Figure 4). In light of the preferential tax treatment given to employer-based transit subsidies, which will sum to nearly $14 billion for fiscal years 2016-2026, the results of my empirical analysis suggest a pattern of access to employer-based transit subsidies that is regressive and inconsistent with the principles of transport justice. Recall that Martens was motivated to develop his theory of transport justice

because of the tendency for traditional planning to recommend projects that support those with the most resources and least constraints. He was concerned with the regressive nature of policies that led to the compounding and exacerbation of inequities, and argued for the separate Walzerian sphere of transport to ensure its distribution would not be determined by factors that influence free exchange (i.e., money and power). Of particular bearing, Martens argued that the value of accessibility gains should be considered highest among those with the fewest resources and greatest constraints, and that tax-generated supports should be reserved for those with insufficient accessibility. The results of my analysis suggest that the "double injustice" of commuter benefits that Martens warned about is prevalent – those with sufficient income are subsidized while the working poor are not.

I also hypothesized that employer-based transit subsidies would be associated with accessibility levels as well as accessibility differentials. Specifically, I expected transit subsidies to be positively associated with daily trips among low-income workers, and reduced accessibility differentials between low-income workers and those with higher incomes. I found support for these hypotheses in a minority of cases; in most cases, there was no evidence that transit subsidies are significantly associated with accessibility levels for low-income workers or accessibility differentials between income groups. Among workers in the 1st income quintile, the transit subsidy offering was significantly and positively associated with daily trips in only two cases (BAL & DC, and NY & NJ) (see Table 10). With regard to accessibility differentials, there were two cases in which there was a positive association between income and daily trips among workers without a transit subsidy, and an insignificant association in the presence of a transit subsidy. This is the pattern we might expect if transit subsidies were to have the effect of reducing accessibility differentials between groups. However, for two additional cases, there was

an unexpected negative association between income and daily trips among workers without a transit subsidy. Meanwhile, in four cases, mean daily trip rates were not significantly associated with income across both workers offered and not offered a transit subsidy. In general, the lack of evidence of lower levels of trip-making among low-income workers was unexpected; as described in Chapter 1, a large body of evidence indicates that the poor tend to make fewer trips (and also own fewer vehicles, make shorter trips, and travel on slower and cheaper forms of transit). This could relate to additional factors relevant to daily trip levels, such as the number of jobs per worker and workers per household, as well as consumption versus accessibility poverty tradeoffs; low-income workers could maintain daily trip levels comparable to higher-income workers while enduring consumption poverty. This would be consistent with some of the evidence from prior research about the relative lack of price sensitivity found among low-income workers in terms of their travel costs. From this perspective, even though I found a lack of evidence of a positive association between transit subsidies and daily trips for low-income workers, it could be the case that transit subsidies reduce unobserved consumption poverty pressures for the working poor. Connecting these results to the Martensian theoretical framing of transport justice, I found limited evidence that employer-based transit subsidies play a role in supporting sufficient accessibility for workers in the "domain of justice," or constraining accessibility gaps between the worst-off and the best-off (see discussion in 2.2 above).

Overall, my empirical study of access to employer-based transit subsidies suggests a regressive pattern, consistent with aggregate national statistics for subsidized commuting. I found evidence of their association with accessibility and accessibility differentials in only a minority of cases. What do these findings mean for policymakers interested in supporting transport justice? I turn attention to the implications of the research for both policy and theory in the next section.

5.2. Implications of the Research

With this study's novel application of the Martensian theory of transport justice, I have demonstrated its empirical relevance to the analysis of commuter benefits. This justice-based perspective shifted my focus from *what* impacts commuter benefits have on travel behavior to a more fundamental questioning of *who* should get access to them. In developing his theory, Martens argued for a separate Walzerian sphere for transport, and this led to the consideration of sufficient accessibility as an entitlement. As a result, from a Martensian perspective, those with insufficient income are entitled to subsidies while those with sufficient income should pay the full cost of their transport. Both the maximax criterion, with its explicit consideration of inequalities, and the sufficiency principle, with its emphasis on ensuring a level of accessibility in accordance with a life of dignity, have inspired my empirical investigation of the current distribution of access to employer-based transit subsidies across income groups, as well as the relationship of the subsidies with accessibility. In their current form, employer-based transit subsidies seem to be failing to promote transport justice.

What does this mean for policymakers interested in promoting transport justice? It seems we are at a policy crossroads. One option could be to compel more employers to offer transit benefits, with the hopes that they would become available to a higher share of the working poor. In Chapter 1, I described the movement to promote commuter benefit ordinances, for both transit and (more recently) parking cash-out. These ordinances have typically required that employers of a certain size (e.g., 20 or more employees) offer some type of commuter benefit; to the extent that income and employer size remain uncorrelated (such that the working poor would not be concentrated in employers exempt from the ordinances), commuter benefit ordinances could increase the likelihood that a low-income worker would be offered a transit subsidy. However, I

was surprised to find that low-income workers were offered employer-based transit benefits at significantly lower rates even in the one case (SF) in the study where at least one jurisdiction had a commuter benefit ordinance in place at the time of the survey collection. As a result, the impact of commuter benefit ordinances on low-income access to transit benefits remains an outstanding empirical question and deserves additional study. Connecting back to my review of regional planning efforts, MPOs could consider playing an active role in the development of commuter benefit ordinances across multiple jurisdictions. A recent example of such an effort is the establishment in 2014 of the Bay Area Commuter Benefits Program by the SF MPO and the Bay Area Air Quality Management District, which encompasses San Francisco, Berkeley, and Richmond, as well as additional jurisdictions (TransitCenter and Frontier Group 2017, 40-41).[51]

An alternative could be to reform the tax treatment of employer-based commuter benefits. In their recent report on the subject, TransitCenter & Frontier Group argued that commuter tax benefits "should seek to be as equitable as possible – reaching potential beneficiaries in an equal and nondiscriminatory way and distributing resources in a way that does not reinforce income inequality" (2017, 58). One reform option could be the removal of the tax-preferred status of employer-based commuter benefits (both for transit, and car parking), which would eliminate the tax expenditure. A recent report by the U.S. Government Accountability Office noted that a small fraction (11 out of 169) of the nation's tax expenditures had an identified contribution to the goals or missions of federal agencies (U.S. Government Accountability Office 2016). As noted in Chapter 1, tax expenditures tend to be regressive in nature. Another reform could be the

[51] The combined presence in the SF region of commuter benefit ordinances and an income-based transit subsidy program (Muni Lifeline, see Table 1), as well as robust accessibility-based performance measures (see 3.2 and Appendix C) makes it an especially interesting region to consider for future study of affordable access to opportunities for the working poor.

creation of a commuter income tax deduction that could operate alongside existing employer-based benefits, to "expand access to the benefits and to ensure equity" for workers who do not receive commuter benefits through their employers (TransitCenter and Frontier Group 2017, 62). However, replacing rather than supplementing employer-based benefits could have the added benefit of removing employer control over the benefits. A refundable tax credit for commuting expenses would be one mechanism to allow low-income workers to receive the same subsidy as those with higher incomes (Dutzik 2017), while also reducing modal bias in terms of subsidy levels (see 2.4 above). In contrast, a tax deduction for commuting expenses would require itemized deductions, which is uncommon among low-income households, and would also allow the value of the tax benefit to increase with income (Dutzik 2017). Another reform option could be to shift the focus away from subsidies for commuting, and toward subsidies for all trip purposes, via the use of mechanisms such as direct federal subsidies for transit passes (Phillips 2014), or location- or income-based programs (see Table 1). These alternatives for all trip purposes could be especially effective at relieving the consumption versus accessibility tradeoffs that many low-income households face. They could also improve upon the current system of employer-based commuter benefits from a transport justice perspective if they prioritize subsidies for those experiencing the greatest accessibility deficits. In this sense, a refundable tax credit for commuting for all workers might be a second-best solution; such an approach would remove the "double injustice" of current conditions by making commuter tax benefits more accessible to the working poor, but would not reserve subsidies for those in the Martensian "domain of justice" (i.e., those experiencing insufficient accessibility).

5.3. Reflections, Limitations, and Future Research

I hope that this study may serve as a reference for researchers and policymakers interested in transport justice and commuter benefits. In this concluding section, I share reflections about the theoretical frame, empirical strategy, and policy context, while acknowledging limitations and describing opportunities for future research. The discussion is organized into three subsections.

Theoretical Frame

This study has drawn inspiration from both the maximax criterion and sufficiency principle, but I recognize an interesting tension between them (see Table 2). While the maximax criterion considers inequality through range constraints, it does not necessarily ensure a sufficient level of accessibility for all (Martens 2017a). Meanwhile, in shifting the focus to sufficient accessibility for all, the sufficiency principle leaves open the possibility of a grossly inequitable transport system (Martens 2017a). For the purposes of this study, I have not felt a need to reconcile these differences or choose one over the other.

I also anticipate skepticism regarding the practical implementation of the sufficiency principle, which Martens acknowledges requires extensive participation and deliberation. As Bertolini (2017, 175-176) has recently discussed, even when planners conceptually understand the importance of accessibility, they face barriers to implementation due to the demands of balancing comprehensibility, measurement sophistication, and institutional commitment levels (see also Venter 2016, 8, 12, 21). Martens offers guidance to those interested in implementing his theory in the form of a ten-step process (see Martens 2017b, 173-178 for a description).

I acknowledge that the Martensian perspective on transport justice should be appreciated in relation to contrasting philosophies of social justice. In particular, the emphasis by Martens on

support for the least advantaged draws upon Rawls, who is part of the liberal tradition of social justice (Deka 2004, 333). This is distinct from the libertarian perspective, which opposes public involvement in the redistribution of private endowments due to concerns about entitlement to private property and losses in efficiency (Deka 2004, 333-334, Piachaud 2008). For example, Nozick considers public redistribution of private resources (e.g., taxation) an unfair mechanism for depriving people of their property (Piachaud 2008, 34-35). From this perspective, the notion of using taxes to provide support for those experiencing insufficient accessibility would be unjust. In particular, a libertarian perspective would likely lead to opposition to income-based subsidies for transit financed via taxation, as well as commuter benefit ordinances. Nevertheless, the libertarian perspective has been criticized as insufficiently concerned with past injustices that are likely to influence current endowments (Piachaud 2008, 39-40). The U.S. has adopted a general commitment to ensure access to basic goods and services, and there is broad recognition that redistribution is necessary for ensuring such access; still, there is also concern that such extraction be limited and associated debate regarding what should be considered in the basic set and how long support should be provided (Deka 2004, 334). As discussed in 2.2 above, the shift by Martens away from the Rawlsian maximax criterion and toward the Dworkian sufficiency principle was done in recognition that equality comes at a price. Indeed, a key contribution by Dworkin is the highlighting of the notion of responsibility (Wolff 2008, 20). Still, while the Martensian perspective limits entitlement to support to those experiencing insufficient accessibility, it does carve out a role for transfers via taxation. As a result, it is unlikely to resolve libertarian concerns. While I adopt a Martensian perspective on transport justice for this study, I recognize that alternative perspectives on justice would likely lead to different interpretations about current patterns in access to commuter benefits.

Empirical Strategy

As mentioned in 3.2 above, I chose to forgo pooling the household travel surveys into a single dataset. While pooling the data would enable greater explanatory power from a statistical standpoint, each of the seven cases resulted in worker-level datasets that were large (at least 3,000 observations). As a result, pooling would be insufficiently beneficial when considered in relation to problems associated with survey format variation. Rather than pool the data and use fewer variables with compressed categories, I chose to run separate models that could take advantage of the highest number of variables and degree of variable specificity possible. This means that I generated results for each of the seven cases, rather than the study sample of 10 MPOs as a whole. For this reason, my discussion emphasized patterns in the findings across the seven cases; I made no overall joint probability statements or direct comparisons about the magnitude of estimated effects.[52] The collection of information about employer-based transit subsidies in a national survey could enable more direction comparisons across regions.

I did not incorporate spatial regression modeling techniques, which have been developed to control for spatial autocorrelation. It is reasonable to expect spatial clustering of transit benefit offerings, and failure to properly control for this (through the use of spatial lags) could impact

[52] Joint interpretations about findings from across the seven separate models would risk the compounding of errors. Given the strong theoretical and empirical bases for the variables included in my study, and the parsimonious approach I employed, multiple testing adjustments do not seem warranted for the separate models. As Rothman (1990, 44) describes, these adjustments are motivated by concern that chance alone could cause the generation of a significant finding, and seek to reduce the risk of false positives (Type I errors) – but concomitantly increase the risk of false negatives (Type II errors). They may be more warranted in the case of exploratory modeling with large datasets where little prior basis for hypotheses exists; such efforts are sometimes described as data mining. I recognize that, given the α level of 0.10 I employ (see Chapter 4), the probability of at least one statistically significant finding across the seven cases when the null hypotheses are true in all of them is 52%, based on the probability equaling $1-(1-\alpha)^n$. Nevertheless, multiple comparison adjustments in the presence of true positives have the net effect of weakening information about associations of interest (Rothman 1990). The "penalty for peeking" (Rothman 1990) across seven cases, instead of just one or two, therefore does not seem warranted for the purposes of this study. In addition, variations in the models resulting from survey format variation would complicate the use of multiple comparison adjustments.

the estimated relationships. I was not able to use spatial regression primarily due to its current lack of availability for binary dependent variables in both the Stata statistical software as well as the ArcGIS geospatial software.[53] In future research, I could explore the use of spatial regression modeling techniques using alternative software packages, such as R or MatLab.

I estimated the probability of the transit benefit offering and then separately assessed the offering in relation to total daily trips, but I previously explored the use of generalized structural equation modeling to simultaneously model these outcomes while accounting for dependencies between them. I ultimately chose to leave for future research the use of these modeling techniques, which are complicated by the generalized nature of the outcomes (binary in the case of the transit benefit offering, and count in the case of total daily trips).

In addition, the three negative binomial regressions presented in 4.4 each have only a single independent variable and do not account for the influence of multiple relevant factors on daily trips. As mentioned in 5.1 above, other factors such as the number of jobs per worker and workers per household likely influence daily trip levels. I reiterate that my evaluation of the relationship between transit benefits and accessibility is preliminary. Future research could use a more complex person-level accessibility measure to improve upon this study's use of daily trips, and incorporate more relevant predictors into the modeling. While this study found weak evidence to support the notion that transit benefits are associated with low-income accessibility and reduced accessibility differentials, alternative measures of accessibility and modeling strategies could produce different results.

[53] In correspondence with Stata technical support personnel, I confirmed that neither built-in nor user-written commands are currently available in Stata for spatial regression modeling with binary dependent variables.

I also considered use of a Heckman selection model, but the transit benefit offering did not represent a true selection stage as it did not censor the data; total daily trips were observed for all workers, not only for those offered a transit benefit. In addition, while self-selection is often an issue in studies of travel behavior, it did not seem to have as strong of a conceptual basis in this study. For example, there is probably no expectation for workers to self-select into income categories that suit unobserved preferences for transit benefit offerings.

I chose to include all seven cases in the discussion of patterns in the findings for the models estimating the likelihood of a transit subsidy offering, but acknowledge that the goodness-of-fit measures presented in Table 4 indicate evidence of model misspecification and little to no sensitivity in most cases. Indeed, cross-sectional multiple regression is vulnerable to specification errors and bias due to omitted variables. An alternative approach could have been to select one or two of the best performing cases and focus the presentation of results and accompanying discussion on that limited subsample. One candidate for such an approach could be the model for BAL & DC, which had a pseudo-R^2 of 0.258, a high Link Test p-value, a sensitivity of 37.5%, and a concordance statistic of 0.839. Still, because this is the first attempt to model the transit benefit offering using worker-level data, I felt presenting and discussing the results for all seven cases would make a contribution to the literature.

The travel surveys collected binary information (presence/absence) about employer-based transit subsidies, but not their monetary value (magnitude). Regional household travel surveys offer the best source of disaggregate (worker-level) information currently available about access to transit benefits, but future research could incorporate their monetary value if such data become available. In addition, Agrawal and colleagues note the lack of availability of travel behavior and

cost information in combined datasets; typically, household travel surveys provide detailed information about travel behavior, but collect no information on transport expenditures (2011, 9). Such a combined dataset could enable analysis of the impact of transit subsidies on consumption versus accessibility poverty tradeoffs; qualitative research techniques, as used by Agrawal and colleagues, could also support this avenue of research.

One unexpected occurrence in the data was the relatively large share of workers (41%) in the Philadelphia sample who provided "don't know" in response to the survey question regarding whether they were provided employer-based transit subsidies. No other sample had nearly as many workers unsure of their transit subsidy status (see variable description in Appendix D). As a result, I was forced to exclude a large share of Philadelphia workers from the analysis. However, based on my review of binary tabulations (not presented), "don't know" responses did not vary significantly with the primary variable of interest (income). As a result, systematic loss of observations based on income was not evident.

I chose to use income quintiles, but recognize that further isolating the lowest income workers (e.g., lowest decile) could impact the results. In particular, I expect such an approach would strengthen the contrast between the working poor and all other workers; perhaps this would have resulted in more significant and consistent differences between daily trip levels. Future research on commuter benefits could compare alternative categorizations of workers by income.

Policy Context

My study focused on assessing whether access to transit benefits varied significantly across income groups, but future research could focus on the underlying factors that explain *why* access to transit benefits is more equitable in some places than others, especially if able to draw from a

national dataset that would facilitate direct comparison of the magnitude of estimated effects. In addition, as mentioned in 5.2 above, we need to investigate more about the impact of commuter benefit ordinances on transport justice. This need is especially evident given the alternatives in Table 1, such as income- or location-based transit subsidies that could support low-income accessibility across all trip purposes. A comparative analysis of these policy options could aid local, regional, and national policymakers interested in supporting affordable access to opportunities for the working poor. As mentioned in 5.2 above, further study of the San Francisco region could offer important insights, given the Muni Lifeline income-based program and Bay Area Commuter Benefits Program, as well as relatively robust integration of accessibility and equity performance measures (see Table 1 and Appendix C).

Research attention is also needed to support greater understanding of optimal policies when sustainability and justice impacts are jointly considered. What would be the impact of reserving transit benefits for those with insufficient accessibility in terms of sustainability mode shift goals? A future analysis should assess the best policy strategies to support both the goals of sufficient accessibility for all and sustainable transport.

This study has uniquely applied the Martensian theory of transport justice to the analysis of transit benefits. I hope that it contribute to a more comprehensive understanding of commuter benefit impacts, as well as the need for strategies to support affordable access to opportunities for the working poor.

References

Agrawal, Asha Weinstein, Evelyn Blumenberg, Sarah Abel, Gregory Pierce, and Charles Darrah. 2011. Getting Around When You're Just Getting By: The Travel Behavior and Transportation Expenditures of Low-Income Adults. San Jose, CA: Mineta Transportation Institute.

American Public Transportation Association. 2017a. Fair Treatment: Commuters and Tax Reform. Washington, DC.

American Public Transportation Association. 2017b. Who Rides Public Transportation. Washington, DC.

Association for Commuter Transportation. 2017a. "25 X 20 Campaign Overview." Available online, http://actweb.org/25x20transitbenefitscampaign/.

Association for Commuter Transportation. 2017b. "South Carolina Bans Municipal Governments (other than the State) from Requiring Employer Benefits." Last Modified April 5, 2017. Available online, http://actweb.org/south-carolina-bans-municipal-governments-other-than-the-state-from-requiring-employer-benefits/.

Atlanta Regional Commission. 2017. "The Atlanta Region's Plan (Transportation) ". Available online, https://atlantaregionsplan.org/regional-transportation-plan/.

Baker, Stuart, David Judd, and Richard Oram. 2010. "Tax-Free Transit Benefits at 30: Evolution of a Free Parking Offset." *Journal of Public Transportation* 13 (2):1-22.

Baltimore Regional Transportation Board. 2016. "Maximize 2040: A Performance-Based Transportation Plan for a Greater Baltimore Region." Available online, https://www.baltometro.org/maximize-2040.

Banister, David. 2005. *Unsustainable Transport: City Transport in the New Century*. London: Routledge.

Bertolini, Luca. 2017. *Planning the Mobile Metropolis: Transport for People, Places and the Planet*. London, UK: Palgrave.

Bianco, Martha J. 2000. "Effective Transportation Demand Management: Combining Parking Pricing, Transit Incentives, and Transportation Management in a Commercial District of Portland, Oregon." *Transportation Research Record: Journal of the Transportation Research Board* 1711 (1):46-54.

Block-Schachter, David. 2009. "The Myth of the Single Mode Man: How the Mobility Pass Better Meets Actual Travel Demand." Master's Thesis, Massachusetts Institute of Technology.

Boisjoly, Genevieve, and Ahmed El-Geneidy. 2017. "How to Get There? A Critical Assessment of Accessibility Objectives and Indicators in Metropolitan Transportation Plans." *Transport Policy* 55:38-50.

Bouchard, Mikayla. 2015. "Transportation Emerges as Crucial to Escaping Poverty." *The New York Times*, May 7, 2015. https://www.nytimes.com/2015/05/07/upshot/transportation-emerges-as-crucial-to-escaping-poverty.html?abt=0002&abg=1&_r=0.

Bureau of Labor Statistics. 2016. National Compensation Survey. Washington, DC.

Bureau of Transportation Statistics. 2003. Commuting Expenses: Disparity for the Working Poor. Washington, DC.

Bureau of Transportation Statistics. 2016. Transportation Statistics Annual Report. Washington, DC.

California Air Resources Board. 2017. "Sustainable Communities." Available online, https://www.arb.ca.gov/cc/sb375/sb375.htm.

Cameron, A. Colin , and Pravin K. Trivedi. 2010. *Microeconometrics Using Stata: Revised Edition*. College Station, TX: Stata Press.

Center for Transportation Studies. 2017. "Spatial and Skills Mismatch of Unemployment and Job Vacancies." University of Minnesota. Available online, http://www.cts.umn.edu/Research/Featured/TransitandWorkforce.

Cervero, Robert. 1996. Paradigm Shift: From Automobility to Accessibility Planning. Berkeley, CA: University of California Berkeley.

Cervero, Robert, Onésimo Sandoval, and John Landis. 2002. "Transportation as a Stimulus of Welfare-to-Work: Private versus Public Mobility." *Journal of Planning Education and Research* 22 (1):50-63.

Clifton, Kelly, and Karen Lucas. 2004. "Examining the Empirical Evidence of Transport Inequality in the US and UK." In *Running on Empty: Transport, Social Exclusion and Environmental Justice*, edited by Karen Lucas, 15-36. Bristol, UK: The Policy Press.

Deka, Devajyoti. 2004. "Social and Environmental Justice Issues in Urban Transportation." In *The Geography of Urban Transportation*, edited by Susan Hanson and Genevieve Giuliano. New York, NY: The Guildford Press.

Delaware Valley Regional Planning Commission. 2017a. "Connections 2045: Plan for Greater Philadelphia." Available online, https://www.dvrpc.org/Connections2045/.

Delaware Valley Regional Planning Commission. 2017b. "Data Sources." Available online, http://www.dvrpc.org/Transportation/Modeling/Data/.

Denver Regional Council of Governments. 2017. "2040 Metro Vision Regional Transportation Plan." Available online, https://drcog.org/programs/transportation-planning/regional-transportation-plan.

Dungca, Nicole. 2016. "MBTA Eyes Discounts for Low-Income Riders in the Future." *The Boston Globe*, January 8, 2016. Available online, https://www.bostonglobe.com/metro/2016/01/07/mbta-eyes-discounts-for-low-income-riders-future/y4KOANR1vjtWQ8vjxtYzhN/story.html.

Dutzik, Tony. 2017. "Email Correspondence." November 14, 2017.

Fainstein, Susan S. 2010. *The Just City*. Ithaca, NY: Cornell University Press.

Ferrell, Christopher. 2015. The Benefits of Transit in the United States: A Review and Analysis of Benefit-Cost Studies. San Jose, CA: Mineta Transportation Institute.

Fitzsimmons, Emma. 2016. "Advocates for New York's Working Poor Push for Discounted Transit Fares." *The New York Times*, November 11, 2016. Available online, https://www.nytimes.com/2016/11/12/nyregion/advocates-for-new-yorks-working-poor-push-for-discounted-transit-fares.html.

Gates, Emily. 2015. "New Incentives to Change Modes: An Experimental Design to Reduce Single-Occupant Vehicle Commuting in Kendall Square." Master of Science in Transportation, Departmet of Civil and Environmental Engineering, Massachusetts Institute of Technology.

Geurs, Karst, and Bert van Wee. 2004. "Accessibility Evaluation of Land-Use and Transport Strategies: Review and Research Directions." *Journal of Transport Geography* 12 (2):127-140.

Gifford, Jonathan Lewis. 2003. *Flexible Urban Transportation*. Bingley, UK: Emerald Group Publishing.

Giuliano, Genevieve, and Susan Handy. 2004. "Managing the Auto." In *The Geography of Urban Transportation*, edited by Susan Hanson and Genevieve Giuliano, 382-403. New York, NY: The Guilford Press.

Golub, Aaron, and Karel Martens. 2014. "Using Principles of Justice to Assess the modal Equity of Regional Transportation Plans." *Journal of Transport Geography* 41:10-20.

Handy, Susan. 2002. "Accessibility- Vs. Mobility-Enhancing Strategies for Addressing Automobile Dependence in the U.S." European Conference of Ministers of Transport, May 2002.

Handy, Susan. 2008. "Regional Transportation Planning in the US: An Examination of Changes in Technical Aspects of the Planning Process in Response to Changing Goals." *Transport Policy* 15:113-126.

Handy, Susan, and Deb Niemeier. 1997. "Measuring Accessibility: An Exploration of Issues and Alternatives." *Environment and Planning A* 29 (7):1175-1194.

Hanson, Susan. 2004. "The Context of Urban Travel." In *The Geography of Urban Transportation, Third Edition*, edited by Susan Hanson and Genevieve Giuliano, 3-29. New York, NY: The Guilford Press.

Jeekel, Johan, and Karel Martens. 2017. "Equity in Transport: Learning from the Poicy Domains of Housing, Health Care and Education." *European Transport Research Review* 9 (4):1-13.

Johnston, Robert. 2004. "The Urban Transportation Planning Process." In *The Geography of Urban Transportation, Third Edition*, edited by Susan Hanson and Genevieve Giuliano, 115-140. New York, NY: The Guilford Press.

Joint Committee on Taxation. 2014. Letter to the Honorable Earl Blumenauer and the Honorable Peter King. Washington, DC: Congress of the United States.

Karner, Alex, and Deb Niemeier. 2013. "Civil Rights Guidance and Equity Analysis Methods for Regional Transportation Plans: A Critical Review of Literature and Practice." *Journal of Transport Geography* 33:126-134.

King County Department of Transportation. 2017. "ORCA Lift." Available online, http://kingcounty.gov/depts/transportation/metro/fares-orca/orca-cards/lift.aspx.

Kuppam, Arun, Ram Pendyala, and Mohan Gollakoti. 1998. "Stated Response Analysis of the Effectiveness of Parking Pricing Strategies for Transportation Control." *Transportation Research Record: Journal of the Transportation Research Board* 1649 (1):39-46.

Lazo, Luz. 2015. "More Washington Workers Will Get Commuter Benefits." *The Washington Post*, November 4, 2015. Available online, https://www.washingtonpost.com/news/dr-gridlock/wp/2015/11/04/more-washington-workers-will-get-commuter-benefits/?utm_term=.c8737da31198.

Lazo, Luz. 2017. "D.C. Wants Employers to Pay Workers Not to Drive to Work." *The Washington Post*, March 17, 2017. Available online, https://www.washingtonpost.com/news/dr-gridlock/wp/2017/03/17/d-c-wants-employers-to-pay-workers-not-to-drive-to-work/?utm_term=.3194ada9e851.

Levine, Jonathan. 2011. Getting There: From Mobility to Accessibility in Transportation Planning. In *Policy Commentary*. Washington, DC: Resources for the Future.

Lieber, Ron. 2011. "Commuting Puzzle: Why Driving is Rewarded Over Taking the Bus." *The New York Times*, December 9, 2011. Available online, http://www.nytimes.com/2011/12/10/your-money/why-drivers-get-more-commuter-tax-benefits-than-bus-riders.html.

Lindblom, Mike. 2015. "Discount Fares for Low-Income Bus Riders Will be Offered." *The Seattle Times*, February 11, 2015. Available online, http://www.seattletimes.com/seattle-news/discount-fares-for-low-income-bus-riders-will-be-offered/.

Litman, Todd. 2012. "Current Mobility Trends: Implications for Sustainability." In *Keep Moving, Towards Sustainable Mobility*, edited by Bert van Wee, 23-44. Eleven International Publishing.

Litman, Todd. 2017a. Evaluating Transportation Diversity: Multimodal Planning for Efficient and Equitable Communities. Victoria Transport Policy Institute.

Litman, Todd. 2017b. Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning. Victoria Transport Policy Institute.

Lucas, Karen. 2004a. "Introduction." In *Running on Empty: Transport, Social Exclusion and Environmental Justice*, edited by Karen Lucas. Bristol, UK: The Policy Press.

Lucas, Karen. 2004b. "Locating Transport as a Social Policy Problem." In *Running on Empty: Transport, Social Exclusion and Environmental Justice*, edited by Karen Lucas. Bristol, UK: The Policy Press.

Lucas, Karen. 2004c. *Running on Empty: Transport, Social Exclusion and Environmental Justice*. Bristol, UK: The Policy Press.

Lucas, Karen. 2004d. "Towards a 'Social Welfare' Approach to Transport." In *Running on Empty: Transport, Social Exclusion and Environmental Justice*, edited by Karen Lucas. Bristol, UK: The Policy Press.

Manaugh, Kevin, Madhav Badami, and Ahmed El-Geneidy. 2015. "Integrating Social Equity into Urban Transportation Planning: A Critical Evaluation of Equity Objectives and Measures in Transportation Plans in North America." *Transport Policy* 37:167-176.

Martens, Karel. 2006. "Basing Transport Planning on Principles of Social Justice." *Berkeley Planning Journal* 19:1-17.

Martens, Karel. 2011. "Substance Precedes Methodology: On Cost-Benefit Analysis and Equity." *Transportation* 38 (6):959-974.
Martens, Karel. 2012. "Justice in Transport as Justice in Accessibility: Applying Walzer's 'Spheres of Justice' to the Transport Sector." *Transportation* 39 (6):1035-1053.
Martens, Karel. 2015. "Accessibility and Potential Mobility as a Guide for Policy Action." *Transportation Research Record* 1 (2499):18-24.
Martens, Karel. 2016a. "Book Review of The Capability Approach: From Theory to Practice (Eds Ibrahim & Tiwari)." *Journal of International Development* 28 (5):822-823.
Martens, Karel. 2016b. "Transport Justice: Designing Fair Transportation Systems (Webinar)." [Webinar]. The Institute for Transportation and Development Policy. Presented November 17, 2016, https://www.itdp.org/transport-justice-webinar/.
Martens, Karel. 2016c. "Why Accessibility Measurement Is Not Merely An Option, But An Absolute Necessity." In *Accessibility Tools and Their Applications*, edited by N. Punto and A. Hull. New York, NY: Routledge.
Martens, Karel. 2017a. "Email Correspondence." May 7, 2017.
Martens, Karel. 2017b. *Transport Justice: Designing Fair Transportation Systems*. New York, NY: Routledge.
Martens, Karel, Aaron Golub, and Glenn Robinson. 2012. "A Justice-Theoretic Approach to the Distribution of Transportation Benefits: Implications for Transportation Planning Practice in the United States." *Transportation Research Part A* 46 (4):684-695.
Martens, Karel, and Eyal Hurvitz. 2011. "Distributive Impacts of Demand-Based Modelling." *Transportmetrica* 7 (3):181-200.
Metropolitan Transportation Commission. 2017. "Plan Bay Area 2040." Available online, http://planbayarea.org/.
Metropolitan Washington Council of Governments. 2016. State of the Commute Technical Survey Report. Washington, DC: Metropolitan Washington Council of Governments.
Mondon, Marielle. 2015. "Denver Activists Push for Income-Based Bus Fares." *NextCity*. Available online, https://nextcity.org/daily/entry/income-based-bus-fare-denver-bus-fare-increase-2016.
Moore, John. 1973. Letter Regarding Parking Spaces for Federal Employees. Washington, DC: U.S. General Acounting Office.
Morris, Jennifer, P. L. Dumble, and Marcus Wigan. 1979. "Accessibility Indicators for Transport Planning." *Transportation Research Part A: General* 13 (2):91-109.
National Capital Region Transportation Planning Board. 2016. "Financially Constrained Long-Range Transportation Plan for the National Capital Region." Available online, http://www1.mwcog.org/clrp/.
National Renewable Energy Laboratory. 2017. "Transportation Secure Data Center." Available online, https://www.nrel.gov/transportation/secure-transportation-data.html.
New York City Department of Consumer Affairs. 2017. "Commuter Benefits Law FAQs." Available online, https://www1.nyc.gov/site/dca/about/commuter-benefits-FAQs.page.
New York City Transit Riders Council. 2015. "New York City Transit Riders Council Calls for Freedom Ticket to Reduce Travel Time and Cost." Available online, http://www.pcac.org/wp-content/uploads/2015/12/16-15-NYCTRC-Press-Release-Freedom-Ticket1.pdf.
New York Metropolitan Transportation Council. 2017a. "Data and Modeling ". Available online, https://www.nymtc.org/DATA-AND-MODELING/Travel-Surveys/2010-11-Travel-Survey.
New York Metropolitan Transportation Council. 2017b. "Plan 2045: Maintaining the Vision for a Sustainable Region." Available online, https://www.nymtc.org/Required-Planning-Products/Regional-Transportation-Plan-RTP/Plan-2045-Maintaining-the-Vision-for-a-Sustainable-Region.
North Jersey Transportation Planning Authority. 2017. "Plan 2045: Connecting North Jersey." Available online, https://apps.njtpa.org/plan2045/index.html.
Office of Tax Analysis. 2016. Tax Expenditures FY2018. Washington, DC.

Phillips, Shane. 2014. "End the Transit Commuter Benefit, And Replace It With This." *Planetizen*. Available online, https://www.planetizen.com/node/67154.
Piachaud, David. 2008. "Social Justice and Public Policy: A Social Policy Perspective." In *Social Justice and Public Policy: Seeking Fairness in Diverse Societies*, edited by Gary Craig, Tania Burchardt and David Gordon, 33-51. Bristol, UK: The Policy Press.
Pirie, Gordon. 1979. "Measuring Accessibility: A Review and Proposal." *Environment and Planning A* 11 (3):299-312.
Ralph, Kelcie. 2015. "Stalled on the Road to Adulthood? Analyzing the Nature of Recent Travel Changes for Young Adults in America, 1995 to 2009." PhD, Urban Planning, University of California Los Angeles.
Raphael, Steven, Michael A. Stoll, Kenneth A. Small, and Clifford Winston. 2001. "Can Boosting Minority Car-Ownership Rates Narrow Inter-Racial Employment Gaps? [with Comments]." *Brookings-Wharton Papers on Urban Affairs* 2001 (1):99-145.
Root, A. 2001. "Can Travel Vouchers Encourage More Sustainable Travel?" *Transport Policy* 8 (107-114).
Rothman, Kenneth. 1990. "No Adjustments Are Needed for Multiple Comparisons." *Epidemiology* 1 (1):43-46.
San Diego Association of Governments. 2015. "San Diego Forward: The Regional Plan." Available online, http://www.sdforward.com/.
San Francisco Department of the Environment. 2017. "San Francisco Commuter Benefits Ordinance." Available oneline, https://sfenvironment.org/commuter-benefits-ordinance-sf.
San Francisco Municipal Transportation Agency. 2017. "Lifeline (Low Income) Pass." Available online, https://www.sfmta.com/getting-around/transit/fares-passes/low-income-lifeline-pass.
Sanchez, Thomas. 1999. "The Connection Between Public Transit and Employment." *Journal of the American Planning Association* 65 (3):284-296.
Sanchez, Thomas. 2008. "Poverty, Policy, and Public Transportation." *Transportation Research Part A: Policy and Practice* 42 (5):833-841.
Sanchez, Thomas, Marc Brenman, Jacinta Ma, and Richard Stolz. 2007. *The Right to Transportation: Moving to Equity*. Chicago, IL: APA Planners Press.
Sanchez, Thomas, Qing Shen, and Zhong-Ren Peng. 2004. "Transit Mobility, Jobs Access and Low-income Labour Participation in US Metropolitan Areas." *Urban Studies* 41 (7):1313-1331.
Santos, Adella, Nancy McGuckin, Hikari Yukiko Nakamoto, Danielle Gray, and Susan Liss. 2011. Summary of Travel Trends: 2009 National Household Travel Survey. Washington DC: Federal Highway Administration, U.S. Department of Transportation.
Segelhorst, Elbert, and Larry Kirkus. 1973. "Parking Bias in Transit Choice." *Journal of Transport Economics and Policy*:58-70.
Shoup, Donald. 1997. "Evaluating the Effects of Cashing Out Employer-Paid Parking: Eight Case Studies." *Transport Policy* 4 (4):201-216.
Shoup, Donald. 2005a. *The High Cost of Free Parking*. Chicago, IL: APA Planners Press.
Shoup, Donald. 2005b. *Parking Cash Out*. Chicago, IL: APA Planners Press.
Shoup, Donald, and Don Pickrell. 1980. Free Parking as a Transportation Problem. Washington, DC: U.S. Department of Transportation, .
Shoup, Donald, and Richard Willson. 1992. Commuting, Congestion and Pollution: The Employer-Paid Parking Connection. Berkeley, CA: The University of California Transportation Center.
Soja, Edward. 2010. *Seeking Spatial Justice*. Minneapolis, MN: University of Minnesota Press.
Southern California Association of Governments. 2016. "The 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy: A Plan for Mobility, Accessibility, Sustainability and a High Quality of Life." Available online, http://scagrtpscs.net/Pages/FINAL2016RTPSCS.aspx.
Stolper, Harold, and Nancy Rankin. 2016. The Transit Affordability Crisis: How Reduced MTA Fares Can Help Low-Income New Yorkers Move Ahead. New York, NY: Community Service Society, .

Thakuriah, Piyushimita. 2011. "Variations in Employment Transportation Outcomes: Role of Site-Level Factors." *Papers in Regional Science* 90 (4):755-772.
Thakuriah, Piyushimita, Joseph Persky, Siim Soot, and P. S. Sriraj. 2013. "Costs and Benefits of Employment Transportation for Low-Wage Workers: An Assessment of Job Access Public Transportation Services." *Evaluation and Program Planning* 37:31-42.
The Leadership Conference Education Fund. 2011. "Where We Need to Go: A Civil Rights Roadmap for Transportation Equity." Last Modified March 2011. Available online, http://leadershipconferenceedfund.org/.
The Leadership Conference on Civil and Human Rights. 2017. "Transportation Equity." Available online, http://www.civilrights.org/transportation/.
The Pew Charitable Trusts. 2016. "Issue Brief: Worker Benefits—and Their Costs—Vary Widely Across U.S. Industries." Available online, http://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2016/07/worker-benefits-and-their-costs-vary-widely-across-us-industries.
Thom, Michael, and Thom Reilly. 2015. "Compensation Benchmarking Practices in Large U.S. Local Governments: Results of a National Survey." *Public Personnel Management* 44 (3):340-355.
Tian, Guang. 2017. "Travel and Built Environment: Evidence from 23 Diverse Regions of the United States." PhD, Metropolitan Planning, Policy and Design, The University of Utah.
Tomer, Adie. 2011. Transit Access and Zero-Vehicle Households. In *Metropolitan Infrastructure Initiative Series and Metropolitan Opportunity Series*. Washington, DC: The Brookings Institution.
TransitCenter. 2010. Commuter Benefit Impact Survey. New York, NY: TransitCenter.
TransitCenter, and Frontier Group. 2014. "Subsidizing Congestion: The Multibillion-Dollar Tax Subsidy That's Making Your Commute Worse." Available online, http://transitcenter.org/subsidizing-congestion/.
TransitCenter, and Frontier Group. 2017. "Who Pays for Parking? How Federal Tax Subsidies Jam More Cars into Congested Cities, and How Cities Can Reclaim Their Streets." Available online, https://frontiergroup.org/reports/fg/who-pays-parking.
Tyndall, Justin. 2017. "Waiting for the R train: Public Transportation and Employment." *Urban Studies* 54 (2):520-537.
U.S. Department of Transportation. 1980. Bicycle Transportation for Energy Conservation. Washington DC.
U.S. Department of Transportation. 2017a. "Metropolitan Planning Organization Database ", accessed June 2017. Available online, http://www.planning.dot.gov/mpo.asp.
U.S. Department of Transportation. 2017b. "National Transportation Atlas Database." Available online, https://www.bts.gov/geospatial/national-transportation-atlas-database.
U.S. General Accounting Office. 1993. Mass Transit: Federal Participation in Transit Benefit Programs. Washington, DC.
U.S. Government Accountability Office. 2016. Tax Expenditures: Opportunities Exist to Use Budgeting and Agency Performance Processes to Increase Oversight. Washington, DC: U.S. Government Accountability Office,.
Venter, Christo. 2016. Developing a Common Narrative on Urban Accessibility: A Transportation Perspective. Washington, DC: The Brookings Institution.
Vuchic, Vukan. 1999. *Transportation for Livable Cities*. New Brunswick, NJ: Center for Urban Policy Research.
Wachs, Martin. 2004. "Reflections on the Planning Process." In *The Geography of Urban Transportation, Third Edition*, edited by Susan Hanson and Genevieve Giuliano, 141-162. New York, NY: The Guilford Press.
Wachs, Martin, and T. Gordon Kumagai. 1973. "Physical Accessibility as a Social Indicator." *Socio-Economic Planning Sciences* 7 (5):437-456.
Wall, Rickard. 2007. "Taxation of Car Commuters' Employer-Subsidized Parking." In *Time and Space in Economics*, edited by T. Asada and T. Ishikawa. Japan: Springer.

Washbrook, Kevin, Wolfgang Haider, and Mark Jaccard. 2006. "Estimating Commuter Mode Choice: A Discrete Choice Analysis of the Impact of Road Pricing and Parking Charges." *Transportation* 33 (6):621-639.

Weimer, David, and Aidan Vining. 1999. *Policy Analysis: Concepts and Practice*. Third Edition ed. Upper Saddle River, NJ: Prentice Hall.

Wickstrom, George V. 1971. "Defining Balanced Transportation - A Question of Opportunity." *Traffic Quarterly* 25 (3):337.

Williams, Kristine, and Aaron Golub. 2017. Evaluating the Distributional Effects of Regional Transportation Plans and Projects. Portland, OR: National Institute for Transportation and Communities.

Willson, Richard. 1992. "Estimating the Travel and Parking Demand Effects of Employer-Paid Parking." *Regional Science and Urban Economics* 22 (1):133-145.

Willson, Richard, and Donald Shoup. 1990. "Parking Subsidies and Travel Choices: Assessing the Evidence." *Transportation* 17 (2):141-157.

Wolff, Jonathan. 2008. "Social Justice and Public Policy: A View from Political Philosophy." In *Social Justice and Public Policy: Seeking Fairness in Diverse Societies*, edited by Gary Craig, Tania Burchardt and David Gordon, 17-31. Bristol, UK: The Policy Press.

Wolter Kluwer. 2016. How to Navigate the Transit Benefit U-Turn. In *Payroll Manager's Letter*. New York, NY.

Worland, Justin. 2015. "Seattle Bus Fares Are Now Based on Your Income." *Time*, March 2, 2015. Available online, http://time.com/3728160/seattle-bus-fares-income/.

Appendix A. Processes Used to Obtain Travel Surveys

Atlanta: I obtained data files for the 2011 regional household travel survey by accessing the National Renewable Energy Laboratory's Transportation Secure Data Center (2017).

Baltimore: I obtained data files for the 2007-2008 regional household travel survey by request to MPO staff.

Philadelphia: I obtained data files for the 2012-2013 regional household travel survey through open-access download from the MPO website (Delaware Valley Regional Planning Commission 2017b) with assistance from MPO staff.

Denver: I obtained data files for the 2009-2010 regional household travel survey by request to MPO staff. **MPO Disclaimer:** The Denver Regional Council of Governments makes no warranty on the results or opinions derived from this data for any project or study.

San Francisco, Los Angeles, & San Diego: I obtained data files for the 2010-2012 California state household travel survey by accessing the National Renewable Energy Laboratory's Transportation Secure Data Center (2017).

Washington DC: I obtained data files for the 2007-2008 regional household travel survey by request to MPO staff.

New York & Newark: I obtained files for the 2010-2011 joint New York Metropolitan Transportation Council and Norther Jersey Transportation Planning Authority survey through open-access download from the NYMTC website (New York Metropolitan Transportation Council 2017a) with assistance from MPO staff.

Appendix B. Large Metropolitan Regions Not Included in the Study

MPO	Major City	2010 Population	Reason for Exclusion
Boston Region MPO	Boston, MA	3,159,512	2010-2011 state survey did not collect information on employer-based transit subsidies
Chicago Metropolitan Agency for Planning	Chicago, IL	8,454,538	2007-2008 regional survey did not collect information on employer-based transit subsidies
East-West Gateway Council of Governments	Saint Louis, MO	2,571,327	2002 regional survey did not collect information on employer-based transit subsidies
Houston-Galveston Area Council	Houston, TX	5,892,002	2008-2009 NHTS add-on did not collect information on employer-based transit subsidies
Maricopa Association of Governments	Phoenix, AZ	4,055,281	2008-2009 NHTS add-on did not collect information on employer-based transit subsidies
Metropolitan Council	Saint Paul & Minneapolis, MN	2,906,684	2010 regional survey did not collect information on employer-based transit subsidies in a way comparable to the other regions included in study
Miami-Dade MPO	Miami, FL	2,569,420	Unable to obtain survey information
North Central Texas Council of Governments	Arlington, TX	6,417,630	2008-2009 NHTS add-on did not collect information on employer-based transit subsidies
Puerto Rico MPO	San Juan, PR	3,725,789	Unable to obtain survey information
Puget Sound Regional Council	Seattle, WA	3,690,866	2006 regional survey did not collect information on employer-based transit subsidies in a way comparable to the other regions included in study
Southeast Michigan COG	Detroit, MI	4,703,593	Unable to obtain survey information
Southwestern Pennsylvania Commission	Pittsburgh, PA	2,574,953	2001-2002 regional survey did not collect information on employer-based transit subsidies

Note: Compiled using the U.S. Department of Transportation's Metropolitan Planning Organization Database (U.S. Department of Transportation 2017a).

Appendix C. Integration of Accessibility & Equity in Regional Plans

MPO	Long Range Plan	Adoption Date	Summary
Atlanta Regional Commission	The Atlanta Region's Plan (Transportation)	December 2017	This MPO describes ***goals*** regarding the promotion of an "accessible and equitable" system, which will "maintain and expand transportation options" for the most vulnerable populations. It developed the Equitable Target Area ("ETA") Index to identify communities of concern, and highlights the overlap between ETAs and concentrations of zero-car households. An accessibility-based EJ ***performance measure*** is included: jobs within a 45 minute transit ride from ETAs.
Baltimore Regional Transportation Board	Maximize 2040: A Performance-Based Transportation Plan for a Greater Baltimore Region	January 2016	This MPO describes ***goals*** to "improve accessibility" and "help people of all ages and abilities to access" destinations. It developed a Vulnerable Population Index, which considers zero-car households a sensitive population. It describes "analyses to estimate accessibility by EJ populations" and includes ***performance measures*** to assess the degree to which projects support accessibility for EJ populations, such as per mile benefits and a 1/4 mile buffer for access to specific destinations.
Delaware Valley Regional Planning Commission	Connections 2045: Plan for Greater Philadelphia	October 2017	This MPO describes ***goals*** to "promote equitable access to transportation for vulnerable populations" as well as lower-cost and equitable transportation networks and options. It developed Indicators of Potential Disadvantage ("IPD"), which includes zero-car households. It describes assessing how well projects serve EJ & IPD groups based on ***performance measures*** such as project length and transit station stops.
Denver Regional Council of Governments	2040 Metro Vision Regional Transportation Plan	April 2017	This MPO describes the ***goal*** to "make connections that increase access and travel choices." It developed the Denver Regional Equity Analysis to focus on "access to opportunity for everyone in the region, especially the region's most economically disadvantaged." An accessibility-based EJ ***performance measure*** is included: share of the population in low-income or minority areas with good transit-job accessibility.
Metropolitan Transportation Commission	Plan Bay Area 2040	July 2017	This MPO describes the ***goal*** of "equitable access" including a decrease in the share of low-income budgets devoted to housing and transportation. It developed a Transportation Equity Roadmap, and a Lifeline Transportation Program. It places emphasis on displacement trends, and includes several specific equitable access ***performance measures***: share of lower-income residents' household income consumed by transportation and housing, share of affordable housing in Priority Development Areas, Transit Priority Areas, or high-opportunity areas, and share of low- and moderate-income renter households at risk of displacement in PDAs, TPAs, or high-opportunity areas.
National Capital Region Transportation Planning Board	Financially Constrained Long-Range Transportation Plan for the National Capital Region	November 2016	This MPO has a ***goal*** of "reasonable access at reasonable cost to everyone." It developed Equity Emphasis Areas to assess in relation to regional accessibility. The Regional Transportation Priorities Plan emphasizes ensuring accessibility for low income and other vulnerable citizens. It describes a performance measure for access to jobs by transit, but not specifically for EJ populations. Additional EJ analyses are forthcoming.

MPO	Long Range Plan	Adoption Date	Summary
New York Metropolitan Transportation Council	Plan 2045: Maintaining the Vision for a Sustainable Region	June 2017	This MPO describes the ***goal*** to "provide mobility and transportation options, to maximize individuals' opportunities to participate in society, regardless of income level, residence, access to transit, age, or ability." Accessibility-based performance measures for EJ populations are not readily available.
North Jersey Transportation Planning Authority	Plan 2045: Connecting North Jersey	November 2017	This MPO describes the ***goal*** to "provide affordable, accessible and dynamic transportation systems responsive to all current and future travelers." It describes transportation investments as a strategy to increase location efficiency and lower travel costs, supporting "equity for all." It emphasizes that "residents need to be able to accomplish essential activities within reasonable times and at reasonable costs". Accessibility-based performance measures for EJ populations are not readily available.
San Diego Association of Governments	San Diego Forward: The Regional Plan	October 2015	This MPO describes the ***goals*** to "invest in transportation projects that provide access for all communities to a variety of jobs with competitive wages" and "provide safe, secure, healthy, affordable, and convenient travel choices." It describes attention to whether the relative costs of transportation are changing similarly for all communities. In a section devoted to "the need for widespread access to quality transportation," the plan describes how, "without access to transportation, it's extremely difficult for poor people to improve their economic prospects." It details several ***performance measures*** for social equity analysis, in which differences between communities of concern and the general population of greater than 20% are identified for further consideration: average travel time across all modes and by auto, carpool, transit, share of income consumed by out-of-pocket transportation costs, share of population within a half-mile of high frequency transit, or any transit, share of population within a quarter-mile of a bike facility, share of population within 30 minutes of employment center or higher education, and share of population within 15 minutes of goods/services.
Southern California Association of Governments	The 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy: A Plan for Mobility, Accessibility, Sustainability and a High Quality of Life	April 2016	This MPO describes the ***goal*** of "giving people more transportation choices" and maximizing mobility and accessibility for all. It focuses on accessibility in relation to land use. It describes accessibility as "vital for social and economic interactions" and describes how both lower costs (time and money) and more choices support greater accessibility. It includes several accessibility-based ***performance measures*** for EJ populations: percent of employment & shopping within a one- or two-mile travel buffer from each neighborhood, share of employment & shopping within 30 minutes by car or 45 minutes by transit, share of population within a one- or two-mile travel buffer of a park or school, and share of park acreage within 30 minutes by car or 45 minutes by transit.

Sources: I compiled this table based on review of publicly available documents for each MPO, including their most recent long range transportation plan and associated documents regarding equity and environmental justice analyses (Atlanta Regional Commission 2017, Baltimore Regional Transportation Board 2016, Delaware Valley Regional Planning Commission 2017a, Denver Regional Council of Governments 2017, Metropolitan Transportation Commission 2017, National Capital Region Transportation Planning Board 2016, New York Metropolitan Transportation Council 2017b, North Jersey Transportation Planning Authority 2017, San Diego Association of Governments 2015, Southern California Association of Governments 2016).

Appendix D. Variable Definitions

Across all variables, I treated "don't know" (DK) and "refused" (RF) responses as missing values.

Outcome Variables

Employer-Based Transportation Subsidies

MPO	Survey Question Regarding Transit Subsidies
ATL	Employer Subsidized Transit: 1: Yes; 2: No; 8: DK; 9: RF Employer Provided Parking: 1: Yes; 2: No; 8: DK; 9: RF Employer Subsidized Parking: 1: Yes; 2: No; 8: DK; 9: RF
BAL & DC	Employer Provides Subsidies for Transit/Vanpooling: 1:Yes; 2: No; -9: NA Employer Provides Free Parking: 1:Yes; 2: No; -9: NA Employer and Employee Share Parking Cost: 1:Yes; 2: No; -9: NA
DEN	Employer Provided Transit Pass at No Charge: 1: Yes; 2: No; 8: DK; 9: RF Employer Provided Free Parking: 1: Yes; 2: No; 8: DK; 9: RF
PHL	Employer Offers to Subsidize/Pay for Part of Transit Fare: 1; Employee Must Pay for Transit Fare Out-of-Pocket: 2; DK: 8 Employer Offers to Subsidized/Pay for Part of Workplace Parking: 1; Employee Must Pay for Workplace Parking Out-of-Pocket; Free Parking Available for Employees; 8: DK
NY & NJ	Employer Transportation Benefit: 1: Toll/EZ Pass Payment or Reimbursement; 2: Public Transit Payment or Reimbursement; 3: Free Parking or Reimbursement; 4: Secure Bike Parking; 5: I do Not Use Any Employer-Provided Transportation Subsidies; 7: Other Subsidies; 8: DK; 9: RF
LA & SD, SF	Employer or School Pays for All or Any Part of Transit Fare: 1: Yes; 2: No; 8: DK; 9-RF ***(only collected for those with 1 or more transit trips in prior week)***

Note: I created a binary transit subsidy variable for region/set of regions. The share of workers who did not know whether they were offered an employer-based transit subsidy varied as follows: ATL (8%); BAL & DC (DK not an option, 11% listed NA); DEN (4%); PHL **(41%)**; NY & NJ (2%). Employer-based transit subsidy information was collected from all workers, except for in the case of the California statewide survey, which only collected that information from workers who had taken at least one transit trip in the prior week. I created a binary parking subsidy variable for each region where possible. Where both were asked (ATL, BAL & DC, PHL), I combined free and subsidized parking into a single "parking subsidy" category. For NY & NJ, workers were able to list up to three employer transportation benefits, and I incorporated all responses into the transit and parking subsidy binary variables. I was not able to include a parking subsidy variable for LA & SD, or SF, as the California statewide survey did not collect information in the person file about employer-based parking subsidies.

Daily Trips

I generated worker-level daily trip totals using the trip files included with each survey.

Explanatory Variables

Income Quintiles

MPO	Survey Question Regarding Household Income
ATL	1: <$10,000; 2: $10,000-$19,999; 3: $20,000-$29,999; 4: $30,000-$39,999; 5: $40,000-$49,999; 6: $50,000-$59,999; 7: $60,000-$74,999; 8: $75,000-$99,999; 9: $100,000-$149,999; 10: $150,000 or more; 99: RF
BAL & DC	1: <$10,000; 2: $10,000-$14,999; 3: $15,000-$29,999; 4: $30,000-$39,999; 5: $40,000-$49,999; 6: $50,000-$59,999; 7: $60,000-$74,999; 8: $75,000-$99,999; 9: $100,000-$124,999; 10: $125,000-$149,999; 11: $150,000-$199,999; 12: $200,000 or more; 99: RF
DEN	1: $0-$14,999; $15,000-$19,999; 3: $20,000-$29,999; 4: $30,000-$39,999; 5: $40,000-$49,999; 6: $50,000-$59,999; 7: $60,000-$74,999; 8: $75,000-$99,999; 9: $100,000-$134,999; 10: $135,000-$149,999; 11: $150,000 or more; 99: RF
PHL	1: $0-$9,999; 2: $10,000-$24,999; 3: $25,000-$34,999; 4: $35,000-$49,999; 5: $50,000-$74,999; 6: $75,000-$99,999; 7: $100,000-$149,999; 8: $150,000-$199,999; 9: $200,000-$249,999; 10: $250,000 or more; 98: DK; 99: RF
NY & NJ	1: <$15,000; 2: $15,000-$29,999; 3: $30,000-$49,999; 4: $50,000-$74,999; 5: $75,000-$99,999; 6: $100,000-$149,999; 7: $150,000-$199,999; 8: $200,000 or more; 99: RF
LA & SD, SF	Identical to Philadelphia

Note: Each survey collected information about income in categories. I created income quintiles for each region/set of regions by tabulating household income categories for workers using sample weights, and then creating groups as close to quintile cutoffs as possible. Below I list the income categories combined to create income quintiles for each region, as well as the percent of workers contained in each quintile.

ATL

Quintile	Income Categories	Income Range	Percent of Workers
1	1-3	<$10,000-$29,999	16.3%
2	4-6	$30,000-$59,999	27.3%
3	7-8	$60,000-$99,999	25.0%
4	9	$100,000-$149,999	17.8%
5	10	$150,000 or more	13.6%

BAL & DC

Quintile	Income Categories	Income Range	Percent of Workers
1	1-5	<$10,000-$40,000-$49,999	15.2%
2	6-7	$50,000-$74,999	17.0%
3	8	$75,000-$99,999	16.8%
4	9	$100,000-$124,999	20.0%
5	10-12	$125,000-$200,000 or more	31.0%

DEN

Quintile	Income Categories	Income Range	Percent of Workers
1	1-4	$0-$39,999	22.8%
2	5-6	$40,000-$59,999	14.3%
3	7-8	$60,000-$99,999	26.6%
4	9-10	$100,000-$149,999	19.7%
5	11	$150,000 or more	16.6%

PHL

Quintile	Income Categories	Income Range	Percent of Workers
1	1-4	$0-$49,999	19.0%
2	5	$50,000-$74,999	19.4%
3	6	$75,000-$99,999	18.8%
4	7	$100,000-$149,999	27.4%
5	8-10	$150,000-$250,000 or more	15.4%

NY & NJ

Quintile	Income Categories	Income Range	Percent of Workers
1	1-3	<$15,000-$49,999	25.5%
2	4	$50,000-$74,999	17.4%
3	5	$75,000-$99,999	14.7%
4	6	$100,000-$149,999	20.6%
5	7-8	$150,000-$200,000 or more	21.9%

LA & SD

Quintile	Income Categories	Income Range	Percent of Workers
1	1-3	$0-$34,999	23.3%
2	4	$35,000-$49,999	12.7%
3	5-6	$50,000-$99,999	31.4%
4	7	$100,000-$149,999	15.2%
5	8-10	$150,000-$250,000 or more	17.4%

SF

Quintile	Income Categories	Income Range	Percent of Workers
1	1-4	$0-$49,999	22.7%
2	5	$50,000-$74,999	13.2%
3	6-7	$75,000-$149,999	32.2%
4	8	$150,000-$199,999	15.1%
5	9-10	$200,000-$250,000 or more	16.8%

Schedule Type

MPO	Survey Question Regarding Employer Type
ATL	Number of Work Days Per Week: 1-7
BAL & DC	Work Days for Primary Job: 1: Just Weekdays; 2: Weekdays & Weekends; 3: Just Weekends; 4: Varies; 8: DK; 9: RF
DEN	Number of Work Hours Per Week
PHL	Typical Days Worked: Monday-Saturday
NY & NJ	Identical to Atlanta
LA & SD, SF	Identical to Atlanta

Note: For ATL, NY & NJ, and LA & SF, and SF, I created three categories: 1-4 days per week, 5 days per week, and 6-7 days per week. For BAL & DC, I created dummy variables for each category. For PHL, I created a binary variable for whether a worker had a Monday-Friday schedule. For DEN, I created four categories based on the number of hours worked per week: 1) 1-29; 2) 30-39; 3) 40; 4) more than 40.

Employment Location

MPO	Survey Question Regarding Work Location
ATL	Work jurisdictions using FIPS codes (derived from workplace TAZ) of Cobb County (13067), DeKalb County (13089), Fulton County (13121), and Gwinnett County (13135)
BAL & DC	Work jurisdictions using FIPS codes of Arlington County (51013), Baltimore City (24510), Baltimore County (24005), Fairfax County (51059), Montgomery County (24031), Prince George's County (24033), and Washington, DC (11001)
DEN	Work City: Aurora, Boulder, Denver, Englewood, Littleton
PHL	Work jurisdictions using FIPS codes for Bucks County (42017), Burlington County (34005), Camden County (34007), Chester County (42029), Delaware County (42025), Mercer County (34021), Montgomery County (42091), Philadelphia (42101)
NY & NJ	Work City: Jersey City, New York City (including Bronx, Brooklyn, Manhattan, Queens, and Staten Island), Newark
LA & SD	Work City: Anaheim, Burbank, Carlsbad, Chula Vista, El Cajon, El Segundo, Escondido, Glendale, Irvine, La Jolla, Long Beach, Los Angeles, Oceanside, Orange, Pasadena, Riverside, San Bernardino, San Diego, Santa Ana, Santa Monica, Ventura
SF	Work City: Berkeley, Oakland, Palo Alto, San Francisco, San Jose

Note: I created binary variables for each region/set of regions to represent workers in the jurisdictions with the largest numbers of workers. ATL was a special case that required unique data preparation, as it was the only region that identified work location by Travel Analysis Zone, but not jurisdiction. I assigned each workplace TAZ to a CTFIPS code. Because the City of Atlanta includes portions of both Fulton and DeKalb counties, I could not include a variable for the City of Atlanta.

Employer Type

MPO	Survey Question Regarding Employer Type
ATL	1: A Private Company; 2: Government; 3: Non-Profit; 4: Self-Employed; 7: Other; 8: DK; 9: RF
BAL & DC	1: Private For-Profit Firm; 2: Private Non-Profit Firm; 3: Federal Government; 4: State or Local Government; 5: Foreign Government or International Organization; 6: Self-Employed; 8: DK; 9: RF
DEN	Not Included in Survey
PHL	Not Included in Survey
NY & NJ	Identical to Atlanta
LA & SD, SF	Not Included in Survey

Note: I created dummy variables for each of the employer types for each region/set of regions with data available on employer type. BAL & DC separate different types of government employers, while ATL and NY & NJ include a single category for government employers.

Occupation Categories

MPO	Survey Question Regarding Occupation Type
ATL	11: Management; 13: Business & Financial Operations; 15: Computer & Mathematical; 17: Architecture & Engineering; 19: Life, Physical, & Social Science; 21: Community & Social Services; 23: Legal; 25: Education, Training, & Library; 27: Arts, Design, Entertainment, Sports, & Media; 29: Healthcare Practitioners & Technical; 31: Healthcare Support: 33: Protective Service; 35: Food Preparation & Serving Related; 37: Building & Grounds Cleaning & Maintenance; 39: Personal Care & Service; 41: Sales & Related; 43: Office & Administrative Support; 45: Farming, Fishing, & Forestry; 47: Construction & Extraction; 49: Installation, Maintenance, & Repair; 51: Production; 53: Transportation & Material Moving; 55: Military Specific; 97: Other; 98: DK; 99: RF
BAL & DC	Not Included in Survey
DEN	Occupation (verbatim); Manually assigned to be identical to Atlanta
PHL	Identical to Atlanta
NY & NJ	Identical to Atlanta
LA & SD, SF	Identical to Atlanta

Note: ATL, PHL, NY & NJ, and LA & SD, & SF all included worker occupation codes consistent with the 23 Major Groups of the Bureau of Labor Statistics Standard Occupational Codes. I created six collapsed occupational categories: 1) Management & Finance (11, 13); 2) Science & Health Professionals (15, 17, 19, 29); 3) Professional Services (21, 23, 25, 27); 4) Support Services (31, 33, 35, 37, 39, 41, 43); 5) Production, Extraction, Military (45, 47, 49, 51, 53, 55); and 6) Other (97). For DEN, I manually reviewed verbatim occupation entries for all workers in the sample, and assigned occupation codes consistent with the categories used by the other regions in the sample.

Appendix E. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the Atlanta Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (Atlanta)

	Correlation Coefficient	p-value
Other Transportation Benefit		
Parking Subsidy	-0.100	0.000
Income Quartile		
1st Income Quintile	-0.085	0.000
2nd Income Quintile	-0.051	0.001
3rd Income Quintile	0.002	0.819
4th Income Quintile	0.050	0.000
5th Income Quintile	0.103	0.000
Schedule Type		
1-4 Days Per Week	-0.036	0.000
5 Days Per Week	0.046	0.000
6-7 Days Per Week	-0.023	0.015
Employer Location		
Cobb County	-0.047	0.000
DeKalb County	0.056	0.000
Fulton County	0.133	0.000
Gwinnett County	-0.045	0.000
Employer Type		
For Profit Firm	-0.062	0.000
Government	0.098	0.000
Non Profit	0.004	0.628
Self-Employed	-0.040	0.000
Other Employer Type	0.020	0.031
Occupational Group		
Management & Finances	0.084	0.000
Science & Health Professionals	0.067	0.000
Professional Services	-0.024	0.008
Support Services	-0.072	0.000
Production, Extraction, Military	-0.029	0.001
Other Employer Type	0.007	0.454

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (Atlanta)

Variable	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefits					
Transit Subsidy	7,784	0.132	0.338	0	1
Parking Subsidy	7,784	0.912	0.283	0	1
Income Quartile					
1st Income Quintile	7,784	0.168	0.374	0	1
2nd Income Quintile	7,784	0.286	0.452	0	1
3rd Income Quintile	7,784	0.252	0.434	0	1
4th Income Quintile	7,784	0.169	0.375	0	1
5th Income Quintile	7,784	0.125	0.331	0	1
Schedule Type					
1-4 Days Per Week	7,784	0.310	0.463	0	1
5 Days Per Week	7,784	0.621	0.485	0	1
6-7 Days Per Week	7,784	0.069	0.253	0	1
Employer Location					
Cobb County	7,784	0.139	0.346	0	1
DeKalb County	7,784	0.154	0.361	0	1
Fulton County	7,784	0.294	0.456	0	1
Gwinnett County	7,784	0.116	0.320	0	1
Employer Type					
For Profit Firm	7,784	0.625	0.484	0	1
Government	7,784	0.211	0.408	0	1
Non Profit	7,784	0.109	0.312	0	1
Self-Employed	7,784	0.053	0.223	0	1
Other Employer Type	7,784	0.002	0.046	0	1
Occupational Group					
Management & Finances	7,784	0.181	0.385	0	1
Science & Health Professionals	7,784	0.086	0.280	0	1
Professional Services	7,784	0.282	0.450	0	1
Support Services	7,784	0.319	0.466	0	1
Production, Extraction, Military	7,784	0.109	0.312	0	1
Other Employer Type	7,784	0.023	0.150	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (Atlanta)

	Odds Ratio	***Std. Err.***	***z***	***p-value***
Other Transportation Benefit				
Parking Subsidy	0.571	0.060	-5.3	0.000
Income				
1st Income Quintile				
2nd Income Quintile	1.160	0.207	0.8	0.405
3rd Income Quintile	1.482	0.252	2.3	0.021
4th Income Quintile	1.863	0.324	3.6	0.000
5th Income Quintile	2.456	0.439	5.0	0.000
Schedule Type				
1-4 Days Per Week (Base)				
5 Days Per Week	1.223	0.102	2.4	0.015
6-7 Days Per Week	1.191	0.203	1.0	0.305
Employer Location				
Cobb County	1.157	0.155	1.1	0.277
DeKalb County	2.406	0.282	7.5	0.000
Fulton County	2.473	0.255	8.8	0.000
Gwinnett County	1.087	0.161	0.6	0.572
Employer Type				
Private Firm (Base)				
Government	1.566	0.146	4.8	0.000
Non Profit	1.127	0.140	1.0	0.338
Self-Employed	0.708	0.142	-1.7	0.085
Other Employer Type	1.578	0.968	0.7	0.457
Occupation				
Management & Finances (Base)				
Science & Health Professionals	0.878	0.102	-1.1	0.265
Professional Services	0.516	0.054	-6.3	0.000
Support Services	0.615	0.061	-4.9	0.000
Production, Extraction, Military	0.718	0.103	-2.3	0.020
Other Employer Type	0.540	0.134	-2.5	0.013
Constant	0.110	0.024	-10.1	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=7,784; pseudo-R^2=0.070; Hosmer-Lemeshow Goodness-of-Fit p-value=0.075 (fail); Link Test squared-term p-value<0.01 (fail); 0.5% sensitivity; 99.9% specificity; 0.0% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix F. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the Baltimore & Washington DC Regions (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (Baltimore & Washington DC)

	Correlation Coefficient	p-value
Other Transportation Benefit		
Parking Subsidy	-0.171	0.000
Income Quartile		
1st Income Quintile	-0.058	0.000
2nd Income Quintile	-0.020	0.013
3rd Income Quintile	-0.006	0.476
4th Income Quintile	0.021	0.011
5th Income Quintile	0.048	0.000
Schedule Type		
Weekdays Only	0.119	0.000
Weekdays & Weekends	-0.104	0.000
Weekends Only	-0.032	0.000
Variable Schedule	-0.040	0.000
Employer Location		
Arlington County	0.121	0.000
Baltimore City	-0.036	0.000
Baltimore County	-0.093	0.000
Fairfax County	-0.086	0.000
Montgomery County	0.000	0.976
Prince George's County	-0.065	0.000
Washington DC	0.354	0.000
Employer Type		
For Profit Firm	-0.217	0.000
Non Profit Firm	-0.019	0.019
Federal Government	0.363	0.000
State/Local Government	-0.079	0.000
Foreign/International	0.003	0.756

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (Baltimore & Washington DC)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefits					
Transit Subsidy	14,413	0.161	0.367	0	1
Parking Subsidy	14,413	0.594	0.491	0	1
Income Quartile					
1st Income Quintile	14,413	0.150	0.357	0	1
2nd Income Quintile	14,413	0.170	0.376	0	1
3rd Income Quintile	14,413	0.172	0.377	0	1
4th Income Quintile	14,413	0.202	0.401	0	1
5th Income Quintile	14,413	0.307	0.461	0	1
Schedule Type					
Weekdays Only	14,413	0.732	0.443	0	1
Weekdays & Weekends	14,413	0.239	0.427	0	1
Weekends Only	14,413	0.006	0.078	0	1
Variable Schedule	14,413	0.022	0.146	0	1
Employer Location					
Arlington County	14,413	0.050	0.219	0	1
Baltimore City	14,413	0.091	0.288	0	1
Baltimore County	14,413	0.080	0.271	0	1
Fairfax County	14,413	0.129	0.336	0	1
Montgomery County	14,413	0.100	0.300	0	1
Prince George's County	14,413	0.073	0.260	0	1
Washington DC	14,413	0.206	0.404	0	1
Employer Type					
For Profit Firm	14,413	0.499	0.500	0	1
Non Profit Firm	14,413	0.150	0.357	0	1
Federal Government	14,413	0.196	0.397	0	1
State/Local Government	14,413	0.150	0.357	0	1
Foreign/International	14,413	0.005	0.073	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (Baltimore & Washington DC)

	Odds Ratio	***Std. Err.***	***z***	***P>z***
Other Transportation Benefit				
Parking Subsidy	0.577	0.032	-9.8	0.000
Income Quartile				
1st Income Quintile (Base)				
2nd Income Quintile	1.243	0.125	2.2	0.030
3rd Income Quintile	1.288	0.129	2.5	0.012
4th Income Quintile	1.336	0.132	2.9	0.003
5th Income Quintile	1.206	0.110	2.1	0.040
Schedule Type				
Weekdays Only (Base)				
Weekdays & Weekends	0.651	0.047	-5.9	0.000
Weekends Only	0.231	0.172	-2.0	0.050
Variable Schedule	0.435	0.099	-3.7	0.000
Employer Location				
Arlington County	7.969	0.975	17.0	0.000
Baltimore City	3.631	0.469	10.0	0.000
Baltimore County	1.319	0.245	1.5	0.136
Fairfax County	2.261	0.293	6.3	0.000
Montgomery County	4.238	0.499	12.3	0.000
Prince George's County	1.737	0.251	3.8	0.000
Washington DC	11.149	1.107	24.3	0.000
Employer Type				
For Profit Firm (Base)				
Non Profit Firm	1.303	0.100	3.5	0.001
Federal Government	5.323	0.345	25.8	0.000
State/Local Government	1.224	0.115	2.2	0.031
Foreign/International	0.784	0.212	-0.9	0.368
Constant	0.034	0.004	-27.8	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=14,413; pseudo-R^2=0.258; Hosmer-Lemeshow Goodness-of-Fit p-value=0.015 (fail); Link Test squared-term p-value=0.343 (pass); 37.5% sensitivity; 95.7% specificity; 16.9% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix G. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the Denver Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (Denver)

	Correlation Coefficient	p-value
Other Transport Benefit		
Parking Subsidy	-0.242	0.000
Income Group		
1st Income Quintile	-0.074	0.000
2nd Income Quintile	-0.027	0.014
3rd Income Quintile	0.014	0.210
4th Income Quintile	0.034	0.002
5th Income Quintile	0.058	0.000
Schedule Type		
1-29 Hours Per Week	-0.095	0.000
30-39 Hours Per Week	-0.025	0.027
40 Hours Per Week	0.088	0.000
More Than 40 Hours Per Week	0.010	0.363
Employer Location		
Aurora	-0.001	0.947
Boulder	0.197	0.000
Denver	0.049	0.000
Englewood	-0.051	0.000
Littleton	-0.042	0.000
Other	0.058	0.000
Occupational Group		
Management & Finances	0.053	0.000
Science & Health Professionals	0.081	0.000
Professional Services	0.002	0.846
Support Services	-0.091	0.000
Production, Extraction, Military	-0.038	0.001
Other	-0.032	0.004

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (Denver)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefits					
Transit Subsidy	7,409	0.118	0.322	0	1
Parking Subsidy	7,409	0.886	0.317	0	1
Income Group					
1st Income Quintile	7,409	0.095	0.293	0	1
2nd Income Quintile	7,409	0.114	0.318	0	1
3rd Income Quintile	7,409	0.334	0.472	0	1
4th Income Quintile	7,409	0.263	0.440	0	1
5th Income Quintile	7,409	0.194	0.395	0	1
Schedule Type					
1-29 Hours Per Week	7,409	0.188	0.391	0	1
30-39 Hours Per Week	7,409	0.115	0.319	0	1
40 Hours Per Week	7,409	0.426	0.494	0	1
More Than 40 Hours Per Week	7,409	0.271	0.445	0	1
Employer Location					
Aurora	7,409	0.071	0.257	0	1
Boulder	7,409	0.078	0.268	0	1
Denver	7,409	0.373	0.484	0	1
Englewood	7,409	0.091	0.288	0	1
Littleton	7,409	0.046	0.209	0	1
Occupational Group					
Management & Finances	7,409	0.268	0.443	0	1
Science & Health Professionals	7,409	0.222	0.415	0	1
Professional Services	7,409	0.233	0.423	0	1
Support Services	7,409	0.170	0.376	0	1
Production, Extraction, Military	7,409	0.099	0.298	0	1
Other	7,409	0.009	0.095	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (Denver)

	Odds Ratio	**Std. Err.**	**z**	**P>z**
Other Transport Benefit				
Parking Subsidy	0.275	0.026	-13.6	0.000
Income Group				
1st Income Quintile (Base)				
2nd Income Quintile	1.139	0.251	0.6	0.554
3rd Income Quintile	1.219	0.232	1.0	0.298
4th Income Quintile	1.391	0.271	1.7	0.090
5th Income Quintile	1.696	0.336	2.7	0.008
Schedule Type				
1-29 Hours Per Week (Base)				
30-39 Hours Per Week	1.712	0.318	2.9	0.004
40 Hours Per Week	2.845	0.404	7.4	0.000
More Than 40 Hours Per Week	2.013	0.304	4.6	0.000
Employer Location				
Aurora	1.168	0.234	0.8	0.440
Boulder	11.077	1.478	18.0	0.000
Denver	2.542	0.297	8.0	0.000
Englewood	1.065	0.213	0.3	0.754
Littleton	0.856	0.275	-0.5	0.629
Other (Base)				
Occupational Group				
Management & Finances				
Science & Health Professionals	1.228	0.130	2.0	0.051
Professional Services	0.912	0.098	-0.9	0.391
Support Services	0.557	0.083	-4.0	0.000
Production, Extraction, Military	0.641	0.114	-2.5	0.013
Other	0.383	0.213	-1.7	0.084
Constant	0.068	0.018	-10.1	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=7,409; pseudo-R^2=0.174; Hosmer-Lemeshow Goodness-of-Fit p-value=0.028 (fail); Link Test squared-term p-value=0.036 (fail); 11.8% sensitivity; 99.3% specificity; 6.5% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix H. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the Los Angeles & San Diego Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (Los Angeles & San Diego)

	Correlation Coefficient	p-value
Income Group		
1st Income Quintile	-0.058	0.000
2nd Income Quintile	-0.018	0.094
3rd Income Quintile	0.028	0.009
4th Income Quintile	0.036	0.001
5th Income Quintile	0.044	0.000
Schedule Type		
1-4 Days Per Week	-0.053	0.001
5 Days Per Week	0.069	0.000
6-7 Days Per Week	-0.030	0.048
Employer Location		
Anaheim	0.022	0.033
Burbank	0.001	0.933
El Segundo	0.023	0.022
Glendale	0.018	0.081
Irvine	-0.009	0.365
Los Angeles	0.132	0.000
Long Beach	0.000	0.978
Orange	0.038	0.000
Pasadena	0.003	0.775
Riverside	0.031	0.002
Santa Ana	0.009	0.381
Santa Monica	0.002	0.843
San Bernardino	0.014	0.171
San Diego	0.068	0.000
Torrance	-0.004	0.711
Ventura	-0.011	0.288
Occupation Group		
Management & Finances	0.076	0.000
Science & Health Professionals	0.063	0.000
Professional Services	0.032	0.036
Support Services	-0.104	0.000
Production, Extraction, Military	-0.033	0.032
Other Employer Type	0.006	0.708

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (Los Angeles & San Diego)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefit					
Transit Subsidy	3,811	0.134	0.341	0	1
Income Group					
1st Income Quintile	3,811	0.321	0.467	0	1
2nd Income Quintile	3,811	0.130	0.336	0	1
3rd Income Quintile	3,811	0.270	0.444	0	1
4th Income Quintile	3,811	0.143	0.350	0	1
5th Income Quintile	3,811	0.136	0.343	0	1
Schedule Type					
1-4 Days Per Week	3,811	0.276	0.447	0	1
5 Days Per Week	3,811	0.601	0.490	0	1
6-7 Days Per Week	3,811	0.123	0.328	0	1
Employer Location					
Anaheim	3,811	0.018	0.132	0	1
Burbank	3,811	0.009	0.092	0	1
El Segundo	3,811	0.009	0.092	0	1
Glendale	3,811	0.011	0.105	0	1
Irvine	3,811	0.023	0.151	0	1
Los Angeles	3,811	0.190	0.392	0	1
Long Beach	3,811	0.010	0.101	0	1
Orange	3,811	0.012	0.108	0	1
Pasadena	3,811	0.016	0.127	0	1
Riverside	3,811	0.012	0.109	0	1
Santa Ana	3,811	0.009	0.096	0	1
Santa Monica	3,811	0.009	0.094	0	1
San Bernardino	3,811	0.009	0.094	0	1
San Diego	3,811	0.055	0.228	0	1
Torrance	3,811	0.009	0.093	0	1
Ventura	3,811	0.006	0.077	0	1
Occupation Group					
Management & Finances	3,811	0.148	0.355	0	1
Science & Health Professionals	3,811	0.125	0.331	0	1
Professional Services	3,811	0.189	0.391	0	1
Support Services	3,811	0.380	0.485	0	1
Production, Extraction, Military	3,811	0.126	0.332	0	1
Other Employer Type	3,811	0.032	0.175	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (Los Angeles & San Diego)

	Odds Ratio	**Std. Err.**	**z**	**P>z**
Income Group				
1st Income Quintile				
2nd Income Quintile	1.272	0.288	1.1	0.287
3rd Income Quintile	2.015	0.317	4.5	0.000
4th Income Quintile	2.032	0.347	4.2	0.000
5th Income Quintile	2.399	0.421	5.0	0.000
Schedule Type				
1-4 Days Per Week				
5 Days Per Week	1.132	0.130	1.1	0.279
6-7 Days Per Week	1.124	0.211	0.6	0.534
Employer Location				
Anaheim	1.438	0.601	0.9	0.384
Burbank	0.717	0.379	-0.6	0.529
El Segundo	1.662	0.707	1.2	0.232
Glendale	2.723	0.853	3.2	0.001
Irvine	0.626	0.227	-1.3	0.198
Los Angeles	2.593	0.288	8.6	0.000
Long Beach	0.668	0.420	-0.6	0.521
Orange	2.401	0.969	2.2	0.030
Pasadena	1.222	0.410	0.6	0.550
Riverside	1.508	0.594	1.0	0.297
Santa Ana	1.395	0.626	0.7	0.459
Santa Monica	0.498	0.299	-1.2	0.245
San Bernardino	2.300	1.072	1.8	0.074
San Diego	2.082	0.473	3.2	0.001
Torrance	0.623	0.449	-0.7	0.511
Ventura	0.363	0.255	-1.4	0.149
Occupation Group				
Management & Finances				
Science & Health Professionals	0.867	0.126	-1.0	0.326
Professional Services	0.663	0.095	-2.9	0.004
Support Services	0.574	0.079	-4.0	0.000
Production, Extraction, Military	0.467	0.091	-3.9	0.000
Other Employer Type	0.819	0.220	-0.8	0.456
Constant	0.098	0.019	-11.9	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=3,811; pseudo-R^2=0.062; Hosmer-Lemeshow Goodness-of-Fit p-value=0.618 (pass); Link Test squared-term p-value=0.010 (fail); 0.0% sensitivity; 100.0% specificity; 0.0% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix I. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the New York & Newark Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (New York City and Newark)

	Correlation Coefficient	p-value
Other Transport Benefit		
Parking Subsidy	-0.074	0.000
Income Group		
1st Income Quintile	-0.069	0.000
2nd Income Quintile	-0.005	0.500
3rd Income Quintile	-0.020	0.004
4th Income Quintile	0.017	0.015
5th Income Quintile	0.078	0.000
Schedule Type		
1-4 Days Per Week	-0.073	0.000
5 Days Per Week	0.079	0.000
6-7 Days Per Week	-0.025	0.000
Employer Location		
Jersey City	0.016	0.021
New York City	0.255	0.000
Newark	-0.006	0.368
Employer Type		
For Profit Firm	0.011	0.102
Government	0.004	0.566
Non Profit	0.049	0.000
Self-Employed	-0.084	0.000
Other Employer Type	0.022	0.001
Occupational Group		
Management & Finances	0.051	0.000
Science & Health Professionals	0.030	0.000
Professional Services	-0.021	0.003
Support Services	-0.041	0.000
Production, Extraction, Military	-0.002	0.777
Other Employer Type	0.002	0.796

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (New York City and Newark)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefits					
Transit Subsidy	20,009	0.076	0.264	0	1
Parking Subsidy	20,009	0.109	0.312	0	1
Income Group					
1st Income Quintile	20,009	0.252	0.434	0	1
2nd Income Quintile	20,009	0.173	0.379	0	1
3rd Income Quintile	20,009	0.148	0.355	0	1
4th Income Quintile	20,009	0.206	0.404	0	1
5th Income Quintile	20,009	0.220	0.414	0	1
Schedule Type					
1-4 Days Per Week	20,009	0.194	0.396	0	1
5 Days Per Week	20,009	0.698	0.459	0	1
6-7 Days Per Week	20,009	0.108	0.310	0	1
Employer Location					
Jersey City	20,009	0.014	0.117	0	1
New York City	20,009	0.372	0.483	0	1
Newark	20,009	0.016	0.124	0	1
Employer Type					
For Profit Firm	20,009	0.582	0.493	0	1
Government	20,009	0.197	0.398	0	1
Non Profit	20,009	0.095	0.293	0	1
Self-Employed	20,009	0.096	0.295	0	1
Other Employer Type	20,009	0.017	0.129	0	1
Occupational Group					
Management & Finances	20,009	0.194	0.395	0	1
Science & Health Professic	20,009	0.087	0.282	0	1
Professional Services	20,009	0.306	0.461	0	1
Support Services	20,009	0.306	0.461	0	1
Production, Extraction, Mil	20,009	0.087	0.282	0	1
Other Employer Type	20,009	0.021	0.142	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (New York City and Newark)

	Odds Ratio	**Std. Err.**	**z**	**P>z**
Other Transport Benefit				
Parking Subsidy	0.249	0.049	-7.1	0.000
Income Group				
1st Income Quintile				
2nd Income Quintile	1.226	0.145	1.7	0.085
3rd Income Quintile	1.535	0.180	3.7	0.000
4th Income Quintile	1.740	0.189	5.1	0.000
5th Income Quintile	2.158	0.232	7.2	0.000
Schedule Type				
1-4 Days Per Week				
5 Days Per Week	2.054	0.225	6.6	0.000
6-7 Days Per Week	1.842	0.281	4.0	0.000
Employer Location				
Jersey City	5.263	1.072	8.2	0.000
New York City	9.365	0.724	28.9	0.000
Newark	3.146	0.821	4.4	0.000
Employer Type				
For Profit Firm				
Government	1.182	0.100	2.0	0.049
Non Profit	1.620	0.150	5.2	0.000
Self-Employed	0.203	0.052	-6.3	0.000
Other Employer Type	1.308	0.268	1.3	0.189
Occupational Group				
Management & Finances				
Science & Health Professionals	1.319	0.135	2.7	0.007
Professional Services	0.667	0.058	-4.6	0.000
Support Services	0.761	0.068	-3.1	0.002
Production, Extraction, Military	0.821	0.114	-1.4	0.157
Other Employer Type	0.761	0.180	-1.2	0.247
Constant	0.009	0.002	-27.7	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=20,009; pseudo-R^2=0.193; Hosmer-Lemeshow Goodness-of-Fit p-value=0.001 (fail); Link Test squared-term p-value<0.01 (fail); 0.0% sensitivity; 100.0% specificity; 0.0% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix J. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the Philadelphia Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (Philadelphia)

	Correlation Coefficient	p-value
Other Transport Benefit		
Parking Subsidy	-0.039	0.005
Income Group		
1st Income Quintile	-0.047	0.001
2nd Income Quintile	-0.029	0.039
3rd Income Quintile	0.050	0.000
4th Income Quintile	0.017	0.231
5th Income Quintile	0.009	0.537
Schedule Type		
Monday to Friday	0.083	0.000
Employer Location		
Bucks	-0.062	0.000
Burlington	-0.087	0.000
Camden	-0.069	0.000
Chester	-0.036	0.007
Delaware	-0.084	0.000
Mercer	0.053	0.000
Montgomery	-0.039	0.004
Philadelphia	0.210	0.000
Occupational Group		
Management & Finances	0.040	0.003
Science & Health Professionals	0.061	0.000
Professional Services	-0.024	0.076
Support Services	-0.091	0.000
Production, Extraction, Military	0.014	0.320
Other	0.062	0.000

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (Philadelphia)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefits					
Transit Subsidy	4,830	0.109	0.311	0	1
Parking Subsidy	4,830	0.813	0.390	0	1
Income Group					
1st Income Quintile	4,830	0.185	0.388	0	1
2nd Income Quintile	4,830	0.191	0.393	0	1
3rd Income Quintile	4,830	0.185	0.389	0	1
4th Income Quintile	4,830	0.281	0.450	0	1
5th Income Quintile	4,830	0.157	0.364	0	1
Schedule Type					
Monday to Friday	4,830	0.687	0.464	0	1
Employer Location					
Bucks	4,830	0.070	0.255	0	1
Burlington	4,830	0.062	0.241	0	1
Camden	4,830	0.059	0.236	0	1
Chester	4,830	0.067	0.249	0	1
Delaware	4,830	0.068	0.252	0	1
Mercer	4,830	0.073	0.259	0	1
Montgomery	4,830	0.145	0.352	0	1
Philadelphia	4,830	0.305	0.460	0	1
Occupational Group					
Management & Finances	4,830	0.200	0.400	0	1
Science & Health Professiona	4,830	0.128	0.334	0	1
Professional Services	4,830	0.270	0.444	0	1
Support Services	4,830	0.270	0.444	0	1
Production, Extraction, Milita	4,830	0.101	0.302	0	1
Other	4,830	0.032	0.176	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (Philadelphia)

	Odds Ratio	**Std. Err.**	**z**	**P>z**
Other Transport Benefit				
Parking Subsidy	1.617	0.206	3.8	0.000
Income Group				
1st Income Quintile				
2nd Income Quintile	1.356	0.280	1.5	0.140
3rd Income Quintile	1.714	0.335	2.8	0.006
4th Income Quintile	1.951	0.364	3.6	0.000
5th Income Quintile	2.045	0.386	3.8	0.000
Schedule Type				
Monday to Friday	1.107	0.132	0.9	0.393
Employer Location				
Bucks	0.314	0.103	-3.5	0.000
Burlington	0.215	0.093	-3.5	0.000
Camden	0.358	0.131	-2.8	0.005
Chester	0.531	0.135	-2.5	0.013
Delaware	0.486	0.144	-2.4	0.015
Mercer	1.397	0.333	1.4	0.161
Montgomery	0.673	0.129	-2.1	0.039
Philadelphia	4.224	0.652	9.3	0.000
Occupational Group				
Management & Finances				
Science & Health Professionals	1.375	0.197	2.2	0.027
Professional Services	0.684	0.088	-2.9	0.003
Support Services	0.679	0.106	-2.5	0.013
Production, Extraction, Military	0.808	0.185	-0.9	0.350
Other	1.349	0.374	1.1	0.280
Constant	0.041	0.011	-11.8	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=4,830; pseudo-R^2=0.122; Hosmer-Lemeshow Goodness-of-Fit p-value=0.312 (pass); Link Test squared-term p-value=0.042 (fail); 0.0% sensitivity; 100.0% specificity; 0.0% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.

Appendix K. Correlation Coefficients, Summary Statistics, and Logistic Regression Results for the San Francisco Region (Employer-Based Transit Subsidy Offering)

Correlation Coefficients (San Francisco)

	Correlation Coefficient	p-value
Income Group		
1st Income Quintile	-0.093	0.000
2nd Income Quintile	-0.024	0.149
3rd Income Quintile	0.020	0.234
4th Income Quintile	0.094	0.000
5th Income Quintile	0.015	0.379
Schedule Type		
1-4 Days Per Week	-0.056	0.001
5 Days Per Week	0.064	0.000
6-7 Days Per Week	-0.022	0.176
Employer Location		
Berkeley	0.004	0.824
Oakland	0.062	0.000
Palo Alto	0.050	0.002
San Francisco	0.004	0.783
San Jose	0.046	0.004
Occupation Group		
Management & Finances	0.104	0.000
Science & Health Professionals	0.086	0.000
Professional Services	-0.061	0.000
Support Services	-0.124	0.000
Production, Extraction, Military	0.009	0.564
Other Employer Type	0.022	0.176

Note: Pairwise correlation with employer-based transit subsidy offering; person-level sample weights are applied.

Summary Statistics (San Francisco)

	Obs	Mean	Std. Dev.	Min	Max
Transportation Benefit					
Transit Subsidy	3,449	0.178	0.382	0	1
Income Group					
1st Income Quintile	3,449	0.234	0.423	0	1
2nd Income Quintile	3,449	0.128	0.334	0	1
3rd Income Quintile	3,449	0.311	0.463	0	1
4th Income Quintile	3,449	0.144	0.352	0	1
5th Income Quintile	3,449	0.183	0.387	0	1
Schedule Type					
1-4 Days Per Week	3,449	0.293	0.455	0	1
5 Days Per Week	3,449	0.631	0.482	0	1
6-7 Days Per Week	3,449	0.076	0.264	0	1
Employer Location					
Berkeley	3,449	0.033	0.178	0	1
Oakland	3,449	0.070	0.256	0	1
Palo Alto	3,449	0.024	0.153	0	1
San Francisco	3,449	0.311	0.463	0	1
San Jose	3,449	0.057	0.233	0	1
Occupation Group					
Management & Finances	3,449	0.224	0.417	0	1
Science & Health Professionals	3,449	0.158	0.365	0	1
Professional Services	3,449	0.232	0.422	0	1
Support Services	3,449	0.280	0.449	0	1
Production, Extraction, Military	3,449	0.079	0.270	0	1
Other Employer Type	3,449	0.028	0.164	0	1

Note: Person-level sample weights are applied.

Logistic Regression Results (San Francisco)

	Odds Ratio	**Std. Err.**	**z**	**P>z**
Income Group				
1st Income Quintile				
2nd Income Quintile	1.671	0.349	2.5	0.014
3rd Income Quintile	1.960	0.354	3.7	0.000
4th Income Quintile	2.798	0.559	5.2	0.000
5th Income Quintile	2.043	0.411	3.6	0.000
Schedule Type				
1-4 Days Per Week	1.217	0.127	1.9	0.061
5 Days Per Week	1.361	0.268	1.6	0.117
6-7 Days Per Week				
Employer Location				
Berkeley	1.130	0.308	0.5	0.653
Oakland	2.328	0.368	5.3	0.000
Palo Alto	1.908	0.489	2.5	0.012
San Francisco	1.230	0.132	1.9	0.053
San Jose	2.016	0.386	3.7	0.000
Occupation Group				
Management & Finances				
Science & Health Professionals	1.091	0.141	0.7	0.500
Professional Services	0.518	0.067	-5.1	0.000
Support Services	0.515	0.073	-4.7	0.000
Production, Extraction, Military	0.786	0.156	-1.2	0.224
Other Employer Type	1.168	0.278	0.7	0.513
Constant	0.117	0.024	-10.3	0.000

Note: Binary Outcome (1: Offered Transit Subsidy by Employer); N=3,449; pseudo-R^2=0.048; Hosmer-Lemeshow Goodness-of-Fit p-value=0.642 (pass); Link Test squared-term p-value=0.505 (pass); 0.5% sensitivity; 99.9% specificity; 0.0% Proportional Reduction in Error. Standard errors adjusted for clusters at the household level.