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Evaluating Transportation Equity

Principles and Practices

By Todd Litman

Paper 4977, TRB *Conference on Advancing Transportation Equity*
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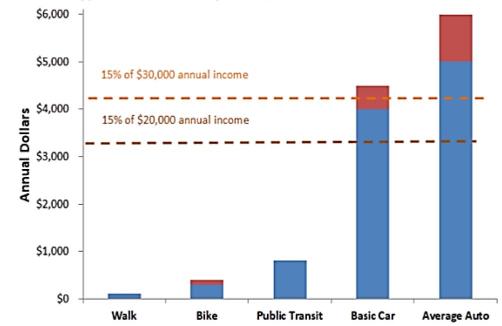
Abstract
Transportation planning decisions often have significant equity impacts; they affect the distribution of benefits and costs. Transport equity analysis is challenging because there are several types of equity to consider, many potential impacts, and various ways to measure impacts. This presentation provides guidance for evaluating transportation equity. It defines various types of equity, equity impacts and objectives, and describes practical ways to incorporate equity evaluation into transportation planning.

Types of Equity

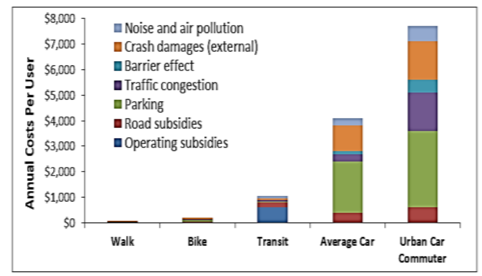
1. *Horizontal equity* (also called *fairness* or *equality)* requires that people with similar needs and abilities be treated similarly, for example, receiving similar benefits and bearing similar costs.
2. *Vertical equity with regard to need and ability* considers how transportation systems serve people with disabilities and other special needs, such as travelling with baggage, children or pets.
3. *Vertical equity with regard to income* considers how transport systems serve lower-income people. Policies that favor lower-income people are called *progressive* and those that favor higher-income people are called *regressive*.
4. *Social justice* considers how transport systems serve disadvantaged and underserved groups, and address structural injustices such as racism and sexism.

Typical User Costs



Walking, bicycling and public transit are the most affordable modes. Automobiles are most expensive and unaffordable to many lower-income households, requiring more than 15% of their budgets.

Estimated External Costs



Transportation tends to impose various external costs (costs imposed on other people).

Typical Transportation Equity Objectives

Horizontal	WRT Ability and Need	WRT Income	Social Justice
• People receive a comparable share of public resources. • Multimodal planning serves. • External costs are minimized and compensated. • All groups are involved in planning.	• *Inclusivity* (accommodate people with disabilities and other special needs). • *Basic accessibility* (ensure that everybody can access basic services and activities). • *Accessible development.* Locate essential services for easy access without a car.	• Favor affordable over expensive modes. • Price discounts and exemptions for lower-income users. • Provide affordable housing in high-accessibility neighborhoods.	• Protect and support minority communities. • Implement affirmative action programs that protect and support disadvantaged groups (women, youths, minorities, etc.).

This table reflects various transportation equity objectives. (WRT = With Respect To)

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Transportation planning decisions often have significant equity impacts; they affect the distribution of benefits and costs. Transport equity analysis is challenging because there are several types of equity to consider, many potential impacts, and various ways to measure impacts. This presentation provides guidance for evaluating transportation equity. It defines various types of equity, equity impacts and objectives, and describes practical ways to incorporate equity evaluation into transportation planning.

Introduction

Transportation planning decisions often determine the allocation of large amounts of money and road space, and affects people's comfort, economic opportunity, safety, health and environment. How can practitioners – transportation engineers, planners and analysts – ensure that these decisions are equitable?

This is an important and timely issue (Verlinghieri and Schwanen 2020). Transportation planning is undergoing a paradigm shift, a fundamental change in the way problems are defined and potential solutions evaluated (Litman 2013). The old paradigm assumed that our primary goal is to maximize travel speeds; other goals, impacts and modes were often overlooked. The results were often unfair. The new planning paradigm is more comprehensive and multimodal. It recognizes other goals, including affordability, economic opportunity for non-drivers, public health, community livability and environmental quality, and it recognizes the important roles that walking, bicycling and public transit play in an efficient and equitable transportation system.

For example, the old paradigm justified the construction of numerous urban highways that displaced and divided multimodal neighborhoods, many with large minority and low income populations, to allow suburban motorists to drive faster to city centers (Brown, Morris and Taylor 2009). More comprehensive evaluation that included equity analysis would surely have resulted in fewer urban highways and more investments in active and public transport, enhancing rather than destroying urban communities.

Consider another example. Imagine you are a traffic engineer in a community with a school with 1,000 students and staff, half of whom arrive by car. The two-lane access road has an unacceptable level-of-serve D. Expanding it to four lanes would cost five million dollars. Is that justified? Conventional planning simply compares the project costs with the value of motorists' travel time savings, but more comprehensive analysis also considers equity impacts. The roadway expansion costs $10,000 per motorist, and the wider roadway with higher traffic speeds would degrade walking and bicycling conditions, harming non-drivers. Five million dollars could finance a lot of pedestrian and bicycle facility improvements, plus a school transportation manager who promotes non-auto commuting. This solution helps achieve equity objectives; it improves inclusive and affordable modes, ensures that non-drivers receive their fair share of infrastructure investments, and reduces the negative impacts that motor vehicle traffic imposes on other road users and nearby residents. More comprehensive analysis is likely to support the multimodal solution.

These examples illustrate the importance of equity analysis. However, such analysis can be challenging. A decision may seem equitable when evaluated one way, but not if evaluated another. This presentation provides an overview of key concepts and methods for more comprehensive transportation equity analysis.

Perspectives and Impacts

Transportation equity analysis is multifaceted. There are four main types to consider:

1. *Horizontal equity* (also called *fairness* or *equality)* requires that people with similar needs and abilities be treated similarly, for example, receiving similar benefits and bearing similar costs. It implies that people should "get what they pay for and pay for what they get," unless subsidies are justified, and external costs be compensated.

2. *Vertical equity with regard to need and ability* considers how transportation systems serve people with disabilities and other special needs, such as travelling with baggage, children or pets. This tends to justify *multimodal planning* with *universal design* to ensure that transport systems accommodate diverse users.

3. *Vertical equity with regard to income* considers how transport systems serve lower-income people. Policies that favor lower-income people are called *progressive* and those that favor higher-income people are called *regressive*. This justifies policies that favor affordable modes, discounts and subsidies for lower-income users, and development policies that allow lower-income households can find homes in multimodal areas.

4. *Social justice* considers how transport systems serve disadvantaged and underserved groups, and address structural injustices such as racism and sexism.

There are also various impacts, metrics, and ways to categorize people for equity analysis, as summarized in Table 1.

Table 1 **Evaluation Factors** (Litman 2021)

Types of Equity	Impacts	Metrics	Groups
Horizontal (Fairness) Equal treatment of equals. Equal benefits and costs. "Get what you pay for and pay for what you get." **Vertical with-respect-to need and ability** Universal design. Special mobility services. Non-auto mobility options. **Vertical with-respect-to income and social class** Affordability. Quality of low-price modes. Fare structures and discounts. Impacts on low-income communities. **Social Justice** Impacts on minority communities. Affirmative action.	**Facilities and Services** Facility planning and design. Funding and subsidies. Involvement in planning. **User benefits and costs** Service quality (convenience, comfort, speed, safety). User information. Fares, fees and taxes. **External Impacts** Traffic congestion. Pedestrian delays. Crash risk. Pollution and hazardous material exposure. **Economic Impacts** Economic opportunities. Job and business impacts. **Regulation and Enforcement** Regulations and enforcement.	**Level of Impacts** *Inputs* (funding, road space, etc.). *Outputs* (amount of mobility and accessibility). *Outcomes* (destinations accessed, user costs, crash casualties, etc.). **Units of People** Per adult. Per commuter or peak-period travel. Per household. **Units of travel** Per vehicle-mile/km. Per passenger-mile/km. Per trip (by type, such as per commute). **Financial** Per dollar. Subsidies. Cost recovery.	**Demographics** Age and household type. (Dis)ability. Income and poverty rates. Race and ethnicity. Driver's licensure. **Location** Jurisdiction and neighborhood. Urban/suburban/rural. **Mode** Active modes. Motor vehicles. Transit user/dependent. **Industries** Equipment/service providers. Shippers. Employees. **Trip type** Emergency. Commutes and errands. Commercial/freight. Recreational/tourist.

There are various types, impacts, measurement units and groupings to consider in equity analysis.

It is generally infeasible to consider all of these perspectives and impacts. A more practical approach is to define measurable equity objectives, such as those in Table 2. Planning decisions can then be evaluated based on the degree that they support or contradict these objectives.

Table 2 **Typical Transportation Equity Objectives** (Litman 2021)

Horizontal	WRT Ability and Need	WRT Income	Social Justice
• People receive a comparable share of public resources. • Multimodal planning serves non-drivers. • External costs are minimized and compensated. • All groups are involved in planning processes.	• *Inclusivity* (accommodate people with disabilities and other special needs with universal design). • *Basic accessibility* (ensure that everybody can access basic services and activities). • *Accessible development.* Locate essential services and jobs for easy access without a car.	• Favor affordable over expensive modes. • Price discounts and exemptions for lower-income users, particularly for essential travel. • Provide affordable housing in high-accessibility neighborhoods.	• Protect and support minority communities. • Implement affirmative action programs that protect and support disadvantaged groups (women, youths, minorities, etc.).

This table reflects various transportation equity objectives. (WRT = With Respect To)

Analysis Methods

Various analysis methods can be used to evaluate equity objectives.

Inclusivity: Accommodating People with Disabilities and Other Special Needs

To be inclusive a transportation system must serve diverse demands, including travellers with disabilities, young children, pets, heavy baggage, and other special needs. This requires multimodal planning, plus targeted improvements for travellers with special needs, such as people with wheelchairs and wheeled luggage, or visual impairments. Even people who do not currently use an option may benefit from having it available for possible future use.

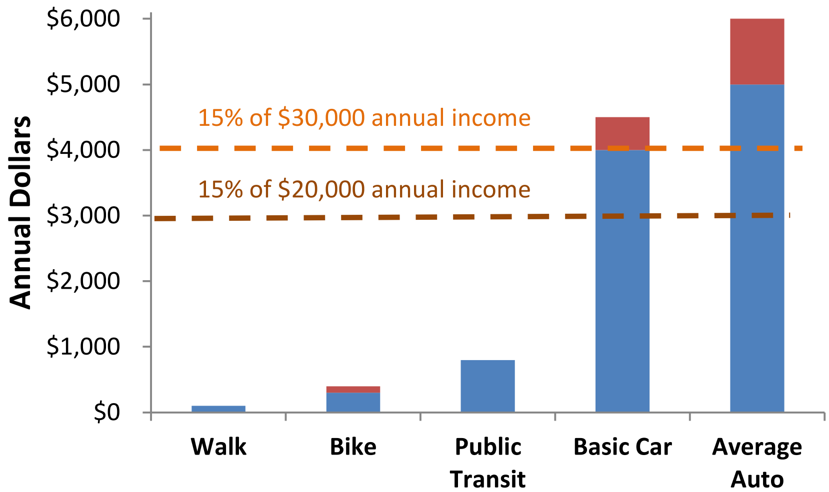
Inclusivity can be evaluated by defining minimal levels of access to essential activities such as healthcare, shopping, education, employment and recreation; a transportation system that fails to achieve these targets is considered to fail and requires necessary improvements. This can be measured using comprehensive accessibility models that measure the destinations that various types of users can reach within their limited time and money budgets (Levinson and King 2020); multimodal level-of-service ratings that measure the quality of various modes (Dowling, et al. 2008), and universal design standards that measure the ease of travel by people with special needs (Saha, et al. 2019). New GIS mapping systems can evaluate these factors, and identify gaps and disparities (Jones, Moffett and He 2018).

Affordability

Transportation affordability refers to households' ability purchase basic mobility within their limited budgets (Litman 2020). This typically means that households spend less than 15% of their budget on transportation, or 45% on transport and housing combined (CNT 2018). Affordability increases households' economic resilience by providing lower-cost options in case their income declines or expenses increase.

Figure 1 compares typical user costs of various modes. Active modes have the lowest costs, public transit has moderate costs, and automobile travel is most expensive, including sometimes large unexpected expenses due to a mechanical failure or crashes, which can be particularly burdensome to financially-precarious households.

Figure 1 **Typical Annual Costs by Mode** (Litman 2019)



Walking, bicycling and public transit are the most affordable modes. Automobiles are most expensive, sometimes imposing large, unpredictable costs. As a result, automobiles are unaffordable to many lower-income people, requiring more than 15% of their budget.

Many households spend more on transportation than is affordable, and surveys indicate that many want more affordable travel options (NAR 2019). Conventional planning gives little consideration to this goal. It evaluates transport system performance based primarily on travel speed, using indicators such as roadway level of service, traffic speed and congestion delay, which favor faster but expensive modes, such as automobile and air travel, over slower but more affordable modes such as active and public transport. If considered at all, affordability is evaluated based on transit fares and fuel prices; conventional planning seldom considers total transportation cost and therefore the potential savings from a more multimodal transportation system.

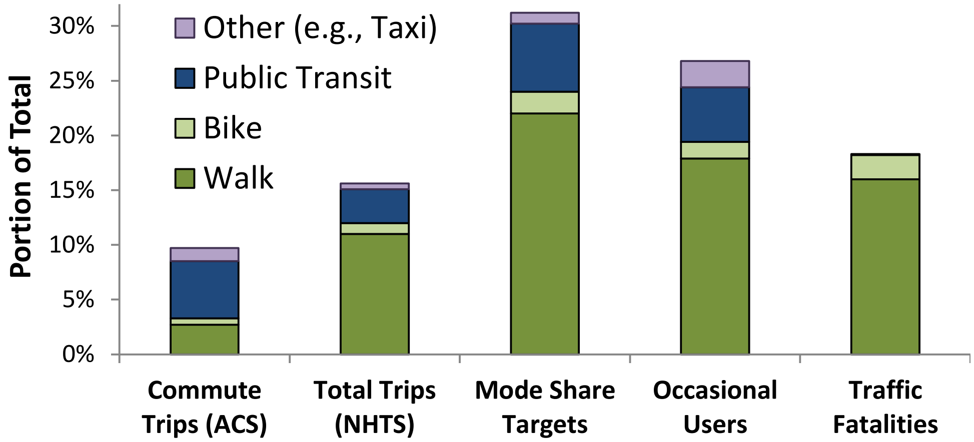
To increase affordability planning can improve lower-cost travel modes, create more compact communities, increase affordable housing options in multimodal areas, and reduce residential parking costs. Some analysis tools can evaluate overall transportation affordability (Lavery 2019). The *Location Affordability Index* (HUD 2019) and the *Housing and Transportation Affordability Index* (CNT 2008), calculate total costs, and therefore the savings provided by more accessible locations.

A Fair Share of Public Resources

Every time somebody purchases a vehicle they expect governments to provide roads and businesses to provide parking facilities for their use. People often assume that this infrastructure is financed through user charges, such as fuel taxes and parking fees, but such fees only pay about half of roadway costs and a small portion of parking facility costs; most of these costs are borne indirectly through general taxes or incorporated into the prices of other goods which consumers pay regardless of how they travel (FHWA 2018, Table HM-72). For example, apartment rents, groceries and restaurant meals cost more to finance parking for the residents and customers who travel by car.

Horizontal equity requires that each person or mode receive a fair share of public resources. This can be evaluated by comparing a mode's demand – its portion of potential trips or users – with the share of public resources devoted to it. For example, if a mode serve 10% of trips or travellers, it would be fair to allocate approximately 10% of money or road space to it. Figure 2 compares indicators of non-auto travel demands. This suggests that in typical U.S. communities it would be fair to invest 10% to 30% of transportation resources in non-auto modes, and more where they have higher-than-average demand, such as areas that are denser, have high rates of people with disabilities and low incomes, or ambitious public health or environmental targets.

Figure 2 **Non-Auto Demand Indicators** (APTA 2017; LAB 2018)



This figure compares indicators of non-auto travel demands.

ACS = American Community Survey

NHTS = National Household Travel Survey

Local governments typically spend $20 to $50 on sidewalks and paths, and state transportation agencies typically spend $1 to $3 annually per capita on active mode programs; in total these represent 2% to 4% of total roadway spending (LAB 2018; Litman 2019). Most bicycling and some walking occurs on general traffic lanes rather than special facilities, but they require less space and impose less wear than motor vehicles, so their roadway costs are small. In 2018, the United State spent about $200 per capita on public transit, $800 per capita on roads and traffic services, about $3,000 per capita on government-mandated off-street parking facilities (APTA 2020; FHWA 2018; Litman 2019). If measured by expenditures per passenger-mile, public transit receives more than its share of funds, but if measured by potential users, assuming that most non-drivers and many large-city residents benefit from transit services, it receives a relatively small share of public infrastructure investments.

This indicates that motorists receive much larger shares of transportation infrastructure investments than people who rely on other modes (Shill 2020). As a result, fairness can justify significantly more investment of money and road space in non-auto modes to achieve equity goals and offset decades of underinvestment.

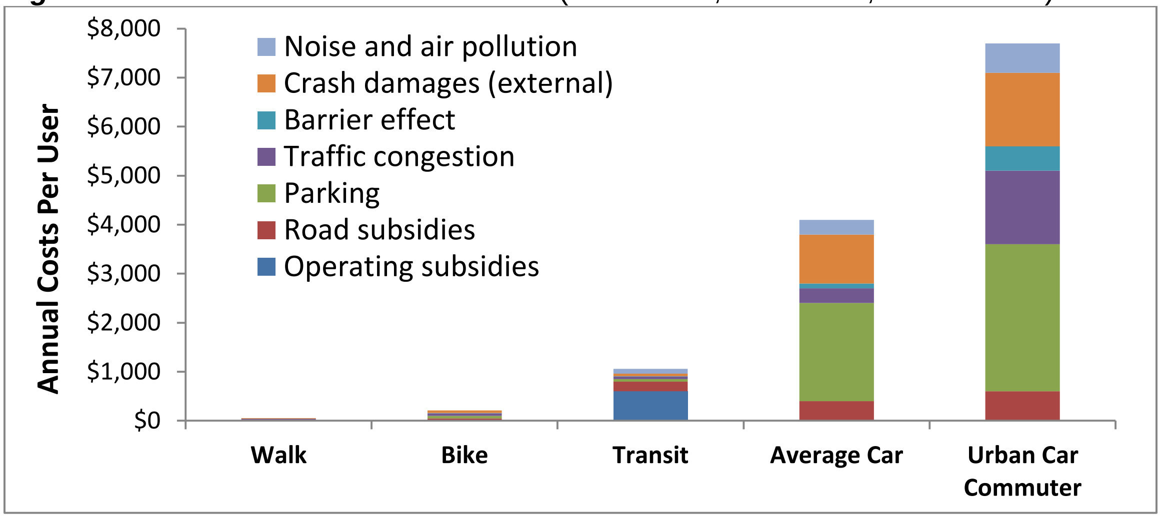
Various cost allocation studies evaluate horizontal equity by comparing road user fee payments with the costs imposed by various user groups, such as cars versus trucks, and urban versus rural motorists (Balducci and Stowers 2008; FHWA 2000). However, those studies consider a limited set of users and impacts. Some transportation organizations have developed more comprehensive cost studies (Holian and McLaughlin 2016; Litman 2019). For example, United Kingdom's Department for Transport (DfT 2018), the European Union (EU 2014), and New Zealand's Transport Agency (NZTA 2020) have frameworks for evaluating various modes and their costs.

External Costs

A basic economic principle is that, to maximize efficiency and equity, the prices that consumers pay for a good should reflect its production costs, unless subsidies are specifically justified. This means that travellers should generally pay for the facilities they use, and compensate for any damages they impose on others. Transportation systems often violate this principle. Vehicle requires costly infrastructure not paid by users, and imposes traffic congestion, pedestrian delays (called the *barrier effect*), crash risk and pollution on communities. Critics sometimes argue that, since most people travel by automobile at least occasionally, these costs are internal to motorists as a group, but that does not make them equitable or efficient; costs that motorists impose on other motorists are still unfair and economically inefficient.

Some studies have quantified and monetized (measured in monetary units) these costs (Litman 2019). For example, *The Economic and Societal Impact of Motor Vehicle Crashes* estimated that crashes caused $242-836 billion worth of damages in the U.S. in 2010 (Blincoe, et al. 2015); the *Urban Mobility Report* estimated that congestion costs totaled $190 billion in 2019 (TTI 2019); and *Quantified Parking* found typical U.S. communities each vehicle has three to six off-street parking spaces, each with $500 to $1,500 annual costs (Scharnhorst 2018). These costs tend to be higher for larger and faster vehicles, and under urban-peak conditions when infrastructure, congestion, barrier effect, crash and pollution costs are greatest. Figure ES-2 illustrates an estimate of these costs.

Figure 3 **Estimated External Costs** (Kockelman, et al. 2013; Litman 2019)



Transportation tends to impose various external costs (costs imposed on other people).

These external costs are horizontally inequitable, and because vehicle travel tends to increase with income, they tend to be vertically inequitable. For example, it is unfair that passengers in space-efficient modes, such as carpools and buses, are delayed by congestion caused by travellers using space-intensive modes such as single-occupant vehicles, particularly since SOV users tend to be wealthier. Similarly, it is unfair that automobile traffic imposes delay, risk and pollution on walkers and bicyclists, and suburban auto commuters degrade lower-income urban neighborhoods.

Evaluating these impacts requires detailed data. Some transportation organizations have comprehensive analysis frameworks with detailed impact data disaggregated by mode and travel conditions (DfT 2020; EU 2014; NZTA 2020), but most jurisdictions lack these resources, forcing practitioners to work with whatever information is available. For example, current project evaluations usually ignore induced travel caused by roadway expansions, and the resulting increases in parking costs, crashes and pollution emissions (Volker, Lee, and Handy 2020). This exaggerates the benefits of highway expansions, and undervalues improvements to other modes, resulting in less diverse, efficient, and therefore less equitable transportation systems.

Taxes and fees to internalize vehicle costs are sometimes criticized for being regressive, but that often reflects incomplete analysis. Although each dollar of tax or fee represents a greater portion of income for lower-income motorists, their overall impacts depend on the amount that each income group pays and how revenues are used. Low income people seldom drive on congested roads, they tend to use other modes or travel during off-peak periods, and other road funding sources are also regressive. User fees can be progressive overall if some revenues are spent on affordable modes such as public transit (Manville 2017; Schweitzer and Taylor 2008). Similarly, since vehicle ownership tends to increase with income, lower-income households tend to benefit overall if parking is priced rather than incorporated in rents and retail prices, so lower-income households are not forced to pay for costly parking facilities they do not need.

Social Justice

Social justice objectives address structural social inequities such as racism, sexism, and unfair disparities (Martens 2016; Romero-Lankao and Nobler 2021). It is usually addressed by establishing affirmative action policies, programs and targets, plus employee training and professional development.

Social justice can be evaluated by identifying, and if possible quantifying, inequities and disparities in planning activities and outcomes, and by setting minority hiring and contracting target, and improved disadvantaged population's economic outcomes.

Conclusions

Transportation equity evaluation is important but challenging because there are many possible ways to analyze impacts. There are several types of equity to consider: *horizontal equity*, which assumes that similar people should be treated similarly; *vertical equity*, with assumes that policies should protect and favor disadvantaged groups; and *social justice* which strives to correct structural inequities. There is no single way to evaluate equity, it is generally best to consider various perspectives, impacts and metrics. A planning process should reflect a community's equity priorities, so public engagement is important.

Because of this complexity, the best way to incorporate equity into a planning process is to define a set of measurable objectives, such as the following:

- *Inclusivity.* Ensure that transportation systems accommodate diverse users, including people with special needs. This can be achieved with multimodal planning that provides diverse transportation options, plus universal design standard to ensure that facilities and vehicles accommodate people with disabilities.
- *Affordability.* Ensure that transportation systems serve users with lower incomes. Favor lower-cost over higher cost modes, and provide affordable housing in multimodal areas.
- *A fair share of resources.* Ensure that each mode and their users receive a fair share of public resources, such as money, road and curb space.
- *Minimize external costs*. Minimize the congestion delay, infrastructure subsidies, crash risks and pollution damages that one mode or group imposes on others.

- *Social justice*. Ensure that public policies and programs address structural inequities such as racism and sexism. Identify and correct unfair disparities.

Conventional transportation planning often overlooks equity objectives. Common planning practices favor faster modes, such as automobile and air travel, to the detriment of slower but more inclusive, affordable and resource-efficient modes such as walking, bicycling, and public transit. Since automobile travel requires more expensive infrastructure and imposes more external costs than other modes, people who drive less than average tend to subsidize the costs of people who drive more than average. This is unfair, and since automobile travel tends to increase with income, is regressive.

Equity objectives are sometimes addressed with special policies, such as targeted discounts and affirmative action programs, which are useful but insufficient. Many equity objectives require structural reforms, such as more multimodal planning, policies that reduce vehicle traffic speeds and volumes, and more compact community development, to create more multimodal and efficient transportation systems. These reforms ensure that non-drivers have convenient and safe travel options, and receive their fair share of public resources. These reforms provide additional benefits besides equity; they help reduce traffic and parking congestion, increase public safety and health, reduce pollution emissions and sprawl-related costs.

New analysis methods and data sets can improve equity analysis. This requires detailed information on travel demands, the quality of travel options, and transportation costs, with particular attention to the needs and travel conditions of disadvantaged groups.

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