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Economically Optimal Transport Prices and Markets

What Would Happen If Rational Policies Prevailed?

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Abstract

This paper investigates the amount and type of mobility (physical travel) that is economically optimal overall. It asks, "How would travel activity change if the transportation system reflected efficient market principles including neutral and responsive planning, and cost-based pricing." It discusses these principles, identifies existing transport market distortions and reforms, estimates how such reforms would likely affect travel activity, and investigates their economic impacts. This analysis indicates that in a more optimal market, which reflects efficient planning and pricing principles, consumers would drive less, use alternative modes more, choose more accessible locations, and benefit overall as a result (increased consumer surplus). Because they reflect efficiency principles these reforms are also likely to increase economic productivity. Although previous studies have evaluated these transport market reforms individually, few have considered their cumulative impacts.

Key Words

Transport Planning, Pricing, Optimality

I will begin with the proposition that in no other major area are pricing practices so irrational, so out of date, and so conductive to waste as in urban transportation.
- William Vickrey, "Pricing in Urban Transportation," *American Economic Review*, 1963.

Introduction

Transportation has tremendous economic, social and environmental impacts. It provides many benefits, but it also incurs significant costs. As a result, either too little or too much mobility is economically inefficient.

This paper identifies various transportation planning and market distortions and their impacts on travel activity. It summarizes a more detailed study (1). Many studies have investigated these distortions individually but only a few studies have examined multiple distortions, and even those tend to have a fairly limited scope. (2, 3, 4) Comprehensive analysis is important because these impacts are cumulative. For example, roadway underpricing not only increases traffic congestion and roadway costs, by increasing total vehicle travel it also increases parking facility costs (the total number of parking spaces needed in an area), accidents, and pollution emissions. Similarly, parking underpricing not only increases parking facility costs, it also increases traffic congestion and roadway costs.

This report explores these issues. It asks, "What amount and mix of travel would people choose if transport planning and pricing reflected the principles of market efficiency." This analysis defines efficient market principles, identifies transport market distortions and potential reforms, estimates the changes in mobility these reforms would cause, and discusses implications. This helps identify the type and amount of mobility that is overall optimal to users and society.

Market Principles, Distortions and Reforms

Markets are systems through which resources (goods, services, land, labor, etc.) are exchanged. An efficient market is like a well-tuned machine: consumers can choose the goods and services that best meets their needs and preferences, with prices maintaining equilibrium between *demand* (the amount consumers will purchase under specific circumstances) and *supply* (the type and quantity of goods producers will provide at a particular price). This tends to efficiently allocate resources, maximizing benefits. But love of markets must not be blind. Optimal markets must reflect certain principles, including adequate consumer options, neutral public policies and efficient pricing (5, 6) This report evaluates the degree that transportation markets violate these principles, and the reforms that would be needed to better reflect them.

1. Neutral and Responsive Planning

Neutral and responsive planning means that the planning process is unbiased and provides the transport options users demand, reflecting consumer sovereignty (the principle that consumers can choose the goods and services they are willing to pay for). Transport options can include:

- *Modes*, such as walking, cycling, public transportation, telework and delivery services.
- *Vehicles types* (cars, trucks, hybrids, alternative fuels, cheap, expensive, new, used) and ownership options (owned, leased, shared, etc.).
- *Service qualities*, such as being able to pay for uncongested lanes, more convenient parking, and more comfortable public transit services.
- *Locations*, such as between automobile dependent and more multi-modal neighborhoods.

The key question for this analysis is whether there is latent demand for cost-effective alternatives (their total cost to society are equal or lower than driving), that are not supplied because the planning process is biased. Since governments supply and regulate paths, roads, parking facilities, and development, various planning decisions affect the quality of transport options (Table 1). For example, if the planning process underestimates walking and cycling demand, or some benefits of these modes (e.g., health benefits or consumer savings), it will underinvest in walking and cycling facilities, forcing travelers to drive more and walk or bike less than optimal.

Table 1 **Planning Decisions That Affect Transportation**

Facilities	Travel Services	Land Use	Pricing
• Transport funding • Road and parking facility design • Traffic regulations	• Public transit service quality • Taxi regulations	• Zoning codes • Parking regulations • Public facility locations	• Transportation taxes • Transport fares • Vehicle insurance

Many policies and planning decisions affect transportation options and activities.

There is little reason to maintain options for which there is little demand (for example, cycling facilities or transit services that attract few users), but it does make sense to give alternative modes at least as much support per trip or per user as automobile modes, and often more for equity sake (to provide basic mobility for non-drivers and cost savings to lower-income people), for external benefits (such as traffic and parking congestion reductions) and to help achieve strategic objectives (such as preserving openspace and increasing public fitness and health). For example, if society spends $5.00 on roads and parking facilities to accommodate an automobile commute trip, it should be willing to devote at least that much to accommodate other modes, and possibly more for equity sake and to achieve other benefits.

Because transport demand is not generally tested by price (users do not generally pay marginal costs for paths, roads, parking, and public transit, including external costs such as accident risk and pollution emissions), it is difficult to determine which transport options should be provided in a particular situation.

Responsive Planning Principles

To respond to consumer demands, planning must reflect the following principles (7):

- *Comprehensive analysis* that considers all significant options (including alternative modes and demand management strategies), impacts (benefits and costs) and objectives (including efficiency, equity and resilience objectives).
- *Unbiased decision-making*, which does not arbitrarily favor certain modes, groups or activities. This is sometimes called *least-cost planning*, since it allows the most cost-effective solution to be applied to transportation problems.
- Evaluation based on *accessibility* rather than *mobility*, so land use accessibility and mobility substitutes (such as delivery services and telecommunications that substitutes for physical travel) can be considered equally with mobility improvements.

Planning Distortions

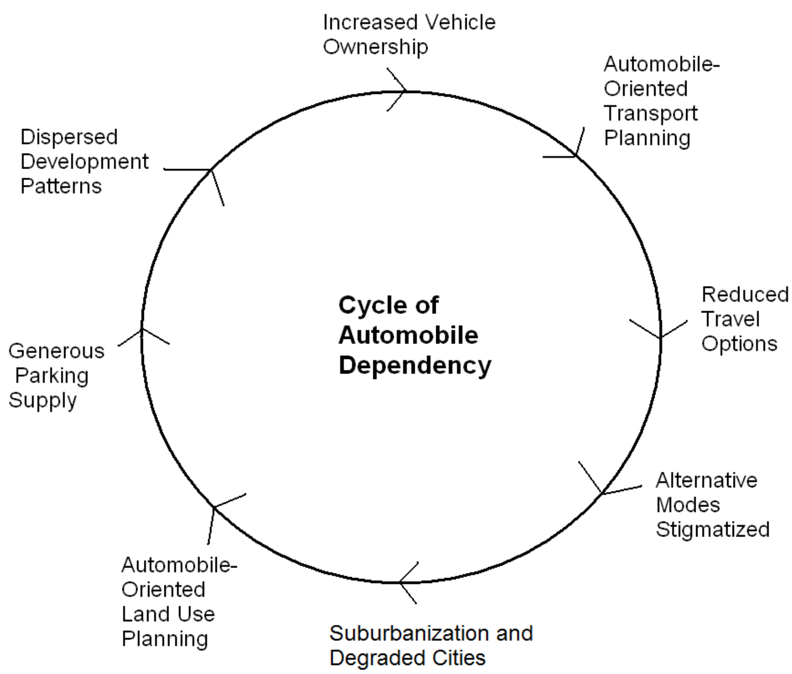
Current planning tends to be biased in various ways that favor mobility over accessibility and automobile travel over other modes. For example (8, 9, 10, 11,12):

- Transport system performance is often evaluated based primarily on motor vehicle traffic speed, using indicators such as roadway level-of-service and the Travel Time Index. This overlooks and undervalues other objectives (such as affordability, mobility for non-drivers, public health and environmental protection), and impacts on other modes (such as the delay that wider roads and heavier traffic have on walking and cycling).
- Transportation project economic evaluation tends to consider some impacts (travel time and vehicle operating costs) but ignores others (travel comfort, vehicle ownership costs, parking facility costs, travel demands by non-drivers, health impacts, land use impacts, etc.). These omissions tend to favor automobile-oriented improvements and undervalue improvements to alternative modes, transportation pricing reforms, smart growth development policies, and transportation demand management programs.
- A major portion of transport funding is dedicated to roads and parking facilities and cannot be used for alternative modes or demand management programs even if they are more cost effective overall (13). Non-motorized modes in particular are underfunded: although walking and cycling represent 10-15% of all trips, and increased walking and cycling can provide many economic, social and environmental benefits, a much smaller portion of surface transportation expenditures are spend on these modes.

- Traffic models and parking generation manuals predict demand based on unpriced roads and parking facilities. This creates a self-fulfilling prophecy as planning decisions are made to satisfy unpriced demand, and demand grows to fill expanded supply.
- Zoning codes and development policies often require generous parking supply and limit development density and mix, subsidizes automobile travel and creates more dispersed, automobile-dependent communities.
- Development fee, tax or utility rate structures seldom reflect the higher costs of providing public services in more dispersed locations, and so underprice urban-fringe development.

The impacts of these planning distortions are cumulative and synergistic (total impacts are greater than the sum of individual impacts), particularly over the long-run. They contribute to a self-reinforcing cycle of automobile dependency and sprawl, as illustrated in Figure 1. Because this cycle has been underway for several decades, significant investments in alternative modes may be justified to help correct past underinvestment. For example, if nonmotorized travel (walking and cycling) currently has 5% mode share, it may be appropriate to devote 15-25% of transport budgets to these modes to correct for past underinvestment and help achieve strategic objectives such as improved mobility for non-drivers, increased public fitness and health, and more compact land use development.

Figure 1 **Cycle of Automobile Dependency and Sprawl**



Biased planning practices contribute to a cycle of automobile dependency and sprawl.

Planning Reforms

Various reforms can result in more neutral and responsive planning (7, 14, 15):

- Evaluate transport system performance based on *accessibility* rather than *mobility*, taking into account various modes, transport network connectivity, land use accessibility, and mobility substitutes, and recognize the trade-offs that often occur between these factors.
- Apply comprehensive evaluation of potential transportation improvement options, including improvements to alternative modes, pricing reforms and other demand management strategies.
- Apply comprehensive evaluation of all impacts (benefits and costs), including travel speed, travel comfort (particularly for public transit passengers), vehicle ownership and operating costs, parking costs, accident risk, pollution emissions, public fitness and health, and land use impacts.
- Apply *least cost* planning, which implements the most cost-effective solution, including demand management strategies and alternative modes.
- Improve transport modeling to more accurately predict how planning decisions affect access by various modes, and their overall economic, social and environmental impacts.
- Integrate transport and land use planning, including better coordination among various levels of government, to create more accessible, multi-modal communities.
- Locate public facilities (schools, government offices, etc.) for multi-modal accessibility.
- Change zoning laws to allow higher densities, more land use mix, and more flexible parking requirements.

Travel Impacts

There is evidence of significant latent demand for alternative modes. In many situations, cost effective (i.e., cheaper than automobile travel, considering all costs) walking, cycling, rideshare and public transit improvements have resulted in significant mode shifts and reductions in automobile travel (16, 17, 18). Similarly, many people want to live and work in more accessible, multi-modal neighborhoods (19, 20), and even accounting for self-selection (the tendency of households to choose neighborhoods that reflect their transportation preferences), people who live or work in such areas tend to drive 10-40% less than national averages (21, 22).

Transport modeling in various U.S. metropolitan regions summarized indicates that more optimal regional transport planning and investment practices, selected to maximize cost efficiency and consumer surplus, would reduce VMT by 10% to 20% compared to trend scenarios, while supporting the same level of job and housing growth, and providing comparable or better highway levels-of-service (23). The optimized plans include increased investment in alternative modes (such as busways and rail transit services), land use policies that improve accessibility (such as more compact and transit-oriented development), and pricing reforms (such as road and parking pricing). Since that modeling only applied to regional facilities, additional VMT reductions could be expected if such reforms were also applied to local planning.

2. Efficient Pricing

This analysis investigates whether motor vehicle travel is currently underpriced, and how travel patterns would change with more efficient pricing.

Efficient Pricing Principles

Market efficiency requires that prices reflect *marginal costs* (the incremental cost of producing a good) unless a subsidy is specifically justified. This tests consumer *willingness-to-pay*, so society avoids devoting $2.00 worth of resources to produce goods users only value at $1.00. Thus, goods that cost $1.00 to produce should be priced at $1.00, not 50¢ (*underpricing*, which encourages excessive consumption) or $2.00 (*overpricing*, which limits consumption and so reduces consumer benefits).

There is some debate among economists as to how to determine optimal prices. Some recommend *short run marginal cost* (SRMC) pricing, ignoring *sunk* (unrecoverable) costs. Others recommend *long-run average costs* (LRAC, also called *cost recovery* or *full cost*) pricing, because over the long-run most costs become marginal, long-run pricing tests user demand for capital investments, and this is the price structure for most other consumer goods (24).

As one leading economist explains,

> "From a short-run perspective, FCP (Full Cost Pricing) is primarily an equity issue, but in the long run it has consequences for efficiency. First, agencies forced to recover all costs from their consumers will seek and find ways to reduce costs for each level of output...FCP is aimed at efficiency through the concept of economic neutrality. Unless there is a particular reason to favor one activity or enterprise over another, then the government should attempt to make all decisionmaking in the private sector neutral with respect to economic choices of pricing, investment, and whether to stay in business." (25)

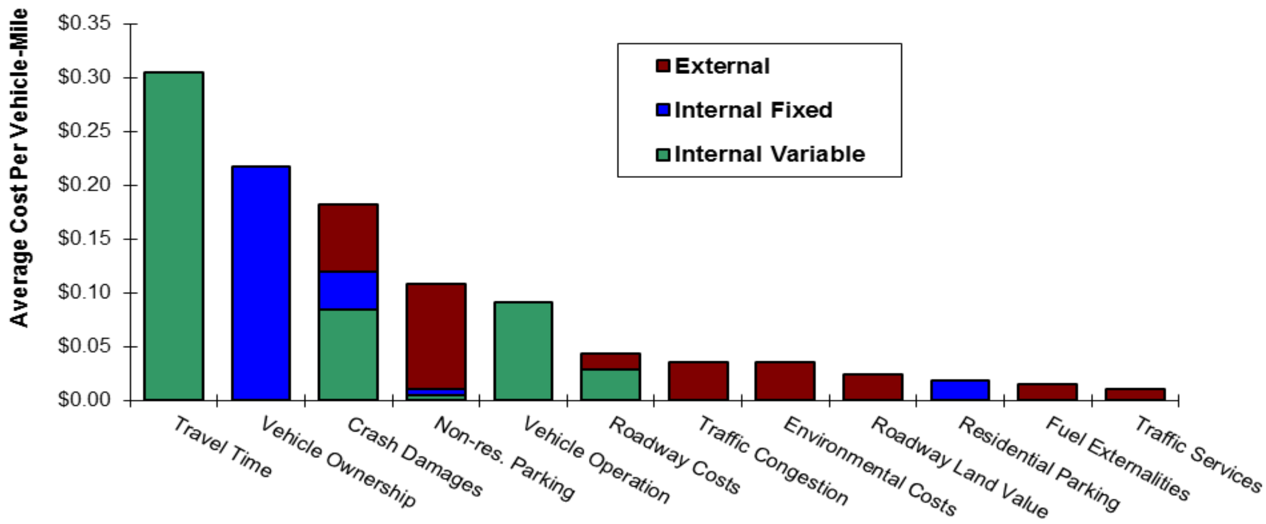
Price Distortions

Several specific market distortions contribute to transportation underpricing:

- A portion of roadway costs (about half in the U.S.) are funded by general taxes (which people pay regardless of how much they travel) rather than user fees (26).
- User fees and taxes often fail to accurately reflect factors such as the type of vehicle, driver ability, time and location. This creates cross-subsidies among vehicle users, and fails to encourage the most efficient vehicle and travel behavior.
- Most parking is provided free, significantly subsidized, and when priced, fees seldom reflect marginal costs.
- Roadway land is treated as a sunk cost. User fees seldom include the equivalent of rent or taxes on transport facility land. This underprices transport relative to other land uses, and space-intensive modes relative to space-efficient modes.
- Insurance and registration fees are fixed, and so fail to reflect the degree to which crash and roadway costs increase with mileage. Fixed fees encourage motorists to maximize their mileage in order to "get their money's worth" from their fixed investments.
- Tax policies stimulate automobile travel by making subsidized parking and company cars attractive employee benefits. A typical employee would need to earn about $2,000 in pretax income to pay for a parking space that costs their employer $1,000 as a business expense.

Several studies have investigated the full costs of various forms of transport (27, 28). Figure 2 illustrates an estimate of these costs.

Figure 2 **Estimated Automobile Transport Costs** (29)



This figure illustrates the estimated costs of motor vehicle ownership and use.

This indicates that more than half of vehicle costs are either external or internal-fixed. Both external and internal-fixed costs are forms of underpricing that tend to be inefficient and inequitable. For example, parking subsidies are unfair because they force households that own fewer than average vehicles to subsidize others that own more than average vehicles, and fixed automobile insurance premiums are inefficient because the costs they represent (accidents and therefore insurance claim) increase with annual vehicle travel. Such pricing encourages motorists to maximize their driving in order to get their money's worth, and so increases external costs.

Optimal Prices

Efficient transportation pricing should reflect the following practices (30).

Congestion Pricing

Congestion pricing (also called *value pricing*) consists of tolls structured to reduce traffic volumes to optimal levels, based on users willingness-to-pay for increased travel speeds. This typically requires fees that average 5-15¢ per urban-peak mile, which represents about 10% of total vehicle travel.

Table 2 **Congestion Pricing** (Average Per Urban-Peak Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Congestion Fees	0.0¢	0.5¢	10¢	15¢

This table summarizes optimal congestion pricing fees, which would only be applied under urban-peak conditions. Such fees are currently only applied in a few cities (London, Stockholm, Singapore).

Roadway Costs

Optimal *road user fees* recover roadway expenses from users. *Roadway cost allocation* studies calculate the costs imposed by various vehicle types and appropriate fees (31, 32). In 2011, the U.S. spent $206 billion (7.1¢ per vehicle-mile) on roadways of which $127 billion (4.4¢ per vehicle-mile) was from user fees, leaving $79 billion (2.7¢) in general taxes spent on roadways (33). In addition, traffic services (traffic lights, emergency services, etc.) are estimated to cost $50-100 billion annually in the U.S. (26). This indicates that motor vehicle user fees would need to increase 61% for motorists to pay roadway facility costs, and approximately double to recover total roadway and traffic service costs. Efficiency and equity require that road users pay the equivalent of rent and property taxes on roadway land, an estimated annualized value of about $50-150 billion, or about 2-6¢ per VMT (22, 26).

In addition, existing vehicle registration and license fees can be prorated by mileage, so for example, an automobile owner that currently pays $360 per year for registration and licensing would pay 3¢ per mile.

Table 3 **Roadway Fees Summary** (Average Per Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Roadway expenditures	0.3¢	1.0¢	3.0¢	5.0¢
Traffic services	0.0¢	0.5¢	1.0¢	2.0¢
Roadway land	0.0¢	2.0¢	4.0¢	6.0¢
Roadway land use impacts	0.0¢	0.0¢	1.0¢	2.0¢
Replaces fixed registration fees	0.0¢	0.0¢	2.0¢	4.0¢
Totals	*0.3¢*	*3.5¢*	*11. 0¢*	*19.0¢*

This table summarizes the components of an optimal road user fee.

Congestion pricing (also called *value pricing*) consists of tolls structured to reduce traffic volumes to optimal levels on specific roadways. This typically requires fees that average 5-15¢ per urban-peak mile, which represents about 10% of total vehicle travel.

Accident Costs

Efficient pricing of accident costs reflect the marginal crash damages and risks a vehicle imposes on other road users. There are two major inefficiencies with current accident pricing. First, current insurance premiums are primarily fixed costs, not directly affected by annual vehicle mileage, although this does affect crash and claim rates. Optimal pricing requires distance-based (also called *Pay-As-You-Drive*) pricing which prorates premiums by average annual mileage for each rate class, so a $1,000 premium becomes about 7¢ per mile. Second, a significant portion of crash costs (particularly non-market damages such as pain and reduced quality of life from injuries) are currently uncompensated. These costs are ultimately borne by injured parties and by society through medical programs, disability compensation and welfare programs. Described differently, society should be willing to spend more to prevent accidents than what is paid in compensation, since overly-generous compensation encourages inefficient risk-taking. With optimal pricing, motorists would pay about 10¢ per mile on average, based on prorating existing insurance premiums, which would average about 7¢ per vehicle-mile, increased 30-50% to internalize currently uncompensated external crash costs.

Table 4 **Accident Fees Summary** (Average Per Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Prorated insurance premiums	0.0¢	4¢	7¢	9¢
Currently uncompensated crash costs	0.0¢	1¢	3¢	5¢
Totals	*0.0¢*	*5¢*	*10¢*	*14¢*

This table indicates optimal fees for the accident risk a vehicle imposes on other road users. Although insurance compensates a portion of these risks, vehicle insurance is a fixed rather than a variable charge, so the per-mile cost to motorists is virtually zero.

Parking Facility Costs

Optimal pricing requires that, as much as possible, motorists pay directly for using parking facilities, with fees that recover all parking facility construction and operating costs, including the equivalent of rent and taxes on land. Prices should vary with time and location to manage demand. As much as possible, parking should be *unbundled* (rented separately from building space, so for example, instead of paying $1,000 per month for an apartment with two "free" parking spaces, residents pay $800 monthly for the apartment and $100 monthly per space), and if parking is subsidized it should be *cashed-out*, which means that consumers can choose the cash equivalent if they do not use it. When motorists pay directly for parking, or parking is unbundled, demand typically declines 10-30%, indicating that a significant portion of parking costs (the costs to society of providing parking facilities) is economically inefficient, users only consume it if it is underpriced.

Parking facility costs average about $600 annually per off-street space, about $1,200 annually per vehicle-year (assuming two non-residential, off-street spaces per vehicle), and 10¢ per vehicle-mile (assuming about 12,000 annual miles per vehicle). It may be infeasible to price all parking, including infrequently-used, unpaved suburban parking lots or rural road shoulders, although newer electronic pricing systems reduce transaction costs so more parking can be efficiently priced.

Efficient pricing charges for parking per minute, hour or day of occupancy, but for consistency with other types of pricing in this study, these are converted to average cents per vehicle-mile. The table below summarizes estimated optimal parking fees. Lower estimates assume the use of current pricing methods, which only allow about half of current parking subsidies to be efficiently priced. The upper-bound estimate assumes universal implementation of vehicle location pricing systems that automatically calculate parking fees based on time and location.

Table 5 **Parking Fees Summary** (Average Per Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Off-street parking	0.4¢	4.0¢	8.0¢	12.0¢
On-street parking	0.2¢	2.0¢	3.0¢	4.0¢
Residential parking unbundling	0.1¢	0.5¢	1.0¢	4.0¢
Totals	*0.7¢*	*6.5¢*	*12¢*	*20¢*

This table summarizes optimal parking fees. Although measured per vehicle-mile in this table, direct user fees would actually be priced per trip, or as monthly fees.

Emission Fees

Emission fees charge for air, noise and water pollution costs. Such fees give motorists incentives to reduce emissions to optimal levels. Ideally, such fees are calculated using in-vehicle meters that measure emissions as they occur, so they vary by type of vehicle, type of driving and travel conditions, but this has high transaction costs. A less optimal but cheaper alternative is a per-mile charge based on average emission rates for each vehicle class, augmented with roadside sensors to identify gross polluters.

Various studies indicate that air pollution costs range from about 0.5¢ per vehicle-mile for a low-emission vehicle driving in a rural area to more than 10¢ per mile for high emitting vehicles driven in vulnerable airsheds (29, 34). Noise costs are estimated to average 0.2-2¢ per vehicle-mile, depending on vehicle type, time and location, and so require location-based pricing.

Table 6 **Summary of Emission Fees** (Average Per Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Air pollution	0.0¢	1.0¢	3.0¢	6¢
Noise pollution	0.0¢	0.0¢	0.5¢	1.0¢
Water pollution	0.0¢	0.0¢	0.5¢	1.0¢
Totals	*0.0¢*	*1.0¢*	*4.0¢*	*8.0¢*

This table summarizes optimal pollution fees. These should vary by vehicle type and location.

Fuel Taxes

If weight-distance fees are applied as recommended above, fuel taxes need only reflect petroleum production and importation externalities (environmental damages, tax subsidies, micro-economic and security costs of oil imports), carbon emission costs, and general sales tax. These costs are estimated to average $0.40 to $1.00 per gallon or 2-5¢ per vehicle-mile (28, 35), two or three times higher than current U.S. fuel taxes.

Table 7 **Fuel Taxes** (Average Per Vehicle-Mile)

	Current	Lower Bound	Middle	Upper Bound
Production & Import externalities	2.0¢	1.1¢	1.4¢	2.0¢
Climate change impacts	0.0¢	0.5¢	1.0¢	2.0¢
General sales taxes	0.2¢	0.4¢	0.6¢	1.0¢
Totals	*2.2¢*	*2.0¢*	*3.0¢*	*5.0¢*

This table summarizes optimal pollution fees. These should vary by vehicle type and location.

Optimal Pricing Summary

Table 8 summarizes various transportation costs and their appropriate pricing.

Table 8 **Appropriate Pricing Of Various Transport Costs**

Cost	Pricing Method	How Calculated
Congestion	Time and location based vehicle fees or road tolls.	Prices are higher under congested conditions. Price to reduce traffic volume to optimum flow.
Roadway costs	Road tolls or weight-distance fees.	Cost allocation applied to all roadway costs, including traffic services, rent and taxes on roadway land.
Accident risk	Distance-based fees, or time- and location-based fees.	Current insurance premiums prorated by annual mileage, increased to account for uncompensated accident costs.
Parking	Use time and location based fees to charge users directly for parking.	Fees set to recover parking facility costs and maintain 85% maximum occupancy during peak periods.
Pollution Emissions	Time and location based fees (if possible) or distance-based fee.	A vehicle's emission rate (such as grams per mile) times regional pollution unit costs (such as cents per gram).
Fuel externalities	Fuel tax.	External costs of producing, importing and consuming fuel, including greenhouse gas emissions.
General taxes	General sales and property taxes.	General taxes should be applied in addition to any special vehicle and fuel taxes and fees.

This table describes the appropriate way to price various transport costs.

Table 9 summarizes middle-range values of these fees. These are averages, most fees would vary depending on factors such as vehicle type, time and location.

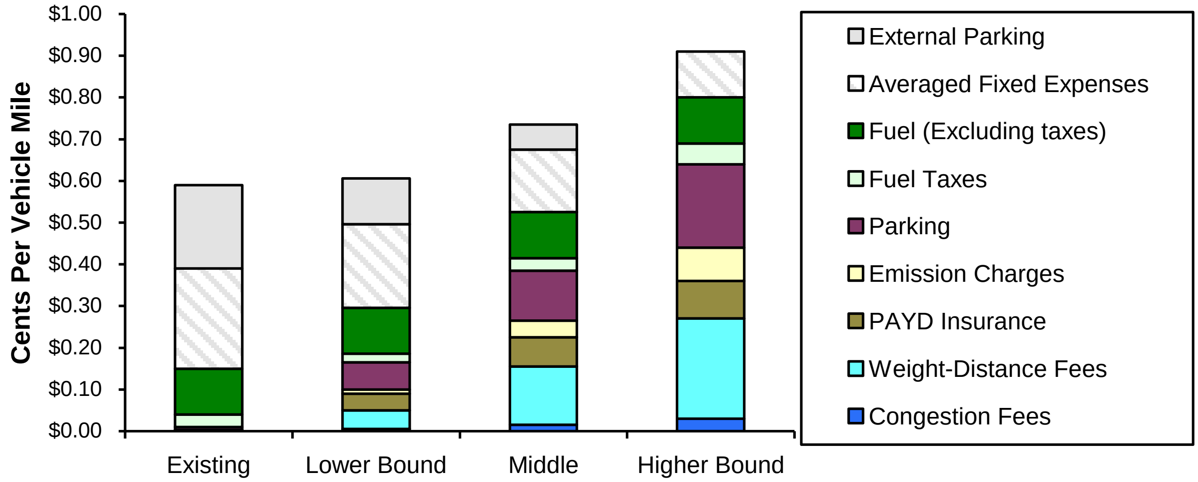
Table 9 **Optimal Pricing Summary – Middle-Range Values** (Average Per Vehicle-Mile)

Cost Category	Road Tolls	Weight-Distance	PAYD Insurance	Emission Charges	Parking	Fuel Taxes	Totals
Vehicle congestion	$0.010						*$0.010*
Nonmotorized delays	$0.005						*$0.005*
Roadway facilities		$0.030					*$0.030*
Registration & Licensing		$0.020					*$0.020*
Roadway land value		$0.040					*$0.040*
Traffic services		$0.010					*$0.010*
Land use impact costs		$0.010					*$0.010*
Accidents		$0.030	$0.070				*$0.100*
Air pollution				$0.030		$0.010	*$0.040*
Noise pollution				$0.005			*$0.005*
Water pollution				$0.005			*$0.005*
Parking facilities					$0.120		*$0.120*
Fuel externalities						$0.014	*$0.014*
General Taxes						$0.006	*$0.006*
Total	*$0.015*	*$0.140*	*$0.070*	*$0.040*	*$0.120*	*$0.030*	*$0.415*
Share of Total	*3.6%*	*33.7%*	*16.9%*	*9.6%*	*28.9%*	*7.2%*	*100.0%*

This table summarizes the middle-range optimal fees estimated in this paper.

Figure 3 illustrates optimal fees. With current pricing, motorists pay an average of about 25¢ per vehicle-mile in fixed expenses: about 11¢ per vehicle-mile for fuel plus about 4¢ per vehicle-mile in variable user fees (fuel taxes, road tolls, parking fees and fines). More optimal pricing converts some currently fixed costs (insurance and registration fees) into distance-based charges and internalizes currently external costs such as congestion, road and parking subsidies, and uncompensated accident costs. Using middle cost estimates, this increases variable costs from about 15¢ to 50¢ per vehicle-mile, and reduces fixed costs from 24¢ to 15¢ per vehicle-mile (36)

Figure 3 **Optimal Fees for an Average Automobile**



With current pricing, motorists pay about 25¢ in averaged fixed costs and 15¢ per vehicle-mile in variable costs. More optimal pricing converts some fixed costs into variable costs and internalizes many currently external congestion, infrastructure and crash costs.

Optimal fees could provide substantial revenues. Some (such as road tolls and parking fees) would be dedicated to replacing current road and parking subsidies. Others (such as emission charges and fuel taxes) could be used to reduce taxes or finance new services. With optimal pricing an average consumer pays the same overall if they continue driving their current mileage and saves overall if they reduce their annual vehicle mileage or in other ways reduce costs, for example, by shifting vehicle travel from congested to uncongested times or by using less expensive parking facilities located farther from their final destination.

Travel Impacts

More efficient transport pricing would significantly reduce motor vehicle travel, particularly under urban-peak conditions. The elasticity of vehicle travel with respect to operating costs is typically about -0.10 in the short-run and -0.30 over the long-run, so a 10% fee increase reduces vehicle travel about 1.0% within the first year, and about 3% after a few years (37). Current vehicle operating costs average about 15¢ per vehicle-mile, so each additional 1¢ per-vehicle-mile represents a 7% price increase, which should reduce vehicle travel by about 0.7% over the short-run and 2% over the long-run.

These reforms have interactive effects, so their impacts cannot simply be added. On one hand, by themselves, large price increases tend to have diminishing marginal effects. On the other hand, many reforms have synergistic effects (total impacts are greater than the sum of individual impacts). For example, individually, improving public transit and efficient parking pricing might each reduce automobile commuting 10%, but implemented together cause a 30% reduction.

Table 10 estimates the reductions in total vehicle travel predicted for the middle-range price estimates, applying a -0.2 elasticity, which means that each 1¢ per mile increase in vehicle operating costs causes approximately a 1.4% reduction in vehicle travel.

Table 10 **Vehicle Travel Reductions – Middle-Range Cost Values**

	Existing Fees	Optimal Fee	Fee Increase	Individual Reduction	Cumulative Reduction
Road Tolls	$0.003	$0.015	$0.012	1.7%	1.73%
Weight-Distance	$0.000	$0.140	$0.140	19.5%	20.87%
Distance-based Insurance	$0.000	$0.070	$0.070	9.7%	28.58%
Emission Charges	$0.000	$0.040	$0.040	5.6%	32.56%
Parking	$0.007	$0.120	$0.113	15.8%	43.18%
Fuel Taxes	$0.030	$0.030	$0.000	0.1%	43.21%
Fuel prices (excluding taxes)	$0.110	$0.110	$0.000	0.0%	43.21%
Totals	*$0.150*	*$0.525*	*$0.375*		*43.21%*

This table summarizes optimal prices and their impacts on vehicle travel.

Conclusions

This study investigates the amount and type of mobility that is economically optimal. Various planning and pricing distortions result in economically excessive mobility. No single reform can correct all existing distortions. An optimal transportation system requires more neutral and responsive planning, which better reflects consumer demands, and more efficient pricing. Table 11 summarizes these distortions, reforms and their travel impacts.

Table 11 **Market Principles, Distortions and Reforms**

Market Requirements	Current Distortions	Reforms	Travel Impacts
Transport options. Consumers need viable transportation and location choices.	In many communities, non-automobile travel options are inconvenient, uncomfortable and poorly integrated.	Apply least-cost planning. Improve alternative modes, connection between modes, and information about those options.	Least-cost planning and related reforms are estimated to reduce automobile travel 10-30%.
Optimal Planning. Policies and planning practices should not arbitrarily favor certain goods or groups.	Many public policies (taxes, regulations, etc.) and planning practices favor motor vehicle travel over alternatives.	Apply more neutral policies and *least-cost* transport planning practices.	More neutral policies and planning practices are estimated to reduce automobile travel 5-10%.
Efficient pricing. Prices should reflect production costs unless a subsidy is specifically justified.	Transport in general, and driving in particular, is underpriced. Many costs are either fixed or external.	Charge directly for roads and parking, distance-based insurance and registration fees and emissions.	Efficient pricing is estimated to reduce automobile travel 20-40%.

This table summarizes optimal market requirements, current distortions, reforms and their travel impacts.

Using experience with individual transport system changes (such as walking, cycling and transit service improvements) and price changes, we can roughly estimate how these reforms would affect travel activity, recognizing that actual impacts are difficult to predict with precision and variable, depending on individual consumers, trip types and travel conditions. Many of these reforms have synergistic effects, so their impacts can be large if implemented together.

This analysis suggest that with more optimal transport planning and pricing, people would drive significantly less, use alternative modes more, and be better off overall as a result (increased consumer surplus). More neutral and responsive transport planning, which accommodates cost-effective latent demand for walking, cycling and public transit, would probably reduce automobile travel 10-20%, correcting land use planning distortions that favor sprawl could reduce automobile travel 5-15%, and more efficient pricing of roads, parking, insurance, pollution emissions and vehicle fuel is likely to reduce automobile travel 35-50%. Other researchers reach similar conclusions, although they consider a somewhat smaller set of reforms (38, 39). Put differently, this analysis indicates that a third to half of current motor vehicle use results from market distortions which reduce transport options and underprices driving. Because these reforms reflect efficiency principles, and could reduce many costs to businesses (for example, more efficient road pricing would allow commercial vehicles to avoid congestion, and more efficient parking pricing would reduce their parking subsidy costs), these reforms are also likely to increase economic productivity.

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