

Using Road Pricing Revenue

Economic Efficiency and Equity Considerations

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Abstract

This paper examines how economic efficiency, equity, external costs, and political feasibility can help determine the distribution of road pricing revenue. Economic efficiency only requires that revenue be used to benefit society and that it not be refunded to users in proportion to how much they paid. There is no efficiency requirement to dedicate revenue to transportation programs. Horizontal equity implies that revenues *should* be returned to vehicle users as a class, but only after external costs are compensated. Since most estimates of motor vehicle external costs are larger than the expected revenue of road pricing proposals, the horizontal equity justification for returning revenues to drivers is reduced or eliminated. Vertical equity requires that revenues benefit low-income drivers as a class at least as much as the costs they bear, and that disadvantaged residents (including non-drivers) benefit overall. Current conventional thinking is that revenues must be dedicated to transportation improvements to be politically feasible, but some analyses indicate that alternative distributions that include broad tax reductions or financial rebates benefit the largest number of citizens and therefore may be more politically popular.

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Introduction

Road space is currently allocated by queuing, with congestion delays limiting growth in peak-period vehicle traffic. This is inefficient since it requires motorists to waste time and vehicle costs to the point that some forego potential peak-period trips. Economists have long recommended using road pricing to more rationally manage traffic congestion.¹ Enthusiasm for road pricing has increased in recent years, and several efforts are now underway to implement demonstration projects.²

Road pricing can raise significant revenue. The distribution of this money is an important consideration in road pricing program development, and one which transport professionals, who traditionally struggle to *obtain* rather than *disperse* money, may be unprepared to evaluate. As people who suddenly become rich often learn, spending money efficiently can be challenging. Decision makers must develop revenue distribution formulas that satisfy conflicting demands. This paper considers four related issues: economic efficiency, equity, externalities, and political acceptability.

Economic Efficiency

Economic efficiency is concerned with the use of society's resources to achieve maximum net benefit. Road pricing increases efficiency by rationing road capacity with less waste than queuing. This benefit is unaffected by the allocation of road pricing revenue. From an overall *economic efficiency* perspective, the revenue must be used to benefit society; the more beneficial the more economically efficient the program. There is no requirement, however, that the money be allocated in any particular way.

Although transportation improvements are one potential use of road pricing revenue, there is no economic efficiency requirement that road charges be spent on roads or transportation in general. Where roadway improvements are expensive due to high land values, high construction costs or environmental constraints, road pricing set at short-run-marginal-costs may result in significant revenue surpluses while still not justifying increasing roadway capacity.^{3,4} Increasing congested roadway capacity often causes generated traffic that, in turn, increases vehicle traffic external costs.^{5,6}

The quality of travel options available to peak-period motorists affects their costs (in terms of money, additional travel time, discomfort and stigma) for reducing peak period driving, and therefore the congestion price needed to achieve a given reduction in traffic.⁷ As a result, there is an economic efficiency justification for using road pricing revenue to fund alternative modes.⁸ This can benefit both those who shift mode (who enjoy better services than would otherwise occur) and motorists, who pay lower congestion fees.

Road pricing revenue *should not* be reimbursed to individuals in proportion to how much they pay. If drivers pay to use a road on Monday knowing that the money will be returned on Friday they have little incentive to change their travel behavior. Revenues could be returned to groups, such as vehicle owners or residents as a class, provided that individuals receive the benefit whether or not they pay the fee. It would be inefficient, however, if targeting revenue at these classes induced individuals to drive more, which may occur if revenues were returned in proportion to car ownership or use.

Equity

The question considered here is what constitutes a “fair” or “equitable” distribution of road pricing revenue, which raises the broader question of how to define transportation equity. There are two basic definitions.⁹

Horizontal Equity

Horizontal equity is concerned with fairness between individuals and classes with comparable needs and resources. It assumes that “like should be treated alike.” Horizontal equity is often interpreted to mean that individuals should “get what they pay for, and pay for what they get.” This is the reason that many people instinctively feel that road pricing revenues should be dedicated (“hypothecated”) to road improvements or to provide other benefits to people who pay the fee. It implies that to do otherwise unfairly transfers benefits from one group (those who pay the fee) to another (those who do not).¹⁰

Who deserves the benefit according to this criterion is a matter of debate. It can be defined as just those who actually pay the toll, or it could also include those who change their travel patterns in response to the toll, thereby incurring costs in terms of inconvenience, and providing the congestion reduction benefit to the toll payers. Since people tolled off the road often shift to transit, bicycling or walking, road pricing revenues could be used to benefit users of those modes.

Horizontal equity is further complicated by the existence of external costs from motor vehicle use, including accident risk, environmental degradation, parking subsidies, resource consumption externalities, and reduced mobility for non-drivers.¹¹ Road pricing itself tends to impose negative impacts on urban neighborhoods by increasing traffic on un-priced roads. That vehicle use imposes costs on other people itself represents horizontal inequity. Horizontal equity requires that road price revenue be returned to vehicle users only after external costs are compensated.¹²

There are various perspectives as to how broadly road pricing revenues should be compensated. The narrowest scope only requires road pricing revenue to compensate for externalities produced on the particular road that is tolled, or on that particular vehicle trip. A more comprehensive approach would allow road pricing revenue to compensate for external costs of a particular driver, or of all drivers as a class. Estimates of automobile external costs (including accidents, pollution, parking, noise, resource consumption externalities and other negative impacts) range from 10¢ to over 30¢ per mile.^{13,14,15} Since most road pricing proposals would generate less revenue than these externality estimates, there is no horizontal equity requirement that revenues benefit only drivers.

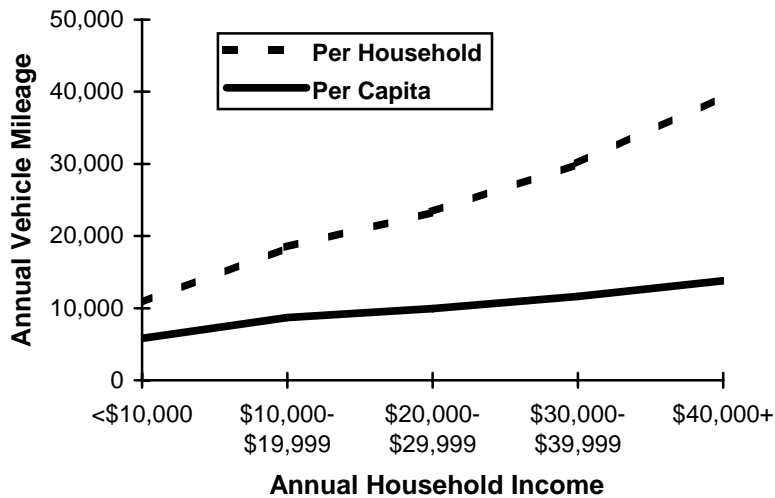
Vertical Equity

Vertical equity is concerned with the treatment of individuals and classes that are unlike. By this principal, the distribution of costs and benefits should reflect people's needs and abilities. Progressive tax rates, and need-based services such as programs to help the poor, seniors and disabled people, are examples of policies reflecting vertical equity. Vertical equity often requires that disadvantaged people receive *more* public resources (per capita or unit of service) than those who are advantaged to accommodate their greater need. For example, transit services for wheelchair users requires greater than average financial subsidy per trip, but this is considered fair because wheelchairs users needs' are also greater than average.

Vertical equity issues are often contentious. People who emphasize vertical equity argue that society is defined morally according to how it treats disadvantaged members,¹⁶ while others point out that providing extra resources to disadvantaged people reduces the incentive for individuals to overcome such disadvantages. Most people seem to recognize vertical equity as being a legitimate social goal, but there is little agreement as to what constitutes the correct allocation of resources by this criterion.

Vertical equity is often measured with respect to income. This is an imperfect metric since people with the same income often have very different needs and abilities. For example, a person with a disability may actually be disadvantaged compared with somebody else with a lower income. Despite this weakness, income data is often the only information available for evaluating broad equity impacts.

Figure 1 Annual Vehicle Travel By Income



Lower income people tend to drive fewer annual miles than higher income people.

Road pricing is usually considered vertically inequitable because fixed charges impose a larger burden on the poor. For example, a \$2 per day toll might be *horizontally equitable* (everybody pays the same amount), but *vertically inequitable* because it represents a larger portion of income for a low-income driver than for a high-income driver. This

impact is tempered by the fact that lower income people drive less on average than those with higher incomes.¹⁷ Lower income people drive less than average on suburban highways that are candidates for road pricing, so as a class they would pay relatively little in tolls,¹⁸ although there may be significant individual exceptions.

Some studies indicate that road pricing is vertically inequitable when the distribution of revenues is ignored, but becomes beneficial to all income classes if revenues are either returned proportionally to each class, distributed equally per capita, or used to replace current motor vehicle taxes.^{19, 20, 21} Since most current transportation taxes are regressive (Table 1), replacement by road pricing has a neutral or positive effect on vertical equity.

Table 1 Incidence of Taxes Used to Support Highway Services²²

Tax	Incidence
Federal, state fuel gasoline tax	Regressive
State use fees	Regressive
State sales tax	Regressive
Local sales tax	Regressive
Federal, state income tax	Progressive
Property tax	Regressive

Most current taxes used for roadway funding are regressive.

Some people may be especially harmed by road pricing, particularly in the short term. These include long distance, automobile-dependent commuters, and working women with significant family responsibilities.²³ Targeted compensation to these groups may be justified for vertical equity. However, these same classes also benefit most from reduced congestion so their net losses may be small to moderate for those in lower and middle income classes, and negative for those with higher incomes.

There is a long history of incorporating vertical equity objectives into transport pricing. Adam Smith, a founder of modern economics, wrote that, “*When the toll upon carriages of luxury coaches, post chaises, etc. is made somewhat higher in proportion to their weight than upon carriages of necessary use, such as carts, wagons, and the indolence and vanity of the rich is made to contribute in a very easy manner to the relief of the poor, by rendering cheaper the transportation of heavy goods to all the different parts of the country.*”²⁴ These objectives can be addressed by targeted exemptions and discounts that benefit lower-income people.

A study of the impacts of tolling Puget Sound region highways found that most poor households would not be substantially affected. Impacts depend on which highways are tolled, the price structure, how much poor travelers depend on those highways, the quality of travel alternatives, and how revenues are used. Lower-income travelers who use routes to be tolled and do not have ready alternatives will have their economic well-being decreased. For the small number of poor households without alternatives, the financial effect of tolling could be large. One hypothetical simulation suggests that a poor household could pay up to 15 percent of its income on tolls.²⁵

Vertical equity can also be defined with respect to driving ability. As a class, non-drivers tend to be economically, physically and socially disadvantaged. Road pricing has the potential of benefiting non-drivers overall by increasing the use of alternative travel modes, resulting in improved service due to economies of scale and increased political support.²⁶ Vertical equity justifies using road pricing revenue to support alternative transportation programs, provide per capita cash rebates, reduce taxes, or fund public services that benefit disadvantaged populations.

Equity impacts depend on available options, including route, mode, and scheduling options in the short term, and location of job, services, and housing in the long term. The more alternatives available, the less net cost individuals bear due to road pricing. For example, with peak period congestion tolls, employees whose schedules are flexible bear less cost than those whose schedules are inflexible. Higher income employees currently tend to have greater job scheduling flexibility, but this regressivity could decline if commute trip reduction programs increase flextime options for all employee classes.

A strategy often advocated to avoid equity conflicts over new user charges, such as road pricing, is to maintain “revenue neutrality,” which means that overall user payments do not change. Under this strategy, road charges would be returned to each group through reduced taxes or cash rebates in proportion to how much the group pays. In practice this may not be desirable or possible. Revenue neutrality assumes that existing tax distribution is acceptable, and that appropriate classes can be defined.

Analysis of congestion pricing impacts in Stockholm, Sweden concludes that if revenues are used to fund transit, Stockholm's road pricing program is progressive with respect to income, but if used to reduce taxes it is regressive.²⁷ Other researchers also conclude that using road pricing to improve public transit services can support overall social equity objectives, such as improving accessibility for disadvantaged populations.²⁸

Equity Analysis Summary

The equity implications of revenue distribution depends on whether horizontal or vertical equity is emphasized, whether the class incurring costs is considered to include only those who pay the fee or also those who change their travel patterns, whether compensation for externalities is required, and if so, what scope of costs are to be compensated. Table 2 evaluates the distribution of road pricing revenue to four classes of people based on horizontal and vertical equity.

Table 2 Road Pricing Revenue Distribution Equity Analysis

Class	Description	Horizontal Equity	Vertical Equity
Non-Drivers	People who cannot drive, usually due to age, disability, or low income. Non-drivers use automobiles as passengers, but their overall use of congested roads is typically low.	Although this group would pay little in road pricing, they deserve a share of revenue if it is considered compensation for existing external impacts of driving.	Since non-drivers include many people who are economically, physically and socially disadvantaged, maximum use of road pricing revenues to benefit this group is justified.
Low Income Drivers	People who can drive and have access to an automobile, but whose travel decisions are significantly affected by vehicle expenses. They will be frequently tolled off by road pricing.	This group pays a relatively small share of road price fees but incurs costs from travel changes which provide a large portion of congestion reduction benefits. They deserve a share of toll revenues in compensation.	This group is, by definition, disadvantaged so use of road pricing revenues to benefit this group is justified.
Middle-Income Drivers	People who drive and have an automobile, and whose travel decisions are only moderately affected by vehicle expenses. They will sometimes be tolled off the roadway and their net benefits of travel are reduced by road pricing.	These drivers pay a large portion of total road pricing and lose net benefits. They deserve to benefit from road pricing revenue on the basis of horizontal equity, but only after all external costs are compensated.	Since this group is not disadvantaged there is no vertical equity justification for using road pricing revenue to benefit them.
Upper-Income Driver	People who drive and have an automobile, and whose travel decisions are not affected by vehicle expenses. They benefit overall from road pricing due to reduced congestion.	These people enjoy net benefits from reduced congestion. They deserve a share of the revenue only after all external costs are compensated.	Since this group is not disadvantaged, there is no vertical equity justification for using road pricing revenue to benefit them.

This table summarizes equity impacts of road pricing on four classes of residents.

This analysis indicates the following about the equity of road pricing revenue distribution.

- If the criterion is horizontal equity and external impacts are *ignored*, then revenue should be returned to each user class (however defined) according to that class's road pricing payments. User classes can include either just drivers who pay the toll, all automobile users in that corridor, or all peak hour travelers in that corridor. Roadway transportation improvements (including transit programs that reduce roadway congestion) could deliver these benefits, as would revenue neutral cash rebates or tax reductions to automobile users.

- If the criterion is horizontal equity and external impacts are *recognized*, then revenues should first be used to compensate for external costs. Suitable funding candidates include environmental and social programs that mitigate the harms of motor vehicle use. There is no requirement to limit such compensation to transportation activities, but it *could* include support for alternative modes such as transit, bicycling and walking (both because these can help reduce environmental and social impacts of motor vehicle use and because they can benefit impacted populations). Whether compensation must cover only the incremental impacts from traffic on a particular road, or total external impacts of automobile use, depends on how broadly the scope of responsibility is defined. Any residual revenues could be used for roadway improvements or tax reductions that benefit drivers.
- If the criterion is vertical equity, road pricing revenue should be used to guarantee that low income drivers and disadvantaged groups benefit overall. This can be accomplished by funding transportation improvements that target lower income drivers and non-drivers, by replacing more regressive taxes, by funding services for disadvantage people, or by cash payments that benefit lower income residents.

Political Acceptability

The final issue to be considered when evaluating options for allocating road pricing revenue is political acceptability. Whereas economic efficiency and equity can be evaluated with a certain degree of objectivity, political acceptability must reflect popular perceptions and the distribution of political power. To be politically feasible, road pricing revenues must be perceived as significantly beneficial to people who wield the most political power.

Hau argues that most drivers, both those who would pay a toll and those who would be tolled off the roadway, perceive a net loss from road pricing.⁴ Gómez-Ibáñez identifies eight groups affected by road pricing (Table 3), three of which are direct winners and five are direct losers. Both winners and losers include a diversity of income classes, so the overall vertical equity and political strength of a particular road pricing scheme depends on the relative size and makeup of these groups, which will vary from one situation to another. Since more groups are direct losers than direct winners, developing political support for road pricing will be difficult, although it may be possible on new highways, where additional transportation taxes are acceptable to voters, or where roads are so congested that the number of direct winners exceeds the direct losers.

Table 3 Road Pricing Winners and Losers³

Direct Winners	Direct Losers
<ul style="list-style-type: none"> • Wealthier motorists who value their travel time savings more than their toll costs. • Bus and rideshare travelers who enjoy improved service due to reduced congestion and economies of scale. • Recipients of toll revenues. 	<ul style="list-style-type: none"> • Lower income motorists who pay the toll because they have no travel alternative, but don't value their time savings more than the toll costs. • Motorists who shift to other routes to avoid a toll. • Road users on un-tolled roads who experience increased congestion. • Motorists who forego trips due to tolls. • Motorists who shift to transit and rideshare modes due to tolls (although service improvements due to economies of scale may make some of these net winners).

The greater number of direct losers makes road pricing politically difficult to implement for demand management.

Market surveys indicate that motorists on corridors that are candidates for tolling consider highway improvements and transit service improvements to be the most acceptable uses of road pricing revenues.^{29, 30} To design a politically feasible congestion pricing package for Southern California, Small suggested that funds be allocated about equally between monetary subsidies to travelers, substitutions of general taxes now used to pay for transportation services, and new transportation services.³¹ The package he proposed is summarized in Table 4. His equity analysis indicates that this program makes every class of traveler better off (taking into account combined travel time saving, financial benefits and transportation improvements), with the greatest benefit to higher income drivers and transit riders.

Table 4 Proposed Congestion Pricing Revenue Distribution

Use	Funding
Fund employee commute allowances.	25%
Reduce road user taxes.	12%
Reduce or eliminate transportation sales-tax surcharges.	18%
Rebate a portion of property taxes.	16%
Fund new highway capacity.	11%
Fund public transit improvements.	10%
Fund business center transportation facilities and services.	11%

Kenneth Small proposed this package to satisfy the goals of the seven interest groups.

Surveys indicate that compensation for externalities and vertical equity are significant considerations in the political acceptability of road pricing proposals, and may outweigh the preference for using revenue only for transportation improvements, at least in that state.¹⁶ One citizen survey in the city of Edinburgh, performed during a major debate over road pricing, indicates broad public support for spending road pricing revenues to improving public transport services.³² The result of the analysis suggests that the preferences of spending within public transport are real-time information, reliability, integrated ticketing, fare reductions and network coverage.

Road pricing advocates often argue that their programs can and should be revenue neutral. This does not always satisfy critics for these reasons:

- Skepticism that public officials will actually implement appropriate financial refunds.
- The inequity from externalities imposed on groups that don't pay the toll, including congestion spillover onto adjacent roads, pollution, and severance in neighborhoods through which tolled roads pass. It could be argued that these externalities should be compensated before user classes are refunded.
- Challenges to the assumption that existing resource allocation is equitable. The regressiveness of existing taxes would increase with a revenue neutral road pricing package.

King, Manville and Shoup recommend that highway toll revenues be returned to the cities through which they pass.³³ This compensates these cities for bearing the local external costs of a regional system, and gives them the resources to help mitigate freeway caused problems. It is also efficient, in that it will give an already organized lobbying group an incentive to champion tolls. Using Los Angeles County as a case study, they find that 70 of the 88 cities in the county would receive toll revenue, and the estimated revenue for the recipient cities would almost double these cities' general fund revenues.

Conclusions And Recommendations

This paper considers four issues for determining how road pricing revenue should be distributed: economic efficiency, equity, mitigation of external costs, and political feasibility. Of these four, economic efficiency is the easiest to address. The only requirements are that revenues be used to benefit society, and road users not be refunded in proportion to how much they individually pay. Economic efficiency does not require that revenue be dedicated to roadway or transportation improvements.

Horizontal equity implies that revenue should be dedicated to roadway projects or rebated to automobile users as class, but this requirement is reduced or eliminated if the analysis recognizes the need for users to compensate for the external costs they impose. Vertical equity justifies using revenues to benefit disadvantaged people, including low-income drivers as a class and non-drivers. This can be achieved by using funds to provide cash rebates or tax reductions that benefit lower income drivers as a class at least as much as they pay in road fees; to improve transportation alternatives such as transit, bicycling and walking; and to fund public services that benefit disadvantaged populations

Political feasibility means road pricing programs must be attractive to voters. Current conventional thinking is that road pricing is politically acceptable only on new highways or where a new road tax is already accepted. In either case revenues would be primarily dedicated to highways, resulting in horizontal inequity to those who incur external costs and no increase in vertical equity. However, increasing congestion costs, growing concern over motor vehicle externalities, more efficient toll collecting technologies, and creative packaging may allow other road pricing plans to be accepted. Using revenues to fund transportation improvements and broad economic benefits to residents through reduced taxes, rebates or community programs may provide the greatest overall benefit and earn the widest political support.

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AFFORD (www.vatt.fi/afford) is an evaluation of optimal transportation pricing policies.

CAPRI (www.its.leeds.ac.uk/projects/capri) is disseminating research on transport pricing.

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IMPRINT: Implementing Pricing Reform in Transport (www.imprint-eu.org) is an effort to promote implementation of fair and efficient transport pricing.

PETS (www.cordis.lu/transport/src/pets.htm) assesses current pricing of transport modes in European Union member countries.

PROGREURSS (*Pricing ROad use for Greater Responsibility, Efficiency and Sustainability in citieS*) (www.progress-project.org) involves research on road pricing.

TRACE (www.hcg.nl/projects/trace/trace1.htm) provides costs of private road travel and their effects on demand, including short and long term elasticities.

TRENEN (www.cordis.lu/transport/src/trenen.htm) is an effort to develop models for transport, environment and energy.

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