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Road Pricing in Theory and Practice: A Canadian Perspective

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I. Introduction

Like other developed countries, Canada experienced massive increases in road transportation since the end of the Second World War, with substantial growth in the number of registered vehicles,[1] annual per capita distances traveled by automobile,[2] and the volume of goods transported by truck.[3] At first, Canadian governments attempted to match the growing demand for road transportation by improving the quality and capacity of roads and highways – significantly increasing the extent of paved roadways and introducing a national highway system supported by federal shared-cost funding.[4] Throughout this period, the cost of constructing and maintaining Canada's road network was financed mostly from consolidated revenue funds and municipal property taxes, though federal and municipal governments levied taxes on automotive fuels and provincial governments collected vehicle registration fees that also contributed to these revenues.[5]

Since the 1970s, Canadian governments have been less willing to invest in roads and highways,[6] as growing environmental concerns lessened public enthusiasm for

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[1] Between 1945 and 1998, the number of registered vehicles in Canada increased from 1.5 million to almost 18 million. Statistics Canada, *Historical Statistics of Canada [Electronic Edition]*, (Ottawa: Statistics Canada., 1999) Series T147-194, online at www.statcan.ca/english/freepub/11-516-XIE/sectiona/toc.htm.

[2] In 1950, Canadians traveled an average of 1,955 km per capita by car; by 1990, this distance had quadrupled to 8,230 km per capita. John Pucher and Christian Lefèvre, *The Urban Transport Crisis in Europe and North America*, (London: Macmillan Press Ltd., 1996) at 162-63.

[3] Transport Canada, *A Millenium of Transportation in Canada*, (Ottawa: Her Majesty the Queen in Right of Canada, 2000) at 15.[Transport Canada, "A Millenium"]

[4] D.R. Owram, "Icons and Albatrosses: Passenger Transportation as Policy And Symbol in Canada," in Directions: The Final Report of the Royal Commission on National Passenger Transportation, vol. 3 (Ottawa: Royal Commission on National Passenger Transportation, 1992) at 92-94. From 1945 to 1970, the total distance of paved public roads in Canada increased from approximately 40,000 two-lane equivalents to almost 200,000 two-lane equivalents. Transport Canada, *Transportation in Canada: 1996 Annual Report*, (Ottawa: Her Majesty the Queen in Right of Canada, 1996), online at http://www.tc.gc.ca/pol/en/anre/transportation_annual_report.htm at figure 7.1 [Transport Canada, "Annual Report"].

[5] In a few cases, tolls were collected in order to help finance new road construction. In each of these cases, however, the costs of construction exceeded the revenue from tolls, which were subsequently removed. See Nancy Bryan, *More Taxes, More Traffic,* (Toronto: Canadian Tax Foundation: 1972) at 43-46; and Fred Nix, *Alternative Road Financing Arrangements*, Research conducted for the Transportation Act Review, (March 2001) at 8-10, online at http://www.reviewcta-examenltc.gc.ca/CTAReview/CTAReview/english/reports/nix.pdf.

[6] While municipal financing of roads has continued to increase since the 1960s, provincial and federal expenditures on roads and highways have declined significantly. Owram, *supra* note 4 at 129-30.

automobiles and urban expressways in particular.[7] From 1975 to 1995, the length of paved roads and highways in Canada increased by approximately 25 percent,[8] while the number of registered vehicles in the country increased by over 50 percent.[9] At the same time, government support for public transit decreased,[10] resulting in recurring fare increases and reduced ridership per capita.[11] As a result, road congestion has increased significantly in Canada, particularly in the largest urban areas (Toronto, Montreal, Vancouver, Calgary and Edmonton), the "Greater Golden Horseshoe" area surrounding Toronto, and along the Trans-Canada highway from Windsor (Ontario) to Quebec City.[12] In recent years, studies have estimated the annual cost of this congestion at approximately $2 billion in Toronto,[13] almost $800 million in Montreal,[14] and between $750 million to $1.0 billion in Vancouver.[15] With a few exceptions during this period, spending on

[7] In Ontario, these concerns culminated in the decision to cease construction of the Spadina Expressway in 1971. Similarly in Vancouver, increasing opposition to urban roadways is reflected in public opposition to a "Third Crossing" of the Burrard Inlet, which began in the 1970s and remains to this day.

[8] Transport Canada, "Annual Report", *supra* note 4 at Figure 7-1 (indicating that Canada had roughly 250,000 two-lane equivalent kilometres of paved public roads in 1975 and approximately 310,000 kilometres in 1995).

[9] The number of registered vehicles in Canada increased from approximately 11.2 million in 1975 to roughly 17 million in 1995. Statistics Canada, *supra* note 1 at Series T147-194; Transport Canada, "Annual Report", *supra* note 4 at Figure 10-1.

[10] Over the course of the 1980s and early 1990s, the share of the transit operating subsidy financed by provincial governments in Canada decreased from 53 percent to 42 percent, while the share of the capital subsidy fell more significantly from 89 percent to 56 percent. Pucher and Lefèvre, *supra* note 2 at 169.

[11] Between 1986 and 1996, rides per capita in Canada's ten largest cities declined by 21.2 percent. Wendall Cox, "Overview of Public Transportation in Canada and the United States" (Presentation to the 6th Annual Conference on Competition and Ownership in Land Passenger Transportation, Cape Town (September 1999) at 27-28, online at http://www.publicpurpose.com/ut-t6-canus.pdf.

[12] See, Jeffrey R. Kenworthy and Felix B. Laube, *An International Sourcebook of Automobile Dependence in Cities 1960-90*, (Boulder CO: University Press of Colorado, 1999); and Neil Irwin, et. al., *Urban Transportation Indicators – 1996 Survey 2*, (Ottawa: Transportation Association of Canada, 1999). For more detailed studies of congestion in Toronto, see Mary Rubinstein, Nancy Mudrinic, and Bruce McCuaig, "Greater Toronto Area Transportation Plan" (Paper for the 1996 Annual Conference of the Transportation Association of Canada, Charlottown, Prince Edward Island, 1996) (reporting that volume-to-capacity ratios for highways and arterial roads into Metropolitan Toronto from surrounding regions were already 0.94, 0.96 and 1.40 by 1991, and predicted to increase to 1.20, 1.64 and 1.83 by 2021 barring any major expansion to the road network); and IBI Group and Hemson Consulting Ltd., *Funding Transportation in the Greater Toronto Area and Hamilton-Wentworth: Report to the Transport Funding Opportunities Taskforce*, (Toronto, April 1999) (reporting that the proportion of the expressway system in the Greater Toronto Area and Hamilton-Wentworth with volume-to-capacity ratios exceeding 0.95 increased from 10 percent in 1981 to 70 percent by 1998). In Montreal, the number of vehicle hours resulting from delays due to congestion (where travel speeds are less than 60 percent of free-flow speeds) during the morning rush-hour increased from 21.5 percent in 1993 to 25.8 percent in 1998. Louis Gourvil and Fannie Joubert, *Evaluation de la Congestion Routiere Dans La Region de Montreal*, (Quebec City: Transport Quebec, 2004) at 57, online at http://www1.mtq.gouv.qc.ca/fr/ministere/recherche/etudes/congestion.asp. In Vancouver, a recent study estimates that 13.6 percent of urban vehicle kilometres traveled in 2002 occurred in congested conditions, a figure that is predicted to increase to 15 percent by 2006. British Columbia Ministry of Transportation, *Service Plan: Ministry of Transportation 2004/05 - 20006/07*, (Victoria: Ministry of Transportation, 2004) at 31, online at www.gov.bc.ca/trans.

[13] Canadian Urban Transit Association (CUTA), *Issue Paper No.5: Transit Means Business: The Economic Case for Public Transit: Executive Summary* (2003) at 5, online at www.cutaactu.ca .

[14] Gourvil and Joubert, *supra* note 12 at ix.

[15] Greater Vancouver Regional District, *2005-2007 Three Year Plan & Ten-Year Outlook.* (Vancouver: Greater Vancouver Regional Authority, 2004) at 8, online at www.translink.bc.ca.

Canada's roads and highways has continued to be financed from general revenues (including gasoline taxes and vehicle registration fees) rather than dedicated taxes or user charges.[16]

In order to finance improvements to road and transit infrastructure and address the growing problem of road congestion in Canada, federal and provincial governments have introduced and proposed a number of measures. In Montreal and Vancouver, provincial legislation has established urban transport agencies, which obtain additional revenues for municipal transportation through fuel taxes collected within the urban area, vehicle licence fees, and sales taxes on paid parking.[17] At the provincial level, governments have promised increased funding for urban public transit and plan to implement high occupancy vehicle (HOV) lanes as an incentive for people to carpool.[18] At the federal level, all major federalist parties are committed to sharing a portion of the federal gasoline tax with municipalities in order to finance new infrastructure projects.[19] Notably absent from these measures, however, are any concrete proposals to introduce more explicit road prices in the form of tolls and congestion-related charges.

This paper hopes to contribute to Canadian public policy by making a case for increased reliance on explicit charges for the use of Canada's roads and highways. Part II considers road pricing in theory, considering the main arguments for and against road user charges as well as their optimal design. Part III reviews international experience with road pricing in order to derive lessons for the Canadian context. Part IV offers tentative conclusions.

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[16] Major exceptions include the Coquihalla highway in British Columbia, a toll highway that opened in 1986; the Saskatchewan Transportation Partnership Fund, under which a dedicated levy is imposed on heavy vehicles operating in the province; the Confederation Bridge linking Prince Edward Island to the mainland, which was partly financed through tolls; and Highway 407 north of Toronto, an all-electronic open access toll highway constructed as a public-private partnership and sold to a private consortium in 1999. See Nix, *supra* note 5 at 22-24 and 29-31.

[17] See CUTA, *supra* note 13 at 6 and 12. In Montreal, the Agence metropolitaine de transport (AMT) receives 1.5 cents per litre from provincial gasoline tax for sales in the area as well as $30 per vehicle from the provincial licence fee. In Vancouver, the regional transportation authority (TransLink) receives 11 cents per litre from the provincial fuel tax (which is higher in the Vancouver area) as well as provincial sales tax on parking in the area. While provincial legislation permits TransLink to levy other charges, such as vehicle charges, parking charges and toll charges, the transportation authority has yet to introduce such charges.

[18] See, e.g., Government of Ontario, *Places to Grow: Better Choices. Brighter Future. A Growth Plan for the Greater Golden Horseshoe*, (Discussion Paper, Summer 2004) at 29-31, online at http://www.placestogrow.pir.gov.on.ca/userfiles/HTML/nts_2_20438_1.html .

[19] See, e.g., Liberal Party of Canada, *Moving Canada Forward: The Paul Martin Plan for Getting Things Done* (Liberal Party Campaign Platform, 2004 Federal Election) at 31, online at http://www.liberal.ca/platform_en.pdf (promising to share up to 5 cents per litre of the 10 cent per litre federal tax within five years). The New Democratic Party campaign platform also promised to share half the federal gas tax with municipalities "for sustainable transportation, public transit, cycling and pedestrian infrastructure" in cities and "freight rail and road investment in rural communities": New Democratic Party of Canada (NDP), *New Energy. A Positive Choice*, (Campaign Platform 2004) at 5, online at http://www.ndp.ca/uploaded/20040527091443_Fed.NDP.Platform.eng.sm.pdf. The Conservative Party platform promised to share at least 3 cents per litre of the federal gasoline tax with municipalities: Conservative Party of Canada, *Demanding Better* (Conservative Platform 2004) at 19, online at http://www.conservative.ca/platform/e.pdf. At the time of writing, it remains unclear which, if any, of these policies will be implemented and over what time frame.

II. Road Pricing in Theory

In order to evaluate options for increased reliance on road user charges it is helpful to begin by considering road pricing in theory – reviewing the main arguments for and against road user charges as well as their optimal design. As a foundation for the review of actual experience with road pricing in Part III of this paper, the following sections provide this theoretical framework.

A. Arguments for and Against Road User Charges

As with arguments for user fees and benefit taxes more generally,[20] arguments for increased reliance on road user charges emphasize both economic efficiency and fairness.[21] Arguments against road pricing tend to appeal to similar objectives – contending that road user charges are actually inefficient and unfair.[22] This section considers both sets of arguments.

1. Efficiency

The main argument in favour of road pricing is that user charges promote economic efficiency.[23] As a normative principle, economic efficiency favours the allocation of scarce resources to their most highly valued uses in order to maximize aggregate welfare.[24] By ensuring that drivers face the full costs attributable to their use of the road system, road user charges promote economic efficiency by ensuring that those who choose to drive value their use of the road system at an amount equal to or greater than its cost. Persons who value use of the road system at an amount less than this cost, on the other hand, will choose not to drive – preventing the wasteful allocation of scarce resources to a use for which people are not willing to pay.

In order to promote economic efficiency, economic analysis suggests that road prices should be set at an amount equal to the marginal costs attributable to each driver's

[20] See, e.g Richard M. Bird and Thomas Tsiopoulos, "User Charges for Public Services: Potntials and Problems" (1997), 45 *Canadian Tax Journal* 25-86; Mark Sproule-Jones, "User Fees" in Allan M. Maslove, ed., *Taxes as Instruments of Public Policy*, (Toronto: University of Toronto Press in cooperation with the Fair Tax Commission of the Government of Ontario, 1994) 3-38; and David G. Duff, "Benefit Taxes and User Fees in Theory and Practice" (2004), 54 *University of Toronto Law Journal* 391.

[21] See, e.g., European Commission, Towards Fair and Efficient Pricing in Transport Policy Options for Internalising the External Cost of Transport in the European Union, Green Paper (1995), online at http://europa.eu.int/en/record/green/gp003en.pdf (emphasizing "fair and efficient" road pricing); and Commission for Integrated Transport (CfIT), *Paying for Road Use*, (February 2002) at 10, online at http://www.cfit.gov.uk/reports/pfru/pdf/pfru.pdf at 10 (describing road pricing as "Fairer, Smarter and More Efficient").

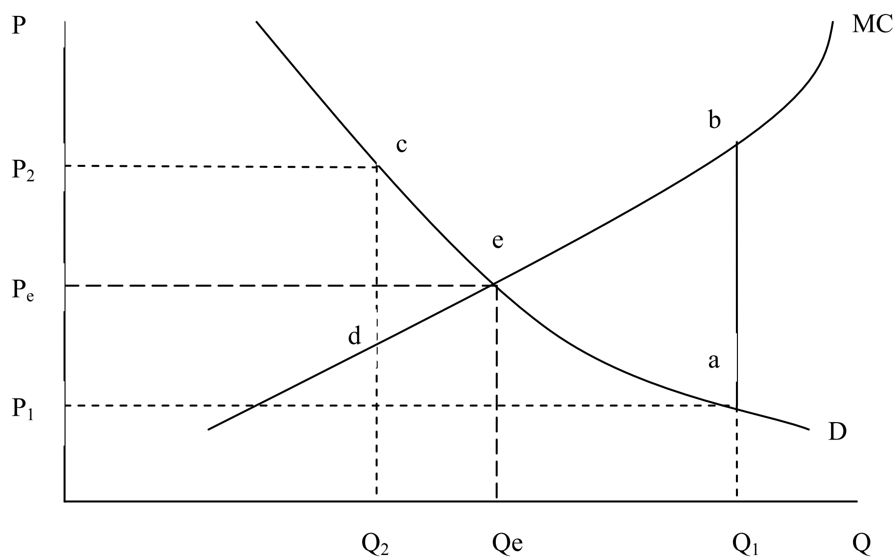
[22] For a useful summary of common objections to road pricing, see Robert Atkinson, "The Role of Road Pricing in Reducing Traffic Congestion" Testimony before the Joint Economic Committee of the U.S. Congress (May 6, 2004), online at http://www.ppionline.org/ndol/print.cfm?contentid=251568.

[23] See, e.g., Chris Nash, Peter Mackie, Jeremy Shires, and John Nellthorp, *The Economic Efficiency Case for Road User Charging* (July 20, 2004), online at http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_029765.pdf.

[24] While the measure of value employed for this purpose might be based on happiness or utility, economic analysis invariably dismisses these standards as indeterminate or unmeasurable, relying instead on more objective measures like willingness-to-pay. Within this framework, therefore, scarce resources should be allocated among different uses according to the relative amounts that people in aggregate are prepared to pay.

use of the road system – that is, the additional costs resulting from each person's decision to drive. Assuming that these marginal costs (MC) increase as the number of drivers increases, and that aggregate demand for road use (D) increases as the price (P) for this use decreases, Figure 1 illustrates that economic efficiency is achieved at a price (P_e) and a quantity of road use (Q_e) where the amount that an additional driver is willing to pay to use the road system (D) is equal marginal cost resulting from that person's use of the system (MC). At a price that is lower than this amount (e.g. at P_1), the marginal cost attributable to an additional person's use of the road system (Q_1b) exceeds the amount that this person is willing to pay for this use (Q_1a), indicating that scarce resources attributable to this use could be employed more efficiently elsewhere.[25] On the other hand, where the price charged for using the road system exceeds this amount (e.g. at P_2), the amount that potential drivers are willing to pay to use the road system (Q_2c) exceeds the costs associated with this use (Q_2d), suggesting that increased use of the road system is economically efficient.

Figure 1



Without some form of road pricing, users incur only private costs associated with their use of the road system, such as vehicle costs (capital and maintenance costs), insurance costs, the cost of fuel, and the cost of time spent driving. Absent from their decisions regarding the use of the road system are so-called "external" costs such as the cost of constructing and maintaining roads, the opportunity cost of the land on which the roads are located, environmental costs resulting from vehicle emissions, accident costs that are not internalized through insurance premiums, and increased travel times resulting from congestion. When these external costs are added to the private costs attributable to road use, the aggregate reflects the real social costs resulting from this use. As Figure 2 illustrates, by failing to account for these external costs, decisions based on marginal private costs of road use (MPC) result in a level of road use (Q_1) at which the marginal

[25] The measure of the resulting "deadweight loss" is defined by the area eab.

social costs (MSC) resulting from an additional person's use of the road system (Q_1b) exceed the amount that this person would be willing to pay for this use (Q_1a), suggesting that scarce resources attributable to this use could be employed more efficiently in other ways. The measure of this inefficiency (and the social benefit resulting from efficient road pricing) is defined by the area eab, and the road price that must be collected in order to promote an efficient level of road use (RP) is defined by the distance ce.

Figure 2

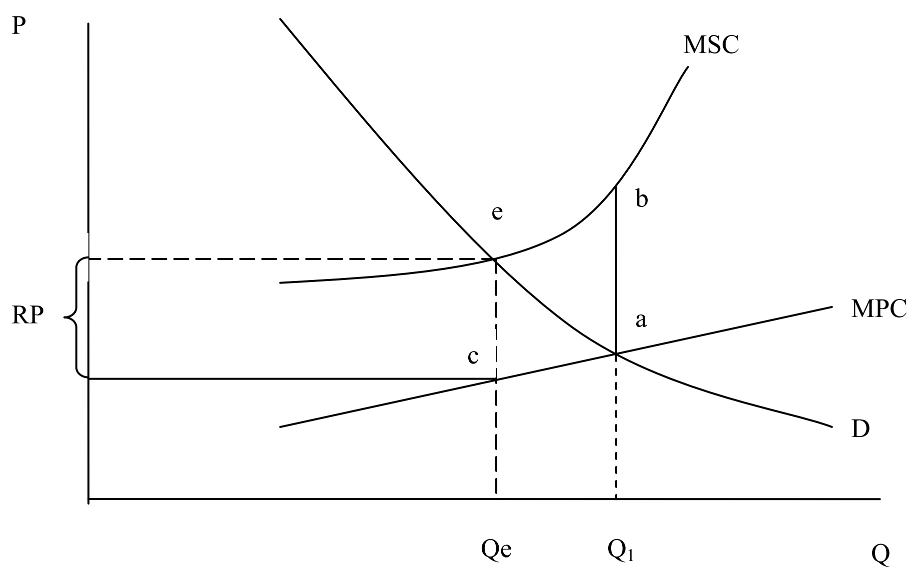


Figure 2 illustrates only one of at least three inefficiencies resulting from an absence of direct charges for use of roads and highways. In addition, since the resulting demand for road use is apt to produce congestion and demands for greater road capacity in order to alleviate this congestion, a lack of efficient road prices can lead to inefficiently large investments in road capacity.[26] As well, roads and highways that are not financed through user charges must be financed through general taxes which can themselves produce inefficiencies by distort economic behaviour. For all these reasons, therefore, it is not surprising that economists and policy-makers generally advocate road pricing arrangements based on marginal social costs.[27]

Despite these efficiency arguments in favour of road user charges, it is important to recognize that road pricing can itself entail significant costs in terms of administration

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[26] See, e.g., Richard M. Bird, *Charging for Public Services: A New Look at an Old Idea*, Canadian Tax Paper No. 59, (Toronto: Canadian Tax Foundation, 1976) [Bird, *Charging*] at 51-52, emphasizing that "[o]ne of the most significant consequences of an incorrect pricing policy is an incorrect investment policy".

[27] For a useful summary of this literature, see Esko Niskanen, Nicole Adler, Joseph Berechman, Jan K. Brueckner, David Milne, Chris Nash, Stef Proost, and Erik Verhoef, *The MC-ICAM (Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis) Approach to Pricing in Transport*, (7 August 2001), online at http://www.strafica.fi/mcicam/handouts/DELIVERABLES/del1.pdf.

and enforcement by authorities charged with establishing and collecting these charges, as well as compliance costs incurred by users themselves. Among arguments against road pricing, a common objection is that the various costs that must be incurred in order to implement more direct road charges are likely to exceed the economic benefits resulting from these charges. Indeed, proponents themselves acknowledge that since more direct road user charging would generally involve significant change, "[t]he economics require it to be demonstrated that the costs of change – including the capital and running costs of the charging system itself – are significantly outweighed by the benefits."[28]

While the specific costs and benefits of any road pricing arrangement are empirical matters that depend on the specific form of the pricing scheme and its impact on actual behaviour, there are three reasons to expect that this efficiency argument against road pricing is probably mistaken. First, studies that have attempted to estimate the marginal social cost of road use in different countries generally concur that these costs significantly exceed the various costs that road users typically bear.[29] Second, evidence from modeling studies and actual experience with road user charges suggests that road pricing can have a significant impact on behaviour.[30] Third, as the various examples in Part III illustrate, technological developments such as electronic transponders, automatic vehicle identification (AVI), and global positioning systems (GPS) make it increasingly possible to collect economically efficient road user charges without the need for costly collection systems such as traditional tollbooths. On efficiency grounds, therefore, the case for increased road pricing seems to be pretty well established.

2. Fairness

In addition to these efficiency arguments for road user charges, road pricing is often promoted on fairness grounds, on the basis that those who use roads and highways should bear the costs associated with this use.[31] Reflecting the so-called "benefit principle" of taxation, this view of fairness suggests that those who use publicly-provided goods and services should pay for this use in the same way that consumers must pay for the goods and services that they purchase in the marketplace.[32] On this basis, it follows, road users should pay for the cost of constructing and maintaining roads, as well as other external costs associated with driving such as environmental costs and lost time attributable to congestion.

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[28] Nash et. al., *supra* note 23 at 3.

[29] See, e.g., Todd Litman, *Socially Optimal Transport Prices and Markets: Principles, Strategies and Impacts*, (Victoria, B.C.: Victoria Transport Policy Institute, 1999) at 12, available at http://www.vtpi.org/opprice.pdf (estimating that external costs associated with road transportation in Canada account for 32 percent of total costs); and Tom Sansom, Chris Nash, Peter Mackie, Jeremy Shires, and Paul Watkiss, *Surface Transport Costs and Charges*, (Institute for Transport Studies, University of Leeds, 2001), available at http://www.its.leeds.ac.uk/projects/STCC/downloads/SurfaceTransportCostsReport.pdf (determining that marginal social costs for the average road user in Great Britain exceed road revenues by 100% or more).

[30] See the summary of these studies and experiments in Nash et. al., *supra* note 23 at 12-21.

[31] See, e.g., European Commission, *supra* note 21. A related argument favours road pricing as a way to prevent unfair competition between road transportation and other modes.

[32] See, e.g., Sproule-Jones, *supra* note 20 at 8-11; and Bird, *supra* note 26 at 11 (observing that the benefit principle of taxation reflects "the commercial principle that it is only fair to pay for what you get").

As a concept of tax fairness, the benefit principle generally competes with another principle according to which taxes and other public levies should be allocated according to each person's "ability to pay".[33] Although the precise definition of this concept is by no means uncontroversial,[34] it is often assumed that a person's ability to pay is best measured by that person's income broadly defined.[35] Taxation according to ability to pay is also generally assumed to require progressive taxation, involving proportionately higher taxes at higher income levels, on the basis that the effective burden of a fixed tax rate decreases as income increases due to a diminishing marginal utility of income.[36] To the extent that road user charges impose a greater proportionate financial burden on persons with lower incomes, therefore, this conception of fairness suggests that they are unfair.[37]

In order to decide between the benefit and ability to pay principles, it is important to consider the purpose for which revenues are raised. Where this purpose is to redistribute resources or to finance the provision of a good or service that is either generally distributed according to right, need or merit (e.g., basic education, medical care and higher education) or difficult to limit to specific beneficiaries (e.g. national defence), the benefit principle is inappropriate or impractical and taxation according to ability to pay may be justified.[38] In contrast, where governments provide a good or service the benefits of which are largely private, the provision of which is intended neither to redistribute resources nor to satisfy a basic right, and the distribution of which can be limited to specific beneficiaries, the benefit principle constitutes an appropriate and feasible approach to public finance.[39]

Although there are undoubtedly public benefits to the expansion of road networks as all users benefit from increased potential interchange,[40] the benefits from the actual use

[33] For useful discussions of these two principles of tax fairness, see Richard A. Musgrave, Peggy B. Musgrave, and Richard M. Bird, *Public Finance in Theory and Practice*, 1st Cdn. ed. (Toronto: McGraw-Hill Ryerson, 1987) at 209-28; and Robin W. Boadway and Harry M. Kitchen, *Canadian Tax Policy*, 3rd edn., Canadian Tax Paper No. 103, (Toronto: Canadian Tax Foundation, 1999) at 86-88.

[34] See, e.g., Alvin Warren, "Would a Consumption Tax Be Fairer Than an Income Tax?" (1980), 89 *Yale Law Journal* 1081 at 1092 (criticizing the concept as lacking specific content).

[35] See, e.g., Boadway and Kitchen, *supra* note 33 at 53. For a prominent definition of personal income for this purpose, see Henry C. Simons, *Personal Income Taxation*, (Chicago: University of Chicago Press, 1938).

[36] See, e.g., Musgrave, Musgrave and Bird, *supra* note 33 at 214-18. In addition to this rationale, progressive taxation may also be justified more directly on the basis that it promotes a particular conception of distributive justice by reducing pre-tax inequalities in the distribution of income. See, e.g., Marjorie E. Kornhauser, "The Rhetoric of the Anti-Progressive Income Tax Movement: A Typical Male Reaction" (1987), 86 *Michigan Law Review* 465); and Neil Brooks, "Flattening the Claims of the Flat Taxers" (1998), 21 *Dalhousie L.J.* 287.

[37] See, e.g., David L. Flewelling, "CAA urges Federal Government to support 'most promising measures' for climate change" (6 June 2002), online at http://www.caa.ca/e/news-issues/btw/2002/btw-02-06-06.shtml (arguing among other things that road tolls "would impose a significant increased financial burden on lower income earners").

[38] See the discussion in Duff, *supra* note 20 at 405-07.

[39] See *ibid*. at 410-13.

[40] Richard M. Bird, "User Charges: An Old Idea Revisited" in Richard Krever, ed., *Tax Conversations: A Guide to the Key Issues in the Tax Reform Debate*, (London: Kluwer Law International, 1997) 513 at 520-21 [Bird, "User Charges"]. Although it is also suggested that road networks generate positive externalities

of roads and highways are largely private and may be attributed to individual users through methods such as electronic tolling.[41] Nor can it be said that the primary purpose of public roads and highways is to redistribute resources, though redistributive considerations may motivate access in sparsely-populated areas and remote communities and among specific groups such as elderly and disabled persons. Nor is equal access to all roads and highways generally regarded as a basic right in the same way that many view access to basic education and medical care. For these reasons, it seems reasonable to conclude that the benefit principle is better suited to financing road and highways than taxation according to ability to pay.

With respect to the distributional impact of road user charges, moreover, it is not at all clear that they would in fact impose a greater proportionate financial burden on persons with lower incomes than on persons with higher incomes. On the contrary, data suggesting that persons with lower incomes are less likely to own automobiles and drive less on average suggest that road user charges may be mildly progressive.[42] Furthermore, in assessing the distributional implications of any reform involving increased reliance on direct road user charges, it is important to consider not only the incidence of these charges themselves but also the incidence of other taxes or levies that might be reduced at the same time and the distributional impact of public expenditures toward which any increased revenues might be devoted. Where a shift to direct road user charges is accompanied by reductions in regressive taxes (e.g., sales taxes) or increased expenditures on public goods and services from which lower-income persons derive greater proportionate benefit (e.g. public transit), the overall impact may be highly progressive.[43]

Even if the impact of increased road pricing on various regions or groups of people is considered unfair, these concerns can be addressed through targeted measures, such as lower charges in remote regions, for low-income drivers, or for elderly and

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in the form of increased productivity and economic growth, evidence suggests that these benefits tend to be internalized in the form of lower transport costs. European Commission, *supra* note 21 at 7.

[41] Werner Rothengatter, "Do External Benefits Compensate for External Costs?" (1994), 28A *Transportation Research* 321.

[42] According to a recent Canadian study, the percentage of household income devoted to private transportation is estimated to increase over the lowest three quintiles of the income distribution, suggesting that road user charges would be progressive over this range. Todd Litman, *Social Inclusion as a Transport Planning Issue in Canada*, (Victoria: Victoria Transport Policy Institute, 2003) at 17, available at http://www.vtpi.org/soc_ex.pdf (reporting that 53 percent of households in the lowest income quintile owned no vehicle, 41 percent owned one vehicle, and 6 percent owned two or more vehicles; that 23 percent of households in the second income quintile owned no vehicle, 57 percent owned one vehicle, and 19 percent owned two or more vehicles; that 12 percent of households in the third income quintile owned no vehicle, 53 percent owned one vehicle, and 35 percent owned two or more vehicles; that 8 percent of households in the fourth income quintile owned no vehicle, 43 percent owned one vehicle, and 49 percent owned two or more vehicles; and that 7 percent of households in the highest income quintile owned no vehicle, 30 percent owned one vehicle, and 63 percent owned two or more vehicles).

[43] See, e.g., Harry W. Richardson and Chang-Hee Christine Bae, “The Equity Impacts of Road Congestion Pricing” in Kenneth J. Button, and Erik T. Verthoef eds., *Road Pricing, Traffic, Congestion, and the Environment*, (Northampton MA: Edward Elgar, 1998) 247 at 248.

disabled persons.[44] Since these measures are likely to lessen the scheme's efficiency-enhancing effects and certain to increase costs of administration and compliance, however, it is preferable to address these distributive concerns through other instruments such as general tax and benefit programs. Where these are designed in order to ensure a fair distribution of all taxes and expenditures, there should be no reason to oppose road user charges on fairness grounds.

B. Optimal Design of Road User Charges

If road pricing is to promote economic efficiency and fairness, it is essential not only that road user charges be levied in some form, but that they be set at an appropriate amount. As the earlier discussion of economic efficiency suggests, efficient road prices should be based on marginal social costs, reflecting the difference between these costs and marginal private costs. The key external costs for this purpose include the cost of constructing and maintaining roads, the opportunity cost of the land on which the roads are located, environmental costs resulting from vehicle emissions, accident costs that are not internalized through insurance premiums, and increased travel times resulting from congestion.[45]

In estimating marginal social costs, it is important to distinguish between short-run marginal costs when infrastructure is assumed to be fixed, and long-run marginal costs which allow for changes in road capacity. While construction and opportunity costs play a key role in the computation of long-run marginal costs, short-run marginal costs include only operating and maintenance costs, environmental costs, accident costs, and congestion costs.[46] Of external short-run marginal costs, studies suggest that the largest component is the cost of congestion.[47]

As a general rule, economic efficiency requires that road user charges should be based on short-run marginal costs in order to make the most efficient use of existing infrastructure.[48] Where long-run marginal costs exceed short-run marginal costs, however, economically efficient road user charges may have to exceed short-run marginal costs in order to obtain sufficient revenues to finance an optimal level of infrastructure.[49] Where short-run marginal costs exceed long-run marginal costs, on the other hand, economic analysis suggests that it is efficient to use road user charges to finance investments in increased capacity.[50] Where urban development makes increases

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[44] For a useful discussion of measures to reduce rates for low-income drivers, see *ibid*. at 249. To the extent that road user charges reflect external congestion costs, it should be noted that charges in remote regions are almost certain to be lower than those in urban areas, even if capital and maintenance costs are higher.

[45] For an excellent discussion of these external costs, see European Commission, *supra* note 21.

[46] Nash et. al., *supra* note 23 at 6.

[47] See, e.g., Sansom et. al., *supra* note 29

[48] See, e.g., Bird, "User Charges", *supra* note 40 at 530-43.

[49] See, e.g., Sproule-Jones, *supra* note 20 at 17. While revenues for this purpose might be obtained from general revenues, this method of finance is generally considered to be less economically efficient than alternative pricing arrangements, such as "multi-part tariffs" consisting of a basic access charge (e.g., in the form of driver and vehicle registration fees) and variable charges related to actual road use. For a useful discussion of multi-part tariffs as a method of road finance, see Bird, "Charging", *supra* note 26 at 58-63.

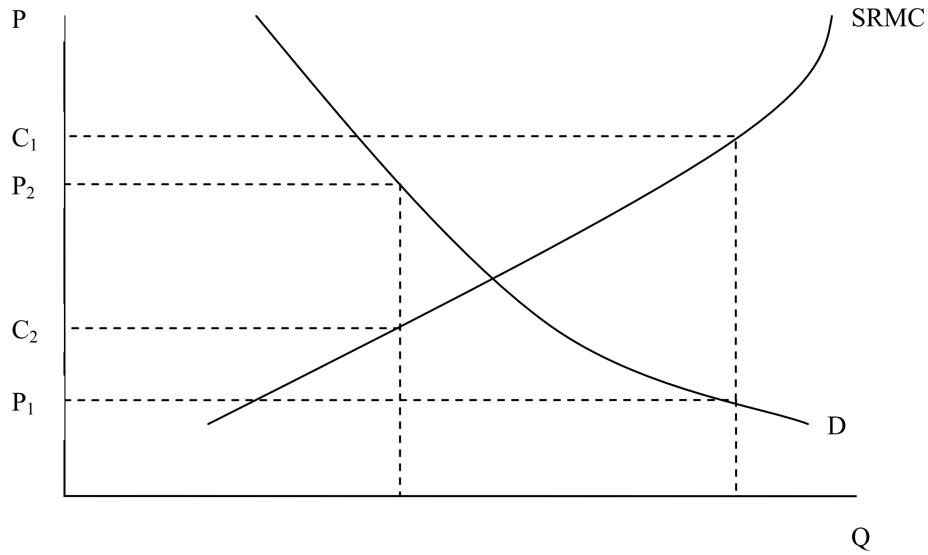
[50] See, e.g., Wayne R. Thirsk and Richard M. Bird, "Earmarked Taxes in Ontario" in Allan M. Maslove, ed., *Taxing and Spending: Issues of Process*, (Toronto: University of Toronto Press in cooperation with the Fair Tax Commission of the Government of Ontario, 1994) 129 at 161.

in road capacity impractical, however, public investments in alternative modes of travel (e.g., public transit and bicycle lanes) are warranted.

In calculating marginal costs attributable to the use of roads and highways, it is important to emphasize that these are not simply financial or accounting costs, but economic or opportunity costs – that is, the economic value of the benefits that could have been obtained had the scarce resources devoted to the use of the road been devoted to their most highly valued purpose.[51] As these costs are often not observable from market transactions, they may be extremely difficult to determine in order to establish economically efficient prices.[52] To the extent that marginal costs vary according to the level of output, moreover, the implementation of economically efficient road user charges requires not only a determination of marginal costs at different levels of output, but also an assessment of the impact of different charges on demand for road use.[53]

As Figure 3 illustrates, for example, where the marginal costs attributable to the use of a road or highway increase as use of the road or highway increases, economically efficient pricing depends on aggregate willingness-to-pay or demand for the road or highway as well as marginal costs attributable to this use. Where the price that is initially

Figure 3



established for use of the road or highway is greater or less than the efficient price, however, excess or insufficient supply relative to demand should provide signals to adjust prices to a more efficient level. Where the price is too low (e.g., at P_1), the short-run marginal cost attributable to the use of the road or highway (C_1) exceeds the price, suggesting that the price should be increased. In contrast, where the price is too high

[51] Bird and Tsiopoulos, *supra* note 20 at 53.
[52] For a useful discussion of the challenges to marginal cost based pricing in transport, see Niskanen et al., *supra* note 27.
[53] See Duff, *supra* note 20 at 415.

(e.g., at P_2), the amount that is collected from each user exceeds the short-run marginal cost attributable to the use of the road or highway (C_2), suggesting that the price should be lowered. As a result, even incorrect road user charges can help point the way toward correct road user charges.

In addition to these challenges to the implementation of economically efficient road prices, two others should be mentioned. First, where not all goods and services are priced on a marginal cost basis, it may be economically inefficient to implement marginal cost pricing in all circumstances.[54] To the extent that urban drivers do not incur the full marginal social costs of driving, for example, it would be economically inefficient to set public transit fares equal to the marginal cost of each trip.[55] On the contrary, as Richard Bird has explained, the objective in these circumstances should be "to establish roughly the same deviation between price and cost in all sectors."[56]

Second, where road use provides more general benefits beyond those available to the direct user, economically efficient rates should be adjusted to account for these positive externalities.[57] In these circumstances, economic analysis suggests that road users should be charged only a portion of marginal social costs, with the remainder financed by general taxes.[58] Although the expansion of road networks presumably generates some public benefits as all users benefit from increased potential interchange,[59] evidence suggests that any other external benefits from road use are internalized in the form of lower transport costs.[60] As a result, while it might be economically efficient to subsidize the cost of network expansions from general revenues, there appears to be little economic justification for subsidizing road use more generally.

In practice, the various challenges to the determination of economically efficient road user charges make it unrealistic to assume that perfectly efficient prices are likely to be implemented in the real world.[61] Nonetheless, as Richard Bird and Thomas Tsiopoulos conclude, "it is better to be roughly "right" – that is, to charge some form of roughly economically sensible price … – than to be clearly wrong."[62] The remainder of this article attempts to demonstrate that more "economically sensible" road prices are not merely theoretical concepts, but practical possibilities.

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[54] See Nash et. al., *supra* note 23 at 22-23; and Niskanen et. al., *supra* note 27 at 36-39 (discussing first-best and second-best pricing).

[55] Erik Verhoef, Esko Niskanen, Stef Proost, and Jan Rouwendal, "Phasing and Packaging of Pricing Reform: The MC-ICAM Approach" Presented at the Fourth Seminar of the IMPRINT-EUROPE Thematic Network "Implementing Pricing Policies in Transport: Phasing and Packaging" (Brussels, 13-14 May 2003) at 12-13, online at http://www.imprint-eu.org/public/Papers/IMPRINT4_verhoef2.pdf.

[56] Bird *Charging*, *supra* note 26 at 36.

[57] See, e.g., Bird and Tsiopoulos, *supra* note 20 at 60-62.

[58] See, e.g., *ibid*. at 39-40 (suggesting that "the continuum between pure 'public' goods and pure 'private' goods matches the continuum between general-fund financing and prices charged to specific users for specific services").

[59] Bird "User Charges", *supra* note 40 at 520-21.

[60] European Commission, *supra* note 21 at 7.

[61] For an excellent analysis of the implications of this practical reality for marginal cost based road pricing, see Esko Niskanen and Chris Nash, *MC-ICAM Final Report for Publication*, (2 March 2004), online at http://www.strafica.fi/mcicam/handouts/DELIVERABLES/mcicam-final-report-for-publication.pdf.

[62] Bird and Tsiopoulos, *supra* note 20 at 60.

III. Road Pricing in Practice

In Canada and other developed countries, most road-related user charges and benefit taxes take the form of driver and vehicle registration fees and taxes on automotive fuels. As a general rule, vehicle registration fees vary according to the type of the vehicle, distinguishing between passenger vehicles and heavy goods vehicles for which the marginal costs of road use are much greater. In many countries, registration fees also vary according to the fuel efficiency of the vehicle, establishing a form of user charge for external environmental costs.[63] Automotive fuel taxes are increasingly differentiated according to external environmental costs,[64] and are obviously related to road use – which is positively correlated to fuel consumption.

While these registration fees and automotive fuel taxes constitute a form of road pricing, however, there are several reasons to question the efficiency of these prices. First, in several countries, the level of these charges is much less than reasonable estimates of the marginal external costs associated with road use.[65] More significantly, perhaps, the structure of existing road prices is only weakly related to marginal external costs, which depend on axle weight and configuration as well as distances traveled,[66] weakly related to external environmental costs which depend on fuel type, vehicle and engine type, and driving patterns (location, speed and acceleration) as well as fuel consumption,[67] weakly related to external accident costs which depend on risk factors as well as driving frequency, and largely unrelated to congestion costs which depend on the type of vehicle, the time of day, and the place where it is driven.[68] Of these external costs, studies suggest that the most significant is the cost of lost time from congestion.[69]

The following sections consider alternative method of road pricing, reviewing experience with these methods in various jurisdictions. This experience suggests that road user charges can take many forms other than registration fees and automotive fuel taxes.

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[63] For a brief review of motor vehicle taxes and registration fees in various countries, see David G. Duff, "Tax Policy and Global Warming" (2003), 51:6 *Canadian Tax Journal* 2063 at 2086-88.

[64] See the discussion in *ibid*. at 2082-86.

[65] In Great Britain, for example, a recent study concludes that marginal external costs from road use exceed existing road prices by a factor of 2.0 or more. Sansom et. al., *supra* note 29.

[66] See, e.g., High Level Group on Transport Infrastructure Charging, *Final Report on Options for Charging Users Directly for Transport Infrastructure Operating Costs*, (Brussels: European Commission, 1999) at 11, online at http://europa.eu.int/comm/transport/infr-charging/library/hlg-9-99-rep-en.pdf.

[67] While fuel consumption is a good proxy for global environmental damage from emissions of greenhouse gases, provided that the tax exempts clean-burning and renewable fuels (as is the case in Ontario and other Canadian provinces and territories), external costs associated with regional pollution such as ozone (smog) depend on fuel consumption as well as vehicle and engine type. External costs resulting from local air pollutants (e.g., nitrous oxides, particulate matter, benzene, carbon monoxide, and volatile organic compounds) depend on vehicle characteristics, and driving patterns (location, speed and acceleration). For conflicting conclusions on the effectiveness of congestion charges in reducing emissions, see Joseph I. Daniel and Khalid Bekka, "The environmental impact of highway congestion pricing" (2000), 46 *Journal of Urban Economics* 180; and Georgina Santos and David M.G. Newbery, "Urban congestion charging: Theory, practice and environmental consequences," CESifo Working Paper 568 (2001), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=284156.

[68] See, e.g., Bird *Charging*, *supra* note 26 at 60 (bserving that "[f]uel taxes are a poor way to levy congestion prices, so on the whole it may be best to let the relative importance of fuel taxes decrease over time ….")

[69] See, e.g., Sansom et. al., *supra* note 29.

A. Toll Facilities

The oldest form of road pricing, toll facilities have existed in various forms for centuries. Indeed, before the expansion of road networks during the twentieth century, many if not most "highways" were built as toll roads.[70] Many jurisdictions continue to use tolls as a means of financing roads and other facilities like bridges and tunnels, though generally not as a means of controlling congestion.[71] In Canada, the 1950's and 60's saw a brief revival of tolls as a means of financing roads and facilities in Canada, while provincial governments, facing increasing financing pressures again turned to tolls as a means of financing roads in the 1990's.[72]

For the most part, these toll roads and facilities employ traditional collection methods involving manual toll booths and automatic coin machines. Relatively costly to administer, these methods restrict traffic flows and require considerable space for toll plazas, making them ill-suited for congestion charging.[73] In a few cases where variable charges have been introduced on existing toll facilities, however, traffic flows have demonstrated a noticeable response to these price signals. In France, for example, traffic volumes on the Autoroute du Nord A1 between Paris and Lille during the peak Sunday afternoon period decreased by 4.4 to 8.2 percent after charges for this period were increased by 25 to 56 percent and charges for Sunday mornings and evenings were reduced by a comparable amount.[74] In South Korea, traffic volume in two tunnels leading into downtown Seoul decreased by over 10 percent when tolls on vehicles with less than three passengers were increased during weekday mornings from 7 am to 9 am and on Saturdays from 7 am to 3 pm, allowing average traffic speed in the tunnels to increase from 21.6 km/hr to 29.8 km/hr.[75] Likewise, in the United States, the introduction of variable tolls on six bridges and tunnels to Manhattan in March 2001 caused a noticeable reduction in traffic during peak morning and evening periods.[76] Although increased peak period tolls in Seoul appear to have caused an initial increase in traffic volume on

[70] See Bryan *supra* note 5, discussing the history of toll roads in Canada prior to the 20th century.

[71] In many European countries toll highways continue to comprise the bulk of inter-urban highway systems; toll roads also fulfill a small but significant role in the American highway system. Similarly, facilities such as bridges and tunnels have often been funded through tolls. See Sheila Farrell, *Financing European Transport Infrastructure: Policies and Practices in Western Europe*, (Hamshire: MacMillan Press Ltd., 1999), reviewing the history of toll roads in Europe; and David M. Levinson, *Financing Transportation Networks*, (Northampton, MA: Edward Elgar, 2002), discussing the history of toll roads in the U.S.

[72] See Nix, *supra* note 5.

[73] See Timothy D. Hau, *Congestion Charging Mechanisms for Roads: An Evaluation of Current Practice*, Working Paper WPS 1071 (Washington, DC: World Bank, 1992) at 21-22, explaining that tollgates and automatic coin machines can accommodate only 350-400 vehicles per hour per toll lane.

[74] John E. Evans, Kiran U. Bhatt, and Katherine F. Turnbull, *Traveler Response to Transportation System Changes Chapter 14 – Road Value Pricing*, (Washington DC: Transportation Research Board, 2003) at 15, reporting that 20 percent of derivers reported that they had changed the time of their trip in response to the change in the price. For further discussion of this experiment, see Kenneth A. Small and José A. Gomez-Ibañez, "Road Pricing for Congestion Management: The Transition from Theory to Policy," in Kenneth J. Button and Erik T. Verthoef, eds., *Road Pricing, Traffic, Congestion, and the Environment*, (Northampton MA: Edward Elgar, 1998) 213 at 227.

[75] Evans, Bhatt, and Turnbull, *supra* note 74 at 14-18, reporting that average daily traffic volume fell from 90,404 vehicles before the change to 78,078 afterward.

[76] United States Federal Highway Administration (FHWA), "Value Pricing Notes" No.7 (Washington DC: US Department of Transportation, 2001) [FHWA, "Value Pricing"] at 5, reporting that traffic volumes during the morning and evening peak periods fell by 7 percent and 4 percent respectively.

alternate routes,[77] the main response to these differential charges has been a shift from peak period travel to off-peak use.[78] In Seoul, where higher peak period toll charges applied only to vehicles with less than three passengers, increased car pooling was also reported.[79]

In contrast to manual toll booths and automatic coin machines, automatic vehicle identification (AVI) technologies provide greater potential for economically sensible road pricing. Administratively less costly than traditional collection methods, AVI technologies require no additional space for toll plazas and operate without any restriction on traffic flow, making them ideal instruments for congestion-based road pricing.[80] Although automatic tolling involving AVI technologies can raise privacy concerns,[81] these can be greatly alleviated through smart card technologies which automatically deduct applicable charges from refillable smart cards as vehicles enter and exit tolled facilities, making it unnecessary to maintain records of driving patterns except as an enforcement measure where drivers have not purchased a card.[82]

Three of the most notable experiments with automatic tolling of roads using AVI technologies are the Highway 407 Express Toll Route (ETR) in Toronto and express toll lanes in San Diego and Orange County, California. The remainder of this section reviews each of these experiments.

1. 407 Express Toll Route, Toronto

The Highway 407 Express Tool Route (ETR) project is a 108-kilometer toll road that runs north of Toronto. It was built and operated as part of a public/private partnership with the provincial government. Although the government had originally hoped to find a private partner to finance, build, and operate the road, it ultimately ended up financing the road publicly, with the private partner operating the road.[83] The road was completed in 1997, although it has since been extended, with current plans to extend it again. In

[77] Evans, Bhatt, and Turnbull, *supra* note 74 at 14-17.
[78] See Small and Gomez-Ibañez, *supra* note 74 at 227 (France); Evans, Bhatt, and Turnbull, *supra* note 74 at 14-17 (Seoul); and FHWA, "Value Pricing", *supra* note 81 at 5 (Manhattan). Similar results are reported from the introduction of variable pricing on the New Jersey Turnpike and various bridges in Lee County, Florida. See United States Federal Highway Administration (FHWA), "Value Pricing Notes" No.7 (Washington DC: US Department of Transportation, 2001) [FHWA, "Value Pricing"] at 5; A. Cain, M. Burris and R. Pendyala, "Impact of Variable Pricing on Temporal Distribution of Travel Demand" (2001), 1747 *Transportation Research Record* at 36-43; and Evans, Bhatt and Turnbull, *supra* note 74 at 14-19.
[79] United States Federal Highway Administration (FHWA), "Congestion Pricing Notes" No.4. (Washington DC: US Department of Transportation, 1998) [FHWA, "Congestion Pricing"] at 11.
[80] Hau, *supra* note 73 at 24-25. AVI technologies use a number of different methods to identify and charge vehicles as they enter and exit toll roads and facilities. The technologies vary from facility to facility but the four main forms of AVI technology are: optical and infrared systems, inductive loop systems, radio and microwave systems (including surface acoustic wave technology), and smart card technology.
[81] Privacy concerns are one reason why Hong Kong rejected a road pricing scheme in the mid-1980's.
[82] José A. Gomez-Ibañez and Kenneth A. Small, *Road Pricing for Congestion Management: A Survey of International Practice*, NCHRP Synthesis 210, (Washington DC: Transportation Research Board, 1994) at 27.
[83] Nix, *supra* note 5 at 29.

1999, the Provincial government leased the road to an international consortium to run the project for 99 years.[84]

The 407 ETR uses electronic road pricing technology to allow it to operate without tollbooths. Regular users of the 407 can purchase transponders that tell the tracking system when their vehicle enters and exits the highway, allowing it to bill them accordingly. Vehicles without transponders are billed using a video-based technology that matches the vehicle's license plate with the Motor Vehicle Registry database and sends the owner (though not necessarily the driver) a monthly bill.[85]

The 407 ETR uses a variable price schedule, with vehicles charged on a per-kilometer basis and charges based on the time of day. Originally, there were three distinct periods and associated prices. During peak hours, vehicles were charged 10 cents (CAN) per km. During non-peak and weekend daytime hours, the charge was 7 cents (CAN) per km, while the charge was 4 cents per km at night.[86] In January 2002, the 407 ETR briefly switched to a flat pricing scheme of 11.5 cents per km at all times, but it has since shifted back to a variable pricing scheme, with only two prices instead of three.[87] The ETR also has higher prices for trucks, to reflect the higher cost imposed on the highway by trucks, with the rate for trucks set at two times that for cars (three times for double-trailers). Although the 407 is privately operated, the tolls are regulated by the provincial government, and can only be increased with inflation, or if there is an increase in traffic volume above certain target levels. Interestingly, in this case, the government seems to encourage higher overall traffic levels on the 407, presumably to reduce congestion levels on the free alternative.[88]

Although there appear to have been no academic studies of the impact of variable charges on traffic demand on the 407, it is interesting to consider what happened to traffic flows when the 407 was first opened. For the first 4 months of its operation the highway operated without tolls, attracting a daily volume of approximately 300,000 vehicles. However, when the tolls were introduced, traffic declined to less than 200,000 vehicles per day.[89] Since then, traffic volume on the 407 ETR has expanded to over 300,000 vehicles per day, although over the same time, the road length has also increased substantially (from approximately 68 km to 108km).[90] One reason for the sharp initial decline in volume after the introduction of tolls is probably the proximity of a free, if congested, alternative to the 407, which may also explain the political viability of the 407 ETR.[91]

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[84] Robin Lindsey, "Road Pricing Issues and Experiences in the U.S. and Canada" Paper Prepared for the IMPRINT-EUROPE Fourth Seminar "Implementing Pricing Policies in Transport: Phasing and Packaging," Katholieke University of Leuven, Belgium, (13-14 May 2003) at 14, online at http://www.imprint-eu.org/public/Papers/IMPRINT4_lindsey-v2.pdf.
[85] Evans, Bhatt, and Turnbull, *supra* note 74 at 14.
[86] *Ibid*.
[87] 407 ETR, "Tolls Explained" (2004), online at http://www.407etr.com/tolls/tolls.asp.
[88] Lindsey, *supra* note 84 at 14.
[89] Evans, Bhatt, and Turnbull, *supra* note 74 at 14.
[90] *Ibid*
[91] Lindsey, *supra* note 84 at 14.

2. I-15 Value Pricing Demonstration Project, San Diego

In 1988, an 8-mile long reversible high occupancy vehicle (HOV) lane was opened along the I-15, a major commuter route northeast of San Diego. Early experience with the exclusive carpool lane was disappointing, with peak-hour volumes well below 1,000 vehicles per lane, while the regular highway remained highly congested.[92] At the same time, a local mayor, who would ultimately become a state legislator, was seeking a means of financing public transit service to his community located along this route. The result was a plan to sell off the unused capacity to single occupancy vehicles, in order to use the revenue to finance a new express bus route along this highway. The plan coincided with interest by the Federal Highway Administration (FHWA) in using road pricing as a means of controlling congestion, which meant that the initial demonstration project was funded by the FHWA.[93]

The initial phase, ExpressPass, involved selling a limited number of monthly permits on a first-come, first-served basis. Drivers with a permit, displayed on their windshield, could use the HOV lanes during all operating hours without meeting the HOV requirement of two or more passengers.[94] The permits were colored decals displayed in the windshield, and were enforced by the police by visual inspection. Initially 500 permits were sold at a price of $50 per month, but demand was so high that both the number of permits and the price were subsequently increased to 700 and $70 respectively. By the end of the ExpressPass phase the number of permits had been increased to 1,000, although there still remained a waiting list for permits.[95] While, single occupant vehicles had to have a permit to use the lanes, vehicles with two or more passengers could continue to use the lanes free of charge.

The early results of the ExpressPass phase were fairly positive. Although a flat monthly fee may not appear to be a form of congestion pricing, using the HOV lane only makes sense during congested travel. As a result, the program operates as a crude form of congestion pricing.[96] During the first 3 months of the demonstration, traffic volume on the HOV lanes increased by 12 percent.[97] Ironically, though, single occupancy use of the lane actually fell while HOV use increased. Whereas before ExpressPass was introduced 15 percent of the carpool user were single occupancy vehicles using the lanes illegally, after the introduction of ExpressPass, high occupancy vehicles accounted for 88 percent of users while ExpressPass permit users accounted for 10 percent, and illegal users accounted for only 2 percent.[98] The decline in illegal users was likely due to increased police monitoring (for the ExpressPass permits) as well as a legal alternative in the form of the permits.

Several explanations have been presented for why HOV use increased when ExpressPass was introduced. One explanation is that, as a result of the pricing program, drivers got a more tangible sense of the cost savings offered by carpooling. A second is

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[92] Small and Ibañez-Gomez, *supra* note 74 at 231.
[93] See Evans, Bhatt, and Turnbull, *supra* note 74 at 54.
[94] *Ibid*. at 20.
[95] *Ibid*. at 20
[96] Small and Ibañez-Gomez, *supra* note 74 at 231.
[97] Evans, Bhatt, and Turnbull, *supra* note 74 at 20.
[98] *Ibid*.

that increased enforcement of the HOV lane encouraged drivers to carpool rather than pay for the permit or use the lane illegally. Finally, it has been suggested the people were more willing to commit to a carpool, since they knew they could still occasionally obtain the timesavings by buying into the lane. This latter explanation is consistent with the observation that 45 percent of permits were used on an occasional or periodic basis.[99]

After a transitional period the ExpressPass phase of the project shifted to the FasTrak phase in the spring of 1998. In this phase, variable fees were collected electronically from single occupancy vehicles in the HOV lane. The fee was (and remains) linked to the quality of traffic flow in the HOV lane.[100] In order to maintain a Level of Service C or better, the fee is recalculated every 6 minutes. As a result, the toll may be different at the same time on different days, depending on traffic levels. The current toll is displayed prior to the point where a motorist must decide between using the premium lanes and the regular lanes. The toll generally varies in 25 cents increments, and under normal traffic conditions usually varies from $0.50 to $4.00. Under the original project protocols, tolls could not exceed preset limits for any time period, except during periods of extreme congestion, when the price could go as high as $8.00. Subsequent refinements also included discounts during shoulder-of-peak hours in order to encourage more traffic spreading.[101]

One result of the shift to electronic pricing is that it made it easier for drivers to make occasional use of the premium lanes. Overall, traffic volume increased on the premium lanes increased steadily during both the ExpressPass and FasTrak phases, without adversely affecting the level of service of the HOV lane.[102] Moreover, growth in traffic on the HOV lane accounted for most of the growth in traffic volume on the I15 during the demonstration period.[103] As a result of the success of the FasTrak demonstration, when the demonstration period ended in 1999, state legislators approved the continued operation of the project. A public opinion survey of users and non-users of the fast track lane, conducted in 2001, also reported strong support for the express lanes project. Interestingly, this support held true not just for FasTrak users, but also among non-users and across socioeconomic groups.[104]

One reason for the public support for the FasTrak program may lie in the use made of the revenue for the express lane. By 1999, it was generating approximately $1.2 million in annual revenue, approximately half of which was devoted to public transit.[105] With these revenues, a new bus service, connecting with the San Diego LRT system, was implemented in March 1997. During the demonstration period, the bus ran every 30 minutes during peak periods, and every 60 minutes during off peak and midday hours.

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[99] *Ibid*. at 21.
[100]See *ibid*. at 20 and 54.
[101] *Ibid.*
[102] *Ibid*. at 55.
[103] *Ibid*.
[104] *Ibid*. at 57.
[105] *Ibid*. at 21.

3. SR91 Express Lanes, Orange County, California

The SR91 Express Lanes (91X) are ten miles of four-lane divided toll highway built in the median of the Riverside Freeway (SR91) in Orange County. They are separated from SR91 by barriers and there are no on or off ramps. Since this route is the only freeway connecter between Orange and Riverside counties, this portion of SR91 is one of the most heavily congested sections of highway in California, with the original four lanes in each direction (8 in total) carrying in excess of 200 vehicles per day, and peak period delays averaging 20 to 40 minutes and sometimes exceeding 50 minutes.[106]

Although an original plan for the expansion of SR91 had called for the construction of one lane each way for high-occupancy vehicles, a new agreement with the private operator provided for the construction of two additional lanes each way with a toll.[107] While the original lanes remain free of charge for all users, drivers must pay to use the Express lanes. The tolls are collected electronically, based on a published schedule. The tolls vary by time of day and day of week, as well as direction of travel. In order to provide the private operator with as much flexibility as possible, it is free to set toll rates as it sees fit, within the constraints of a maximum financial return of 17 percent, beyond which revenues are devoted to state and local highway projects.[108]

As a result of this flexibility, the toll schedule has changed greatly since the SR91 toll lanes opened in 1995. At that time there were five different tolls ranging from $0.25 during off-peak hours to $2.50 during peak hours. By 2001, the tolls ranged from $1.00 to $4.75, with 16 different toll amounts charged based on time and day of the week. Initially, there was an exemption from paying the toll for motorcycles and high-occupancy vehicles (3+), though this was eliminated in 1998 and high-occupancy vehicles were obliged to pay to use the Express lane at a discounted (50%) rate.[109]

While the Express lanes account for 33 percent of the SR91's capacity (4 of SR91's 12 lanes), they only account for 14 percent of daily traffic. This is not entirely surprising since they offer relatively little advantage over the free lanes during non-congested periods of the day. During peak periods, on the other hand, the Express Lanes carry 33 percent of total traffic volume, or their proportionate share.[110] As a result of the expansion of capacity resulting from the construction of the Express Lanes, average peak period delays fell from over 30 minutes on the free lanes to less than 10 minutes.[111] Interestingly, despite the fact that the SR91 toll lanes carry the same volume per lane as the free lanes during congested hours, traffic moves at free flow speeds, while the free lanes move at 30 mph or less.[112] One explanation for this phenomenon may be that the peak period pricing helps keep traffic volume from pushing traffic density out of a relatively stable and efficient flow.[113] An alternative explanation may be that trucks are

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[106] *Ibid*. at 20 and 57.
[107] Small and Gomez-Ibañez, *supra* note 74 at 228.
[108] Richardson and Bae, *supra* note 43 at 255.
[109] Evans, Bhatt, and Turnbull, *supra* note 74 at 58-59.
[110] *Ibid*. at 23.
[111] Small and Ibañez-Gomez, *supra* note 74 at 130; and Kenneth Small, "The Value of Value Pricing," *Access* no. 18 (Spring 2001) at 17.
[112] Evans, Bhatt, and Turnbull, *supra* note 74 at 23.
[113] *Ibid*.

excluded from the Express Lanes (in order to keep down maintenance costs), which may result in a more efficient traffic flow.[114]

It is also interesting to examine who uses the Express Lanes. A 1997 survey reported that nearly 90 percent of peak period travelers along SR91 had an Express Lane transponder, but most did not do so everyday; indeed nearly half of toll lane users drove in the toll lane once a week or less, while less than one third used it on a daily basis. Perhaps not surprisingly, travelers with long commutes reported using the toll lanes more frequently than those with shorter commutes.[115] Similarly, high-income travelers (with incomes in excess of $100,000 per year) were two and a half times more likely to use the Express Lanes than those from the lower income group (with incomes below $40 000 per year). Still, despite this discrepancy, 20 percent of the lower income group reported making using the toll lanes on their most recent trip.[116]

B. Cordon Pricing

Like variable tolls for the use of roads and other facilities such as bridges and tunnels, cordon pricing represents another means of congestion pricing. In effect, this system is essentially an admission charge to a given congested area (usually a central business district) during certain (usually peak) hours. An alternative way to think of cordon pricing is as a toll on an entire area, instead of only on one facility or lane. This section considers four examples of cordon pricing: in Singapore, Norway, London and Rome.

1. Singapore

The earliest cordon pricing scheme was Singapore's central area pricing scheme. The area-licensing scheme (ALS) was originally implemented as part of the Singaporean government's policy to restrict vehicle ownership and use. The ALS method was originally chosen over traditional forms of road pricing such as road tolls or higher parking charges because the crowded city did not have enough space for toll stations in the city center, and a high proportion of through traffic and chauffeur driven cars made parking charges ineffective.[117] The original scheme charged vehicles $60 (Singapore) (about $27 US at the time) per month to enter the central area of the city during morning hours. Travel outside of morning hours (7:30 to 9:30 am originally) or in a taxi or vehicle with four or more passengers was free. Entry was restricted to 30 entry points, marked by gantries and flashing lights, beyond these entry points, vehicles had to display their brightly coloured licenses in their windshields, or face a $50 (Singapore) fine. At the same time, a shuttle bus service was created between new park and ride spaces outside the zone and the city center in order to provide an alternative to commuters.[118]

[114] Richardson and Bae, *supra* note 43 at 257.
[115] Edward C. Sullivan, *Evaluating the Impacts of the SR91 Variable-Toll Express Lane Facility: Final Report*, Prepared for the California Department of Transportation, Sacremento, CA (1998) at 57, online at http://ceenve.calpoly.edu/sullivan/SR91/final_rpt/finalrep_full.pdf.
[116] Edward C. Sullivan, *Continuation Study to Evaluate the Impacts of the SR91 Variable-Toll Express Lane Facility: Final Report*, Prepared for the California Department of Transportation, Sacremento, CA (December 2000), at 86, online at http://ceenve.calpoly.edu/sullivan/SR91/final_rpt/FinalRep2000.pdf.
[117] Small and Gomez-Ibañez, *supra* note 74 at 215.
[118] Evans, Bhatt, and Turnbull, *supra* note 74 at 7.

The initial impact of the ALS on traffic patterns was quite dramatic. In the three months after the introduction of the scheme, vehicle traffic fell by 44 percent during the morning peak hours, from 74,000 vehicles to 41,200. The decline in car traffic was even more dramatic, falling from 42,500 during the morning rush hour to 11,400 – a 73 percent decline.[119] Most of the reduction in traffic was due to travelers shifting to carpooling and public transit. Some of the reduction was also caused by a shift in travel times outside of the morning hours, which resulted in some congestion after 9:30.[120]

On the other hand, the diversion of through traffic to the ring bypass road led to a decrease in average speeds on the periphery of the zone. While bus speeds in the ring increased, they did not improve on the radial routes.[121] As well, household surveys did not demonstrate any significant change in average travel times, except for those resulting from a shift in travel mode (i.e. from car to bus or high-occupancy vehicle).[122]

This is not to suggest that the initial Singapore Area Licensing Scheme was a failure. Although travel times did not improve as much as expected following the introduction of the area-pricing scheme, they could have become worse. Indeed, while the total volume of traffic (during the morning peak) increased by 24 percent between 1975 and 1988, the total number of vehicles registered in Singapore increased by 73 percent – suggesting that, absent road pricing, congestion and travel times could have been much worse. Moreover, many of the earlier problems were alleviated by significant new investment in both ring roads to deal with through traffic and improved public transit to reduce commuting times.[123]

More recently, in 1998, Singapore replaced the paper-based Area Licensing Scheme, with a fully automated Electronic Road Pricing (ERP) scheme. The new system uses in-vehicle transponder units which use stored-value CashCards (in part because they provided better privacy protection) to make payments. The initial cost of establishing the ERP system was relatively high, approximately $110 million (US 1998), in part because this included the cost not only the cost of new equipment for the overhead gantry points, but also the cost of the 1.1 million transponder units which were initially given away free of charge.[124]

The new ERP scheme was a much more subtle and sophisticated scheme than the previous ALS arrangement. The new scheme allows drivers to pay as they go, instead of having to pay a monthly fee. While the restricted zone entry tolls apply on weekdays

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[119] Under the initial scheme the system only applied during the morning rush hour, the theory being that evening traffic would mirror morning traffic. In fact, evening traffic fell only slightly, largely due to the fact that through traffic accounted for a larger share of traffic volume than had been realized and evening non-work trips in the restricted zone increased. Gomez-Ibañez and Small, *supra* note 87 at 15-16. Ultimately, the ALS scheme was extended to evening hours in 1989, resulting in a significant decline in evening peak traffic levels. Evans, Bhatt, and Turnbull, *supra* note 79 at 10. In 1994, it was extended again to mid-day hours, albeit at a discount. Small and Gomez-Ibañez, *supra* note 79 at 216.

[120] Gomez-Ibañez and Small, *supra* at 15-16.

[121] Evans, Bhatt, and Turnbull, *supra* note 74 at 9.

[122] Gomez-Ibañez and Small, *supra* note 82 at 16.

[123] *Ibid*. at 17; and A.P. Menon, Gopinath, Soi-Hoi Lam , and Henry S.L Fan, "Singapore's Road Pricing System: Its Past, Present and Future" (1993), 63 (12) *ITE Journal* 44 at 45.

[124] Evans, Bhatt, and Turnbull, *supra* note 74 at 10 and 53. To prevent cheating, the ERP scheme is enforced using video cameras; as a result the violation rate is reportedly very low.

from 7:30 AM to 7:00 PM, the actual fee charged varies from free (between 10:00 AM and 12:00 PM) to $2.50 (Singapore) (from 8:30AM to 9:00 AM) according to a fixed schedule.[125] The new scheme also includes morning peak tolls on the radial and peripheral highways which lead into and around the city center. As with the tolls in the restricted zone, these tolls vary by time of day, with changes every half hour. In both cases the purpose of the tolls was not to generate revenue, but to manage traffic.[126]

On the whole, the new ERP system seems to have been successful. Following its introduction in 1998, daily traffic volumes fell by 20 to 24 percent compared to the year before the new scheme was introduced, while average speeds in the restricted zone rose from 30-35 km/h to 40-45 km/h. There also appears to have been some peak spreading, as drivers took advantage of lower tolls before and after the peak hours.[127]

2. Norway

In Norway, the cities of Oslo, Bergen, and Trondheim introduced cordon pricing regimes in the late 1980s and early 1990s in the form of tolls that drivers must pay to enter the city.[128] Because of the unique geography of Norway's cities, there were relatively few entry points into these three cities, allowing them to use toll stations as a means of restricting entry.[129] All three cities use a combination of automatic and manual toll booths, as well as electronic toll payment systems.[130]

Since Norwegian law requires that tolls be used as a means of road financing, not traffic management, the pricing schemes in all three cities have been relatively unsophisticated. In Oslo, for example, the toll is set at a relatively low level in order to maximize revenue, and does not vary with time of day.[131] Bergen and Trondheim, on the other hand, have somewhat more sophisticated pricing schemes. In Bergen, there are free periods during which drivers are not charged to enter the city (nighttime and weekends). Trondheim includes not only a free period (also evenings and weekends), but also charges a slightly higher toll during the morning rush hour.[132]

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[125] *Ibid*.

[126] *Ibid*. at 52-53

[127] Indeed, one problem that emerged after the introduction of the ERP system was the practice of vehicles stopping on the shoulder to wait for the scheduled toll reductions, which authorities subsequently addressed by enforcing a no stopping rule near toll gantries. *Ibid*. at 53.

[128]. In the United Kingdom, the City of Durham also established what is, in effect, a toll ring in the city center. The Durham system uses basic technology; drivers must pay a £2 fee at a barrier to exit the central zone. Within three days of the implementation of the charge (on October 1st, 2002), daily traffic volume had fallen by 95 percent relative to pre-charging volumes to roughly 150 cars per day. Subsequent reports suggest that traffic levels have stabilized at about 10 percent of pre-charging levels. Michael Goodwin, *Urban Pricing Initiatives in the UK*, Prepared for the European Council of Minister of Transport and Transport for London International Conference "Managing Transport Demand Through User Charges: Experience to Date", (London, 23 January 2004) and Evans, Bhatt, and Turnbull, *supra* note 79 at 12.

[129]See Farideh Ramjerdi, "An Evaluation of the Impact of the Oslo Toll Scheme on Travel Behaviour," in Borje Johansson, and Lars-Goran Mattson eds., *Road Pricing: Theory, Empirical Assessment and Policy*, (Boston: Kluwer Academic Publishers, 1995) at 108 (describing Oslo); Small and Gomez-Ibañez, *supra* note 79 at.222 (describing Bergen); and Nigel C. Lewis, *Road Pricing: Theory and Practice*, (London: Thomas Telford, 1993) at 49 and 62-63 (describing Bergen and Trondheim).

[130] See Lewis, *ibid*. at 42-43, 54-55, and 62-63.

[131] *Ibid*. at 43; and Ramjerdi, *supra* note 129 at 108.

[132] Lewis, *supra* note 129 at 50-3 and 59-60.

The effectiveness of these toll rings in reducing traffic volumes and congestion has largely depended on the extent to which rates vary by time of day. In Oslo, where the prices were fixed, the effect of the toll ring on traffic volumes was relatively small, and largely affected off-peak hours.[133] In Bergen and Trondheim, on the other hand, there has been a substantial shift in travel from peak to off-peak hours due to variable prices,.[134] Trondheim also reported a 7 percent increase in public transit ridership during peak hours. While the public was initially hostile to the toll ring concept, moreover, support for the entire Trondheim package of the toll ring combined with road and public transit improvements financed by the toll revenue was much more positive.[135]

3. London

The most recent, and most widely discussed, example of area pricing is the Central London Congestion Charge, which was introduced in 2003 as a means of promoting public transportation, reducing congestion, and improving the environment. [136] The actual congestion charge had a relatively simple design, akin to the original Area License Scheme in Singapore but with more advanced technology.[137] The scheme charges vehicles a flat fee of £5 per day to enter the Central London area between 7:00 AM and 6:30 PM, Monday to Friday.[138] To provide commuters with an alternative to driving, introduction of the charge was accompanied by the introduction of 300 new buses in London as well as other transit enhancements – which had the not inconsequential benefit of reducing public opposition to the charge. The charge is enforced using an automatic number recognition technology that uses cameras set up on the boundary and within the central zone.[139]

Although the Central London Congestion Charge has only been in effect since 2003, the initial results have been promising. After the first three months of operation, average traffic speeds inside the restricted zone had increased by 37 percent over the

[133] This was in part due to the relatively small toll, the absence of alternative means of transportation, and the practice of employers subsidizing their workers commuting costs. See Ramjerdi, *supra* note 129 at 111 and 128; and Evans, Bhatt, and Turnbull, *supra* note 74 at 11.

[134] In Bergen, travel during weekdays fell by 6-7 percent, while travel on evenings and weekends increased by 10 percent, when traffic volumes are low. Evans, Bhatt, and Turnbull, *supra* note 74 at 11. Similarly in Trondheim, traffic volumes during peak hours fell by 10 percent, while traffic volumes on weekends and evenings appears to have increased. Tore Hoven, *Implementation of Urban Tolling System: The Trondheim Experience*, (2003) at 4, online at http://www.prelude-portal.org/ettc/uploads/hoven_part1.pdf (describing the decline in traffic volume during tolling hours); Gomez-Ibañez and Small, *supra* note 82 at 38 (reporting a shift in travel from days to evenings); and Small and Gomez-Ibañez, *supra* note 74 at 224 (reporting a shift in travel from weekdays to weekends).

[135] Small and Gomez-Ibañez, *supra* note 74 at 224

[136] Goodwin, *supra* note 128 at 6.

[137] Part of the reason for the relatively simple design was that the type of electronic road pricing currently used in Singapore or on the I-15 in California would have taken longer to set up. The design of the London scheme nonetheless left open the possibility that a more sophisticated form of congestion pricing might be used in the future. William D. Eggers, Peter Samuel, and Rune Monk, *Combating Gridlock: How Pricing Road Use Can Ease Congestion*, (2003) at 19, online at www.deloitte.com.

[138] *Ibid*. Like the original ALS system in Singapore, the London Congestion Charge also includes exemptions for the disabled, taxis, and certain classed of public servants (NHS workers, firefighters, etc.). See Transport For London, "Congestion Charging" (2004), online at http://www.cclondon.com/index.shtml.

[139] Eggers, Samuel, and Monk, *supra* note 137 at 19.

average of the previous year (to 17 km/h from 13km/h) while journey times on round trips to and from the zone had fallen by 13 percent. Congestion fell by 40 per cent during charging hours compared to previous year, while then number of vehicles within the zone had fallen by 16 percent. Bus speed in and around the zone also increased by approximately 7 percent and excess passenger wait times fell by one third.[140] Recent studies suggest that these figures are not temporary. Furthermore, there has not been a significant increase in traffic volumes on the inner ring road, or elsewhere outside of the zone, and where traffic volumes have increased they do not appear to have caused a significant increase in traffic congestion.[141] In addition despite widespread concerns that there would be resistance to paying the fee, this concern has not been borne out.[142] Similarly, concerns amongst businesses in the charging zone that the scheme would deter customers appear to have been overstated, although the evidence is mixed.[143]

4. Rome

Similar area pricing schemes have been considered in Italy. In the 1990's many Italian cities, including Rome, experimented with various forms of traffic management in their city centers. A 1989 Italian law allows municipalities to restrict the stationing and the traffic of vehicles in urban areas in order to protect health, the environment, and historical areas.[144] In 1998 Rome introduced a system where outside drivers could purchase a yearly pass for 320 Euro. Subsequently, in 2001, the city government introduced an automatic access control system that uses a combination of on-vehicle transponders and optical cameras to monitor entry into the zone. The system is currently enforced between 6:30 am and 6:00 pm on weekdays, and between 2:00 and 6:00 pm on Saturdays.[145] As a result of the new pricing scheme traffic during peak hours has been reduced by 10 to 20 percent, and vehicle emissions have declined.[146]

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[140] Greater London Authority, "Mayor Hails Latest Results on the Impact of Congestion Charging" Press Release, (6 June 2003), online: http://www.london.gov.uk/view_press_release.jsp?releaseid=1770.. Indeed, in one sense the congestion charge has been too successful. Since traffic volume fell more than was expected, there has been concern that the congestion scheme will not raise the £120 million that was expected in order to finance public transit improvements, see Eggers, Samuel, and Monk, *supra* note 137 at 20.

[141] Michele Dix, *Central London Congestion Chargin*g. Prepared for the European Council of Minister of Transport and Transport for London International Conference "Managing Transport Demand Through User Charges: Experience to Date", (London, 23 January 2004) at 18-19 at 18-19 and 22-23.

[142] Eggers, Samuel, and Monk, *supra* note 137 at 19. (Although there have been problems with stolen and copied license plates, as well as mistakenly entered license plates, authorities have taken steps to address these problems. If London eventually shifts to a transponder-based system, as expected, fraud and mistakes will become less of a problem.)

[143] Reports from business groups have been mixed, with some suggesting that business has been adversely affected, while other suggesting that business has improved. To aggravate the situation numerous other facts might also have contributed to any decline in business, including the emergency closing of the London Underground's Central Line and concerns about terrorism. Dix, *supra* note 141 at 30.

[144] The third reason is particularly important for Rome since its road network directs traffic through the historic city center. Mario Di Carlo, *Road Charging in London - Presentation.* Prepared for the European Council of Minister of Transport and Transport for London International Conference "Managing Transport Demand Through User Charges: Experience to Date", (London, 23 January 2004) [Di Carlo, *Presentation*] at 2-4.

[145] *Ibid.* at 5-7

[146] The decline in traffic and vehicle emission has also lead to increased pedestrian traffic and business

C. Distance-Based Charges

A final method of road pricing involves directly charging vehicles for the distances they travel with prices varying by vehicle weight. To the extent that these charges reflect external costs to maintain roads and highways, they attempt to achieve directly what fuel taxes aim to achieve indirectly. From another perspective, distance-based pricing is equivalent to simply tolling the entire road network. Unlike toll facilities or cordon pricing schemes, comprehensive distance-based pricing systems do not allow vehicles to avoid road user charges by shifting to alternative, non-charged, routes since all travel is charged under a comprehensive system.

The earliest example of a direct distance-based road charge is the Swedish Kilometer tax on diesel vehicles. The tax was explicitly intended to reflect the real road infrastructure costs and externalities of each vehicle. As a result, the rates charges varied by vehicle type, weight, and the number of axles.[147] The tax was collected using a mechanical counter that was linked to the vehicle's odometer. At the end of every tax period (usually every four months), the vehicle's owner was required to stamp a card in the counter and send it to the Traffic Safety Bureau which would then issue a bill based on the kilometer count. One of the problems with this system was that it led to considerable evasion and required a significant degree of administrative effort. Another problem, which ultimately led to the downfall of the tax, was how to deal with foreign vehicles which were not equipped with the counter.[148]

A more modern incarnation of the Swedish kilometer tax is the Swiss heavy vehicle fee.[149] First introduced in 2001, this tax replaced an existing flat rate charging system. The new system charges vehicles on the basis of distance traveled, vehicle weight, and vehicle emissions. Currently, the average rate is approximately 1 cent per km ton traveled, although this is expected to be increased gradually to 1.8 cents per km ton traveled by 2007.[150] The fee is calculated and collected using an onboard monitor connected to the vehicle's tachometer. Distance traveled is recorded on a smart card that is then sent to the authorities that issue a bill. In order to prevent tampering and fraud, the onboard unit also records GPS readings in order to verify the distance traveled.[151]

Early reports about the effects of the heavy good vehicle fee have been positive. In order to reduce the costs of driving, fleet owners have started to shift towards more

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amongst area businesses. See Mario Di Carlo, *Road Charging in London*, Prepared for the European Council of Minister of Transport and Transport for London International Conference "Managing Transport Demand Through User Charges: Experience to Date" (London, 23 January 2004) [Di Carlo, *Road Charging*] at 16; and Eggers, Samuel, and Monk, *supra* note 137 at 33.

[147] INFRAS Consulting Group, *Variabilisation and Differentiation Strategies in Road Taxation: Theoretical and Empirical Analysis: Final Report*, Prepared for the ECMT Group on Transport and Environment (2000) at 192, available online at http://www1.oecd.org/cem/pub/pubpdf/RdTax.pdf.

[148] Ultimately the tax was phased out in 1993 as part of an effort to harmonize Sweden's policies with those of the European Union. See *ibid*. at 192-93

[149] Germany and the UK have promised to introduce similar systems in 2005 and 2008 respectively, "The road tolls for thee" *The Economist* (12 June 2004) 30 at 30.

[150] Hans Werder, *Impact of the Heavy Vehicle Fee Central Pillar of the Swiss Transport Policy*, Prepared for the European Council of Minister of Transport and Transport for London International Conference "Managing Transport Demand Through User Charges: Experience to Date", (London, 23 January 2004) at 3.

[151] "The road tolls for thee", *supra* note 149 at 30-32.

fuel-efficient and more appropriately sized vehicles (previously, fleet owners often used over-sized vehicles). A related development has been increased productivity in the trucking sector, as fleet owners have worked on reducing the number of trips made by empty trucks.[152]

Another result has been a decline in the number of heavy vehicles on the road. After increasing at an average rate of 7 percent prior to the introduction of the new taxing scheme, the number of trucks on the road declined by 4 percent in 2001 and 3 percent in 2002, and appears to have stabilized in 2003. This change is likely due to the increased productivity brought about by the new tax, as well as regulatory changes introduced as part of the new tax, which allowed trucks to carry more weight (from 28 to 40 tons). In addition, overall traffic levels, which had been increasing steadily at a rate of up to 10 percent a year prior to the new fee, appear to have stabilized.[153]

IV. Conclusion

The theoretical arguments in Part II of this paper suggest that optimally designed road user charges can promote economic efficiency and fairness – ensuring that road users value their use of the road system at an amount equal to or greater than the additional costs attributable to this use, and reflecting a benefit principle of tax fairness according to which persons should pay for the road system in proportion to their actual use of this system. The various examples of road pricing arrangements in Part III of this paper demonstrate that economically sensible road pricing is not just a theoretical concept, but a practical possibility that can be achieved through various kinds of fees, taxes, and direct user charges.

In practice, the choice among different road pricing arrangements should depend on the context in which it is introduced. For example, while toll facilities with variable pricing make considerable sense for limited access highways or lanes or other facilities such as bridges and tunnels, it is less practical for urban surface roads where enforcement costs would be prohibitive. On the other hand, toll lanes have a certain political appeal as a means of both financing road construction and expansion since they often allow governments to finance these network improvements without up-front capital costs, while drivers "get something" (improved facilities) in exchange for the toll – thereby reducing public opposition. Crucially, new electronic payments systems have made it easier and less expensive to bill drivers without space requirements for toll plazas and without disrupting traffic flows.

In other contexts, such as urban city centers, toll facilities will likely be less appropriate. Depending on the geography and urban form, however, some form of cordon pricing may be appropriate. For example, urban areas with limited access points due to their geographic features may be able to adopt toll rings similar to those used in Norway. Alternatively, cities where bridges or tunnels play a significant role as access routes into the city may be able to adopt a quasi-cordon system, akin to the toll on facilities in

[152] This is somewhat ironic in light of the fact that one of the primary rationales for the Heavy Vehicle Fee was to encourage a shift in freight transport from roads to railways. The increase in productivity in the trucking sector appears to have offset whatever competitive advantage was gained by the railways from the Heavy Vehicle Fee. Werder, *supra* note 150 at 2-4.

[153] *Ibid*. at 3-4.

Manhattan. The feasibility and effective of more elaborate cordon pricing schemes akin to those used in Singapore or London will also depend on the urban form of a given city. In these circumstances, experience indicates that cordon pricing schemes can be very effective at promoting efficient traffic levels. To be truly effective, however, comprehensive cordon pricing schemes require the presence of viable alternatives such as public transit or free (or discounted) travel during off-peak hours. Improving public transit or allowing free or discounted travel during off-peak hours also improves the political feasibility of these schemes by allowing voters to avoid the charge by changing their behaviour. Such arrangements can also minimize possible adverse redistributive effects.

Finally, given the emergence of new technology, direct distance-based road charging is increasingly feasible. While this approach is, at least in the immediate future, likely to be limited to heavy goods vehicles rather than private passenger vehicles, it can significantly improve amounts that these vehicles must pay for external costs of driving.[154] Combined with reductions in other less efficient means of road charging, such as fuel taxes, might also limit the extent of political opposition to such charges.

While the most practical method of road pricing in any context necessarily depends on patterns of road use and geography, as well as political constraints, the theoretical arguments and practical examples in this paper suggest that Canadian governments should and could increase the extent to which they rely on direct charges for the use of Canada’s roads and highways.

[154] How feasible it would be to use the same technology for private passenger vehicles is, for now debatable. In that context, the high fixed cost of the technology may be prohibitive for private drivers (though not for commercial trucks), while privacy concerns may be engaged for private drivers which do not exist in the context of commercial freight transportation.