CLIMBING ALONG A PLATEAU: THE EFFECTS OF ECONOMICALLY NON-OPTIMAL TRANSPORTATION PRICING AND INVESTMENT POLICIES

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1. INTRODUCTION

The analytic basis for transportation policy-making has generally been provided by engineers and operations researchers who have concentrated on the development of large-scale trip assignment and simulation models. Rarely, if ever, do they give much attention to the question of whether fees should be charged for the use of transportation facilities. Their advice about facility expansion decisions is usually based on engineering criteria, for example a rule that capacity should be expanded when demand approaches a certain percentage of capacity on the nth busiest hour of the year.

A second strain of transportation policy advice has come from economists. In the area of pricing, they have argued that the fact that the marginal social cost (or the cost to an additional user) of congested facilities exceeds the cost to the average user is cause for the remedial action of congestion tolls, or peak-load pricing.(1) As for investment decisions, economists have advocated the use of benefit-cost analysis, which is based on the maximization of the net present value of the difference between what users are willing to pay for facilities and the cost to society of providing them.(2) Economists' policy advice has met with a mixed reception. Very little use has been made of peak-load pricing by transportation managers anywhere. Benefit-cost analysis has gained more acceptance, and is probably now as important as the engineering criterion approach in determining the nature and timing of public transportation investments.

Economists have not yet given up their research on and advocacy of marginal cost pricing. Some have attempted to show that it could be technologically feasible and relatively inexpensive: for example, William Vickrey proposed the implanting of electronic sensors in the road-bed which would read electronically-coded identification markers on cars, calculate road usage, and then send the owner periodic bills.(3) A second approach is known as the economics of the second-best. Here, one accepts certain optimalities as constraints and then suboptimizies. There has been a substantial literature showing that, if urban roads are implicitly subsidized by virtue of the absence of congestion pricing, then the appropriate response is to subsidize public transit as well. (4) Finally other authors have built empirical models, intending to show the magnitude of the changes in prices, traffic flows, and economic welfare which would result from replacing our present policies with those which are economically optimal. While the models have generally shown that there would be substantial differences in prices and some differences in traffic flows (especially when substitute modes are involved) the relative gains in economic welfare do not appear to be great. For example, in their study of non-optimal pricing and investment in United States highways, Kraus, Mohring, and Pinfold found relative welfare losses (expressed as percentages of real income relative to the optimum) of less than one percent under most circumstances. However, they felt that the absolute dollar magnitudes, between $90 and $1350 million for the entire U.S. were too large to be ignored.(5) Bertrand investigated a first-best pricing scheme for urban transportation in Bangkok, and concluded that the relative welfare gain (between 1.5 and 2.5 per cent of total transportation cost under the suboptimal status quo) would not be enough to overcome implementation cost and political opposition. (6)

The purpose of this paper is to report on my recent research which has attempted to determine how much economic non-optimality matters in transportation planning. This is done by using a transportation simulation model which is based on empirical data and applied to two different cases, airports and urban transportation. The model calculates the economists' maximand-- the net present value of the difference between what passengers are willing to pay for transportation facilities and the social cost of providing them-- for economists' optimal policies as well as for a wide range of suboptimal policies. Thus, absolute and relative losses in this maximand, which is referred to as economic surplus, can be compared. The model used to do this is an improvement on previous models because it is dynamic, rather than static; because it assumes that transportation capital can be expanded only in large, discrete increments, rather than continuously; and because it examines a wide range of deviations from economic optimality, rather than but a few. Finally, a version of the model been developed in which there are several substitutable facilities, rather than a single facility.

An important concept which this model introduces is that of the economic surplus surface surrounding the economically optimal policy. This allows an investigation of the effect on economic surplus of non-optimalities in pricing and/or investment timing. This too is a step beyond the existing literature, which has concentrated on the contrast between the existing and the optimal, rather than realizing that the existing and the optimal are merely two points on an economic surplus surface.

The following sections of this paper describe the model in somewhat more detail and then discuss empirical results using it to examine the effects of non-optimal pricing and investment policies.

2. THE MODEL

An early version of this model dealt with a single transportation facility, and was applied empirically to simulate an urban expressway and an international airport. (7) Travel growth was represented by a shifting demand curve. The facility's supply curve was based on engineering volume-delay curves, so that as travel approached the maximum physical capacity of a given facility, average social cost increased without limit. If the facility was "free," in that the only cost is the traveller's time and out-of-pocket expense in using it, then the point of intersection between the demand curve and the average social cost curve represented the equilibrium travel level. If there was marginal cost pricing, the equilibrium occurred at the intersection of the demand curve and the marginal social cost curve which corresponded to the average social cost curve. Alternative pricing policies, in which the government charged a toll, were represented by shifting the average social cost curve upwards to the extent of the toll. In any case, the model produced a non-linear equation which was solved by Newtonian approximation. As traffic grew over time, the model determined when to add capacity by comparing the reduction in travel costs to the annual capital cost of the next increment in capacity. Capacity was added when the increase in economic surplus with the new capacity relative to economic surplus without it exceeded the cost of advancing the construction of the new capacity by a year, which depended on the social discount rate used. In addition to making a capacity expansion decision every year, the model kept track of the overall net present value of economic surplus as well as revenue flows.

A more sophisticated version of the model incorporates substitutable transportation facilities.(8) The airport model includes peak and off-peak travel, with the two being related by a non-zero cross-elasticity of demand. The urban transportation model incorporates an expressway and a subway which run parallel to one another along a corridor. In it, travellers choose between four inter-related modes: the expressway during either the peak or off-peak, and the subway during either the peak or off-peak. In both cases, the methodology involves specifying a single logarithmic demand function for " common denominator " trips.(9) A translog cost function is used to make the price of "common denominator" trips depend on the prices of trips by means of the substitute modes. From the translog cost function, translog demand functions for each mode can be derived. These are equilibrated with the congestion cost functions, as in the simple model. This produces a system of simultaneous non-linear equations which are solved by Newtonian approximation. The number of "common denominator" trips is derived as a function of the number of trips for each mode by means of the production function which is dual to the translog cost function. The use of the common demoninator demand function enables us to measure passengers' willingness-to-pay for trips as the area under the demand function for "common denominator" trips. Capacity expansion decisions at either or both of the substitutable facilities are made every year, as in the simple model. Finally, the model tracks the net present value of economic surplus and revenue flows.

The airport model is based on data about Toronto International Airport.(10) The airport consists of an initial facility capable of handling 40 aircraft per hour with a capital cost of 800 million and annual maintenance costs of 30 million 1980 dollars. Demand increases at about 5% per annum. The common denominator for the airport model is aircraft operations for the average aircraft serving Toronto, which carries 110 passengers with a 65% load factor. Capacity can be increased by adding increments equal in size to the initial airport. The urban transportation model is based on Toronto data as well. The expressway and subway run between the suburbs and the city centre along a corridor 16 kilometers in length. The expressway has an initial cost of $97.5 million for land and for the first two lanes, with additional lanes costing $4.25 million. Each lane can carry a maximum of 2000 cars or 3000 passengers per hour, since auto ridership in Toronto has average 1.5 persons per hour. Expressway capacity is expanded by building additional lanes. The subway costs $14 million per kilometer and subway cars $400,000 each. Subway capacity is expanded by running longer trains more frequently: its ultimate capacity is 55,000 passengers per hour in the peak period, based on running trains six cars in length every two minutes. The demand for both the expressway and subway increases at 2.5% per annum. The common denominator for the urban model is person-trips.

Both the airport and the urban transportation models are specified in terms of a typical day's operations, since it is daily traffic variations that are of most interest to transportation planners. However, revenue flows are expressed as annual totals, since the budgeting cycle is annual. In both models, the estimates of demand elasticities and cross-elasticities used were at or above the high end of those econometrically estimated because high elasticities make the traffic levels and economic surplus losses more sensitive to variations in pricing policies.(11) In the airport model, existing pricing policy was represented by a fee of $1000 per flight for all flights, which is the total of ticket taxes and landing fees for an average flight using Toronto airport. In the urban transportation model, subway fares are $.60 per trip, in both the peak and the off-peak. The road system is free, in the sense that there are no user fees. It should be noted that there is a provincial gasoline tax in Ontario. However, the tax is not ear-marked for highway construction and maintenance and cannot be considered a user fee. The model uses a gasoline price of $.385 per liter in 1980, which is considered to be its real resource cost. Assuming that this price represents the long-run opportunity cost of alternative sources of energy, then the provincial gasoline tax can be considered as part of the rent which represents the difference between the extraction cost of inexpensive western Canadian oil and the long-run opportunity cost of alternative forms of energy.

Finally, for both the airport and urban transportation models, the estimate of the "correct" social discount rate, and the rate at which net present values are calculated is assumed to be 10%.(12)

3. RESULTS OF THE MODEL

The model can be used to simulate families of non-optimal pricing and investment policies by charging user fees which are not equal to marginal cost pricing tolls and by basing capacity expansion decisions on values of the discount rate which are different from the "correct" social opportunity cost of capital. Non-optimal airport pricing policies were based on the current practice of charging tolls which are constant over peak and off-peak periods and over the life of the facility.

Results for the airport model, run for a period of 100 years, are presented in Table 1. The net present value of economic surplus for the optimal policy of marginal cost pricing with a social opportunity cost of capital of 10% used to make capacity expansion decisions was $15.2 billion. The relative deviations of non-optimal pricing and investment policies are quite small, less than five percent. They are consistent with a large body of literature which has found small relative losses of economic surplus due to the non-optimal pricing of transportation facilities, to the high prices charged in monopolistic or oligopolistic markets, or to tariff barriers.(13)

While the relative welfare losses are small, the absolute losses are somewhat more significant. Within the range of social opportunity cost estimates from 5% to 15% and airport fees ranging from 0 to $2000 per flight, the net present value of the welfare losses is less than $100 million. Increasing non-optimalities, such as airport fees of $5000 per flight and/or investment timing decisions based on social opportunity cost of capital estimates of .5% or 50% lead to substantially larger absolute losses of up to $700 million. The model can be used to show that over the range examined pricing non-optimalities alone (for example, the welfare loss of $529 million for a fee of $5000 with the correct 10% social opportunity cost of capital) lead to greater losses than timing non-optimalities alone (for example, the welfare losses of $156 million and $225 million for marginal cost pricing with cost of capital estimates of .5% and 50%, respectively). Also, the deviations due to non-optimal pricing and timing are roughly additive. For example, the welfare loss due to a fee of $5000 per flight and a cost of capital estimate of .5% is $650 million, while the

Table 2. Absolute and Relative Welfare Losses, Airport Model, Constant Returns to Scale

(demand elasticity = -1.5; cross-elasticity = .75)

Pricing Policy	Investment Policy: Cost of Capital Used (%)	Absolute Loss ($ x 10^6)	Relative Loss (%)	NPV of Revenue ($ x 10^6)	Capacity in Year 100 (airplanes/hour)
Marginal cost pricing	10	0	0	-398	1840
Average cost pricing, no fees	10	69	.5	-1558	1920
Fee of $1000/flight (existing policy)	10	43	.3	-307	1880
Fee of $5000/flight	10	529	3.4	3482	1760
Marginal cost pricing	5	14	.1	-698	1960
Fee of $1000/flight	5	56	.4	-398	2000
Marginal cost pricing	15	15	.1	-193	1760
Fee of $1000/flight	15	60	.4	-245	1840
Marginal cost pricing	.5	156	1.0	-1239	2160
Fee of $5000/flight	.5	650	4.2	3234	2040
Marginal cost pricing	50	225	1.5	574	1440
Fee of $5000/flight	50	696	4.5	3574	1480

welfare loss due to a fee of $5000 per flight with a cost of capital estimate of 10% is $529 million and the welfare loss due to marginal cost pricing with a .5% cost of capital estimate is $156 million. The latter two losses add to $685 million.

The results also demonstrate an application of the economics of the second best. As landing fees increase relative to the average cost pricing (zero fee) case, welfare losses first diminish and then increase. More detailed investigation showed that there was always a point where they were minimized, as was proven for a model of a single transportation facility.(14) This occurs because constant fees over the life of the facility result in prices higher than marginal cost in the early years and lower than marginal cost in the later years, so that the discounted welfare loss over the life of the facility is less than if there is no landing fee at all. While this second-best optimum occurs at different prices for different estimates of the opportunity cost of capital, for those in the 5% to 15% range, it occurs at around $1000 per flight. This suggests that the government, albeit unconsciously, might be sub-optimizing.

These results can also be illustrated by using a three-dimensional computer plotting routine to display the welfare surface for the pricing and timing non-optimalities. This is shown in Figure 1. The surface is relatively flat within the range bounded by the cost of capital estimates of 5% and 15% and fees of 0 to $2000. The existing policy is on this portion of the surface. Beyond that plateau the surface drops off more sharply, with a steeper drop for pricing than for timing non-optimalities. Slightly higher surfaces could be generated by using pricing policies which more closely approximate marginal cost pricing, such as charging higher fees during the peak periods, or increasing fees as traffic increases relative to capacity. Computer runs indicated that those surfaces have a similar shape to that presented here.

One interesting implication of this result pertains to the ongoing debate among students of benefit-cost analysis as to the "correct" social opportunity cost of capital to be used in evaluating public sector investments.(15) The rates suggested all lie well within the 5% to 15% range. If the results of this paper were to hold up in research in other areas, one could conclude that determining the "correct" social opportunity cost of capital is not very important, since the cost of being wrong is not very great.

The tables also show the revenue implications of the various pricing and timing policies. Both the optimal marginal cost pricing and the existing policy do not break even. However, as the relationship between the level of user fees and the net present value of revenues is roughly linear, it is clear that the government would not have to increase its present fees very much to enable the airport to break even. Combining this consideration with the discussion of welfare losses, it appears that, over the range where the welfare surface is relatively flat, the government can manage its transportation facilities without great loss of economic surplus. Thus, if it is concerned with revenue, it can increase the fees enough to make the airport self-financing. If it wishes to achieve balanced utilization of existing facilities and delay the need to build new facilities, it can charge fees which approximate marginal cost prices. If that is politically impossible, it can simply delay expansion by setting a high social opportunity cost of capital for airports.

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Figure 1. Economic Surplus Surface, Airport Model, Constant Returns to Scale

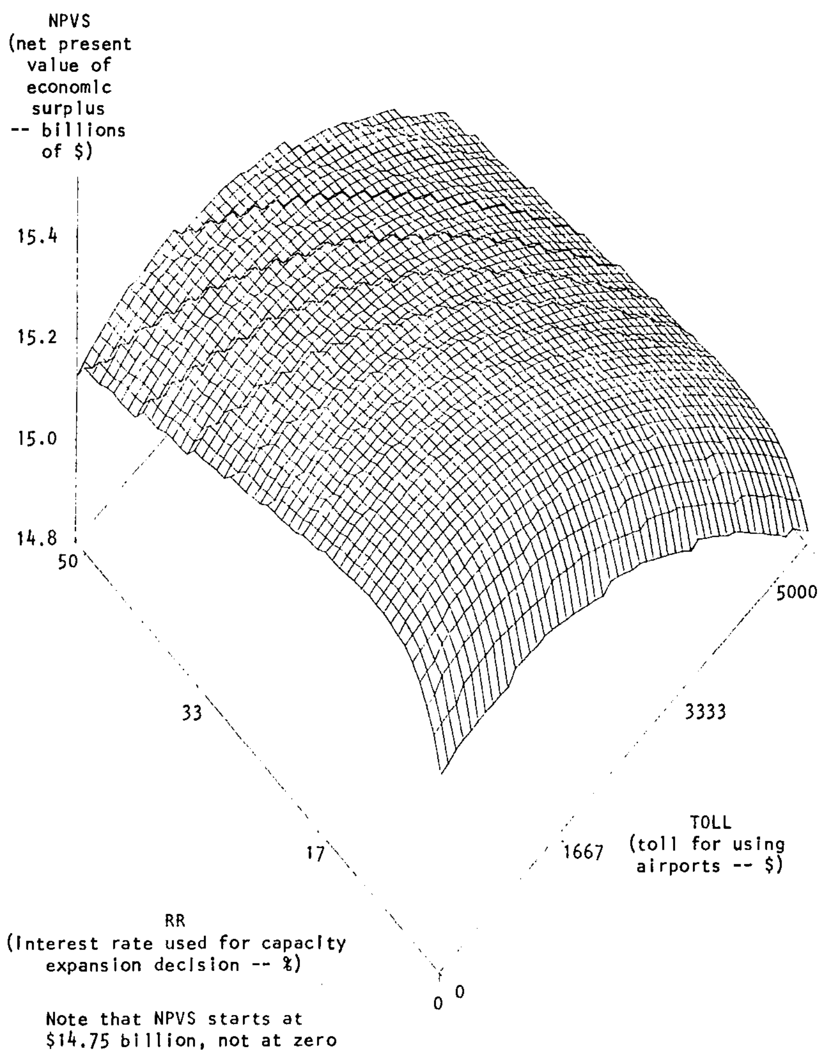
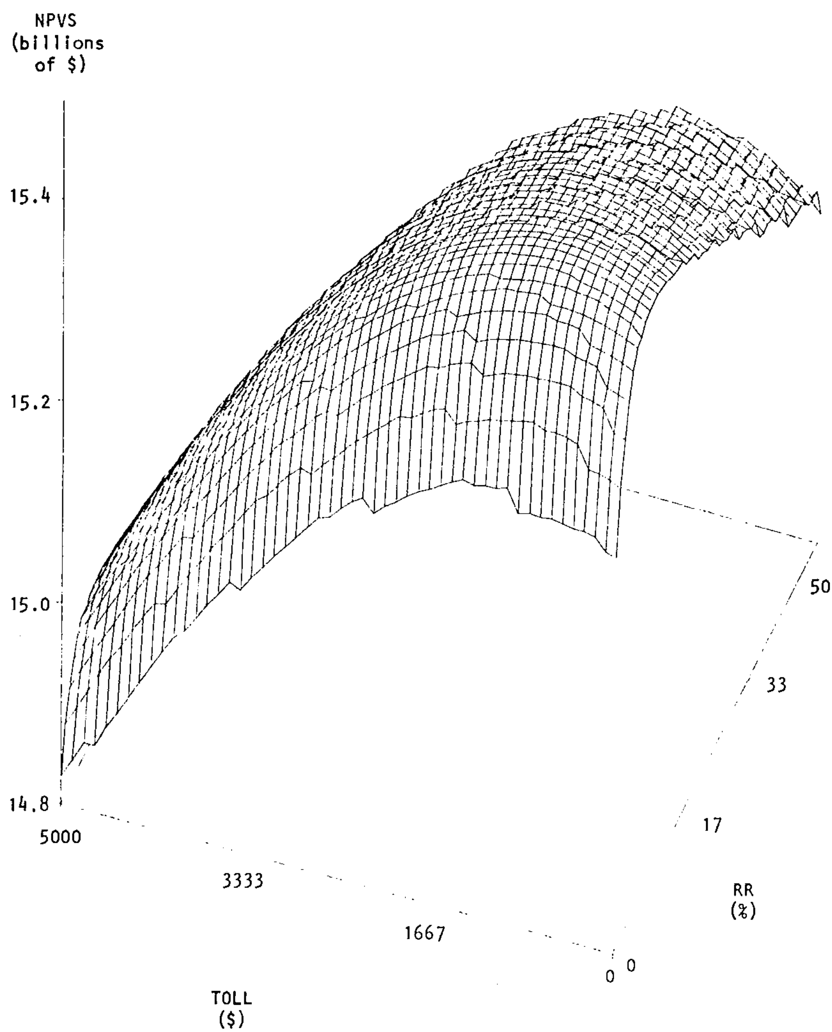


Figure 1. (continued).



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In addition to the two cases presented here, in which the airport exhibits constant returns to scale, the model was run for increasing (and decreasing) returns to scale, in which the capital and maintenance costs both decrease (increase) by 20% for each additional increment. The results indicated that in both these cases the absolute and relative welfare losses were quite similar to those for constant returns to scale. However, capacity was substantially different for each assumption about returns to scale. For the increasing returns case, it was 50% larger than for constant returns, and for decreasing returns it was about 60% smaller than that for constant returns. This occurs because capacity is added more (less) rapidly as the cost of additional increments decreases (increases). Finally, since the marginal cost cases represent long-run marginal cost pricing, albeit with discrete capacity increments, the net present value of revenues was greatest for the decreasing returns case and least for increasing returns.

Table 2 presents results for the urban transportation model, run for a 40-year period. For marginal cost pricing, the net present value of economic surplus was $1.66 billion. The relative welfare losses were quite small, less than 1%, except for the breakeven policy, which does produce substantially larger relative welfare losses. All the pricing policies considered produce absolute welfare losses of less than $20 million in net present value, except for the breakeven policies. Some cases involving social opportunity cost of capital estimates of 5% and 15% showed that the additional welfare losses were again very small, less than $1 million. In the urban transit model, as in the airport model, there is a range over which the economic welfare surface is a relatively flat plateau surrounding the optimal peak. This range incorporates social opportunity cost estimates of between 5% and 15% and subway and/or expressway fees of less than $1 per trip. Again, existing policies are well within that range.

The urban transit model also illustrates the original application of the economics of the second-best. It is possible to improve upon the status quo, in which there are subway fares but no road user fees, either by making the subway free or by charging expressway tolls at both peak and off-peak periods. However, a still better alternative would be to charge fees for both modes at the peak period and make them free at the off-peak. Even fees of $.90 at the peak do better than the status quo.

The model was also used to calculate the net present values of revenues for various policies. Under marginal cost pricing as well as the likely alternatives, the system (that is, the expressway and subway combined) sustains large losses. However, it is possible to find various fees which would allow the system to break even. One of these, involving constant fees on all modes and at all times of day, is presented. This would require fees of close to $3 per trip. The system breaks even because profits from the expressway cover deficits from the subway. The breakeven policy would probably diminish economic welfare substantially since a large city's transportation system consists of several transportation corridors so that the aggregate loss could approach $.5 billion, which would be similar to the losses for the less acceptable airport pricing and investment policies. However, more importantly from the policy-maker's viewpoint, it is unlikely that the level of fees required to break even would ever have any political support. This model suggests that transportation managers must be prepared to accept large financial losses for urban roads and subways, and use pricing policy to achieve other objectives.

Table 2. Absolute and Relative Losses in Economic Surplus, Urban Transport Model

demand elasticity = .75

Pricing Policy	Absolute Loss ($ x 10^6)	Relative (Loss %)	NPV of Revenue ($ x 10^6)	
Marginal Cost Pricing	0	0	-212.9	
Free Expressway, Subway	3.4	.2	-327.5	
Free Expressway, 60¢ Subway (existing policy)	19.5	1.3	-286.3	
25¢ Expressway, 60¢ Subway	15.3	.9	-283.0	
60¢ Expressway, 60¢ Subway	13.2	.8	-222.5	
30¢ for both at peak, free at off-peak	.9	.05	-309.3	
60¢ for both at peak, free at off-peak	2.0	.1	-296.3	
90¢ for both at peak, free at off-peak	5.9	.4	-287.9	
	102.8	6.2	Subway	X-Way
Breakeven pricing	(fee for both = $2.86)		-114.8	115.2

Table 3 shows the influence of the various pricing policies on the capacity of the facilities and the distribution of passengers. The more efficient policies (marginal cost pricing, free expressways and subways, and $.60 peak period fees) result in capacity levels and passenger distributions very similar to marginal cost pricing. The existing policy leads to a larger expressway and smaller subway and less subway traffic, particularly in the off-peak. The breakeven policy discourages substantial traffic, but shifts most of that which remains to the expressway. The results suggests that if a city already has excess subway capacity, transportation managers might well prefer to institute a fee structure which shifts traffic away from the expressway and to the subway, thus saving substantial sums on expressway construction at the expense only of additional subway cars. While this model does not consider other externalities such as air pollution and safety, it is clear that they would simply reinforce this preference.

4. CONCLUSION

This paper has developed a simulation model of substitutable transportation facilities to examine the impacts of non-optimal pricing and investment timing policies upon economic welfare, financial performance, and capacity provided. The data used to apply this model to airports, subways, and expressways in Toronto should be applicable to such facilities in other cities as well.

The most striking finding in this study is that in both cases there is a relatively flat economic welfare plateau surrounding the optimal policy. This plateau includes such pricing policies as "free" transportation (average cost pricing without user fees), existing fee levels which are kept constant over the life of the facilities, as well as various approximations of marginal cost pricing. It also includes the use of estimates of the social opportunity cost of capital between 5% and 15% in determining capacity expansion. Policies that involve large pricing or timing deviations take one off this plateau: fortunately, existing policies, while not optimal, are well-situated on it.

Previously, economists have tried to explain policy-makers' unwillingness to use marginal cost pricing for transportation facilities on several grounds. The income distributional impact of tolls would probably be regressive, because they would exclude from the roads or force to public transit lower income groups who place a smaller value on their time than do upper income groups.(16) The predicted small efficiency gains relative to the status quo means that the public would fail to perceive the benefits of the policy, which is a strong disincentive to politicians attempting to introduce optimal pricing policies.

This study, however, provides a rationale for developing a comprehensive understanding of the behaviour of transportation policy-makers. There are a number of arguments in their professional utility function, of which only one is economic efficiency. Others would almost certainly include the financial performance of the transportation system, the amount of new capital required, income distributional implications, and implementation and enforcement costs. These models show that on the plateau of the economic efficiency surface, surrounding the marginal cost pricing peak, can be found a wide range of policies which can have substantially different implications for financial performance, capital requirements, income distribution, and implementation and enforcement costs. Under most sets of weightings of the

Table 3. Influence of Pricing Policies on Capacity and Traffic, Urban Transport Model

(Results are for year 40. Demand elasticity = -.75)

Pricing Policy	Capacity (Peak Period Pax)		Total Pax	Distribution of Pax (%)			
	X	S		X-peak	X-off-peak	S-peak	S-off-peak
Marginal Cost Pricing	42,000	26,500	108,500	15	32	11	42
Free X, S fee of 60¢ (existing policy)	54,000	20,000	94,600	25	40	11	24
Free X, Free S	42,000	26,500	110,900	16	29	14	41
60¢ peak period, free off-peak	42,000	26,500	112,300	13	32	10	45
Break-even ($2.86 for X and S)	48,000	20,000	61,300	34	36	17	13

Legend: Pax = passengers; X = expressway; S = subway arguments in the policy-maker's utility function (except one putting all the weight on efficiency) the other factors would more strongly influence his choices.

If the efficiency surface were very sharply peaked, looking like the Matterhorn, then efficiency would be of greater concern -- but that does not appear to be the case. This paper suggests that the next step in economic research in transportation is not to regret that the surface does not look like the Matterhorn, but to accept the shape it has, and apply the rigorous methodology of economic analysis to an exploration of the tradeoffs among the arguments in the policy-maker's utility function.

FOOTNOTES

The research assistance of David Gillies and the financial support of Transport Canada are gratefully acknowledged. The views expressed here are solely those of the author and do not necessarily reflect those of Transport Canada.

1. The classic statement is A.A. Walters, " The theory and measurement of private and social cost of highway congestion," Econometrica 29 (1961): 676-699.

2. See A.C. Harberger, Project Evaluation: Collected Papers (Chicago: Markham, 1974) and S.A. Marglin, Approaches to Dynamic Investment Planning (Amsterdam: North-Holland, 1963).

3. William Vickrey, " Pricing in urban and suburban transport," American Economic Review 53 (1963): 452-465.

4. T.J. Bertrand, "'Second best' congestion taxes in transportation systems," Econometrica 45 (1977): 1703-1715; S. Glaister, " Generalized consumer surplus and public transport pricing," Economic Journal 84 (1974): 849-867; S. Glaister and D. Lewis, " An integrated fares policy for transport in London," Journal of Public Economics 9 (1978): 341-355; R. Jackson, " Optimal subsidies for public transit," Journal of Transport Economics and Policy 9 (1975): 3-15; and M. Marchand, " A note on optimal tolls in an imperfect environment," Econometrica 36 (1968): 575- 581.

5. M. Kraus, H. Mohring, and T. Pinfold, " The welfare costs of nonoptimum pricing and investment policies for freeway transportation," American Economic Review 66 (1976): 532-547.

6. T.J. Bertrand, " Congestion costs in a transport system, with an application to Bangkok," Journal of Transport Economics and Policy 12 (1978): 344-370.

7. S.F. Borins, " The effects of non-optimal pricing and investment policies for transportation facilities," Transportation Research 16B (1982):17-29.

8. S.F. Borins, " Pricing and Investment for transportation facilities," University of Toronto-York University Joint Program in Transportation Research Report Number 80, Toronto, September 1981. A similar application

of this methodology to investigate the impact of diesel emission controls on the overall United States automobile market can be found in W.W. Hogan, Decision Analysis of Regulated Diesel Cars (Washington: National Academy Press,1982).

9. The logarithmic travel demand function approaches the vertical (price) axis asymptotically, with the result that the area underneath it is unbounded. Even if it were truncated at a very small number of travellers, much of the consumers' surplus would still accrue to the first infra-marginal travellers. This is problematic because no empirically estimated demand functions have had any observations in that range. Furthermore, because these travellers will be unaffected by any of the pricing policies, their presence will reduce the estimates of relative losses due to non-optimal pricing policies. To counter-act this bias, it was decided to assume that the logarithmic demand function was horizontal for a substantial number of trips, which will produce upwardly-biased estimates of relative welfare losses.

10. Full documentation of the parameters of the airport and urban transportation models is presented in S.F. Borins, " pricing and investment for transportation facilities."

11. See G. Kraft and T.A. Domencich, " Free transit," pp. 459-480 in M. Edel and J. Rothenberg, eds., Readings in Urban Economics (New York: Macmillan, 1972).

12. G.P. Jenkins, " The measurement of rates of return and taxation from private capital in Canada," pp. 211-245 in W. Niskanen et al, eds. Benefit-Cost and Policy Analysis 1972 (Chicago: Aldine, 1972).

13. See Kraus et al," The welfare costs of nonoptimum pricing and investment policies for freeway transportation;" A.C. Harberger, "Using the resources at hand more effectively," American Economic Review 59(1954): 134-137; D. Schwartzman, " The burden of monopoly," Journal of Political Economy 68(1960): 727-729; L.H. Janssen, Free Trade,Protection, and Customs Union (Leiden: Kroese,1961), and H.G. Johnson, " The gains from trade with Europe: an estimate," Journal of the Manchester School of Social and Economic Studies 26(1958): 247-255.

14. S.F. Borins, " The effects of non-optimal pricing and investment policies for transportation facilities."

15. Some recent papers in this debate are H.F. Campbell, " A benefit-cost rule for evaluating public projects in Canada," Canadian Public Policy 1(1975): 171-175; M.T. Sumner, " Benefit-cost analysis in Canadian practice," Canadian Public Policy 6 (1980): 389-393; G.P. Jenkins, " Discount rates for economic appraisal of public sector expenditures," Canadian Public Policy 6 (1980): 549-555; M.T. Sumner, " Comments on the public-sector discount rate: response to Jenkins," Canadian Public Policy 6 (1980): 648-650; D.F. Burgess, " The social discount rate for Canada: theory and evidence," Canadian Public Policy 7(1981): 383-394; H.F. Campbell, " Shadow-prices for the economic appraisal of public sector expenditures," Canadian Public Policy 7 (1981): 395-398; and G.P. Jenkins, " The public-sector discount rate for Canada: some further observations," Canadian Public Policy 7 (1981): 399-407.

16. See R. Layard, " The distributional effects of congestion taxes," Economica 44(1977): 297-304, H. Richardson, " A note on the distributional effects of road pricing," Journal of Transport Economics and Policy 11(1977): 82-85, D. Segal and T. Steinmeyer," the incidence of congestion and congestion tolls," Journal of Urban Economics 7(1980): 42-62.