DIRECTIONS

THE FINAL REPORT OF THE ROYAL COMMISSION ON NATIONAL PASSENGER TRANSPORTATION

Volume 2

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Introduction to Volume 2, and Relation of Volume 2 to the Royal Commission's Research Program

Volume 2 is organized as a set of Notes to Chapters 1, 2, 3, 6, 7, 8, 9 and 18 of Volume 1. The primary purpose of these notes is to explain more fully, and to document, the estimates of the amounts and costs of intercity passenger travel that were developed for this report and are used in Volume 1. Such estimates figure prominently in the analysis of current and potential future passenger transportation costs in Chapters 3 and 18 of Volume 1, in the discussion of environmental impacts of transportation in Chapter 7, and in the discussion of the accident records of the different modes of transportation and of accident costs in Chapter 8. Estimates developed by Royal Commission staff are also used in the reference to total resources devoted to transportation in Chapter 1, and, in Chapter 2, to the amounts of intercity travel by various modes, currently and historically in Canada and in other countries.

In addition, Volume 2 provides supporting material for the section on rail infrastructure in Volume 1, Chapter 6, and for the discussion of legislation, regulations and other developments relevant to the provision of transportation for people with disabilities in Volume 1, Chapter 9.

Many of the estimates developed for this report and used in Volume 1 are inevitably quite rough, and in some cases are based on particular assumptions where alternative assumptions would also have been defensible. The relevant sections of Volume 2 do not quantify the margins of uncertainty to which the various estimates are subject. It is hoped, however, that the presentation and discussion of the approaches used in developing the estimates will allow the reader to form a general impression of the margin of uncertainty, and of the sensitivity of the estimates to key assumptions.

In some cases the notes to a chapter are presented as an integrated discussion of the development of the quantitative estimates in that chapter. In other cases, the notes deal with a series of relatively independent points in the chapter. A detailed table of contents precedes each of the sets of chapter notes.

A substantial part of the contracted research, and of the staff research work, carried out for the Royal Commission contributed to the development of the estimates, particularly the comprehensive cost estimates for the different modes of intercity transportation. Volumes 3 and 4 contain 22 of the research papers prepared for the Royal Commission that were judged to be particularly relevant to the issues discussed in Volume 1 and/or to be of interest to a significant number of readers in the transportation field. In some cases, sections of Volume 2 build on material from papers in Volumes 3 and 4. Some research papers in Volumes 3 and 4 provide a self-contained development of certain estimates and analyses referred to in Volume 1, particularly in Chapters 11, 12 and 13. No further supporting material is provided for these chapters in Volume 2. Several of the papers in Volumes 3 and 4 are summaries of historical, analytical or empirical work that provide a general discussion of issues of interest to the Royal Commission, and are relevant to one or more chapters in Volume 1.

These papers are listed below in the order in which they appear in Volumes 3 and 4.

VOLUME 3

Historical Overview

D. R. Owram	Icons and Albatrosses: Passenger Transportation as Policy and Symbol in Canada
George W. Wilson	U.S. Intercity Passenger Transportation Policy, 1930–1991: An Interpretive Essay

General Surveys

Objectives

Robin Boadway	The Role of Equity Considerations in the Provision and Pricing of Passenger Transportation Services
David W. Slater	Transportation and Economic Development: A Survey of the Literature

Subsidies/Pricing/Competition

Trevor D. Heaver	Subsidies in Canadian Passenger Transportation
David Gillen and Tae Hoon Oum	Transportation Infrastructure Policy: Pricing, Investment and Cost Recovery
John Blakney	Competition Policy and Canadian Passenger Transportation
Keith Acheson and Don McFetridge	Controlling Market Power in Weakly Contestable Canadian Airline Markets

Federal-Provincial Institutional Issues

Patrick J. Monahan	Constitutional Jurisdiction over Transportation: Recent Developments and Proposals for Change
Patrick J. Monahan	Transportation Obligations and the Canadian Constitution

VOLUME 4

Applied Analyses

Other

Eric J. Miller and Kai-Sheng Fan	Travel Demand Behaviour: Survey of Intercity Mode-Split Models in Canada and Elsewhere
Richard Laferrière	Price Elasticities of Intercity Passenger Travel Demand
Ken McKenzie, Jack Mintz and Kim Scharf	Differential Taxation of Canadian and U.S. Passenger Transportation
Richard Lake	Notes on Intercity Passenger Transportation Technology

Several other research papers prepared for the Royal Commission, judged to contain material potentially of use to a more limited number of readers with specialized transportation interests, are being made available in an unpublished research report series that will be distributed to libraries specializing in transportation and to large university and public libraries. These reports are:

	Author	**Title**
RR-01	Hickling Corporation	Transportation for People with Disabilities: A Policy Review and Analysis
RR-02	Peat Marwick Stevenson & Kellogg	Intercity Passenger Bus Regulation in Canada
RR-03	Michael K. Berkowitz	The Potential for Competition in Rail Carriage
RR-04	Sypher : Mueller International Inc.	Air Infrastructure Costing

RR-05	Pilorusso Research & Consulting Inc.	The Cost of Inter-City Travel by Private Motor Vehicle
RR-06	Hickling Corporation	Regulatory Reform in the Intercity Bus Industry: An International Comparison
RR-07	William A. Sims	Externality Pricing
RR-08	Tae Hoon Oum and Chunyan Yu	An International Comparison of the Economic Efficiency of Passenger Railway Systems
RR-09	Geoplan Consultants Inc.	Canadian Ferry Costs and Industry Analysis
RR-10	Richard J. Schultz	Airline Subsidies: Three Case Studies
RR-11	M. Brenckmann	Technological Innovation in Transportation R&D Funding Policy and Approach
RR-12	ADI Limited	Analysis of National Highway System Proposals
RR-13	Ron Hirshhorn	The Ownership and Organization of Transportation Infrastructure — Roads and Airports
RR-14	Robert Leore	Intercity Passenger Transportation Data Compendium

A number of additional reports were prepared by contractors and Research Division staff. These are included in the Royal Commission material transferred to the National Archives. Several of these papers were prepared relatively early in the Royal Commission's work program and were used as inputs in subsequent work.

NOTES TO CHAPTER 1: RESOURCES DEVOTED TO TRANSPORTATION

INTRODUCTION

Chapter 1 of Volume 1 states that in 1989 Canadians devoted resources equal to about 16% of the gross domestic product (GDP) to transportation, of which about 5% to 7% of GDP — depending on how broadly intercity travel is defined — was for intercity travel. These Notes to Chapter 1 introduce the concept of resources devoted to transportation, and sketch the way in which the estimates were derived.

The concept — total resources devoted to the transportation function or activity — is a very broad, and somewhat unconventional, measure of the size of transportation in the economy. It is used by the United States Department of Transportation (*National Transportation Statistics,* 1990, figure 1, p. 4) and the Eno Foundation (*Transportation in America,* 8th edition, May 1990, pp. 5-6) in discussions of transportation in the United States economy. A very similar concept was recently used in an article by Pierre Zalatan and Jean-Pierre Roy of Transport Canada ("The Importance of Transportation in the Canadian Economy," *Evolution in Transportation; Proceedings of the 26th Annual Meeting of the Canadian Transportation Research Forum,* Quebec City, May 1991, pp. 422-435).

The concept is somewhat unconventional because it includes resources devoted to production both of transportation services that are components of final demand, and transportation services (especially freight) that are intermediate inputs used in the production of other goods and services. Although the concept of total resources devoted to the function of transportation is of interest in arraying information on transportation resource use, it is important to recognize the consequences of including both final and intermediate activity.

If parallel estimates were made of the total resources devoted to a range of other major functions or activities in the economy — for example, to manufacturing, distribution, health care, education, public administration and so on — as well as to transportation, the total resources devoted to all these functions could well exceed the conventional measure of the total use of resources in the economy —

the GDP. This is because transportation, as well as being a final product, is an input in most of the other functions including manufacturing, education and health care. Similarly, goods or services produced by several of the other functions are used in carrying out the transportation function. The notion of total resources devoted to an economic function or activity departs from standard national income and expenditure accounts concepts, which generally focus either on final uses (rather than final plus intermediate uses) of goods and services, or on value added by (rather than total resources devoted to) economic activities or "industries." The National Accounts thus avoid counting use of resources more than once when displaying data on the full range of economic activities.

1. The Estimates

The special nature of the estimates of total resources devoted to transportation having been acknowledged, their derivation will be sketched. The objective is to obtain rough estimates of resources devoted to transportation; thus approximate procedures are used at a number of stages. In addition, to the extent possible, the estimates in this section use published data directly. In this they differ from some of the cost estimates in Chapter 3 of Volume 1 where attempts are made to quantify concepts that are judged to be important when comparing comprehensive costs of the different modes of transportation, but for which standard published data are not currently available.

Because individuals, businesses and governments are all involved both in purchasing transportation services and in directly using resources for transportation purposes, it is necessary to assemble data and estimates from a variety of sources to obtain an estimate of total resources devoted to transportation. Table 1(2)-1 shows four broad components of use of resources for transportation purposes:

I. Transportation services produced by business for sale (carrier revenues);

II. Transportation services produced by businesses for their own account — excluding business use of cars;

III. Own account car expenditures; and

IV. Government capital and operating expenditures to support transportation.

Table 1(2)-1
RESOURCES DEVOTED TO TRANSPORTATION, 1980-1989
($ BILLIONS, CURRENT DOLLARS)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
I. Transportation services produced by businesses for sale (carrier revenues including government payments to carriers)										
1. Air	4.0	4.6	4.7	4.7	5.1	5.6	6.0	6.4	7.1	7.9
2. Rail	5.3	6.1	6.3	7.0	7.6	7.7	7.6	7.9	8.0	7.4
3. Marine	1.8	2.1	1.9	2.0	1.9	1.8	1.9	1.8	1.9	2.0
4. Trucking	5.6	6.0	5.9	6.1	7.1	8.2	8.6	9.3	9.6	10.2
5. Intercity bus/ urban transit	1.8	2.1	2.4	2.6	2.7	3.0	3.4	3.7	3.8	4.3
6. Taxicabs	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8
7. Pipelines	0.7	0.8	1.1	1.3	1.4	1.5	1.6	1.9	1.9	1.8
8. Total	**19.6**	**22.3**	**22.8**	**24.2**	**26.4**	**28.5**	**29.8**	**31.7**	**33.1**	**34.5**
II. Transportation services produced on an own account basis — excluding car										
Private trucking										
9. Based on published data	3.8	3.9	4.0	4.4	4.1	4.2	4.1	4.3	4.6	4.8
10. Adjustment for incomplete coverage	3.1	3.6	3.7	4.1	4.4	4.8	5.1	5.5	6.1	6.5
11. Private marine	0.3	0.4	0.3	0.4	0.6	0.5	0.3	0.4	0.4	0.3
12. Pipelines — own account	0.8	1.2	1.3	1.2	1.3	1.4	1.3	1.3	1.1	1.1
13. Allowance for private air	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6
14. Total	**8.4**	**9.4**	**9.8**	**10.5**	**10.8**	**11.4**	**11.3**	**12.1**	**12.8**	**13.3**

Table 1(2)-1 (cont'd)

Resources Devoted to Transportation, 1980–1989
($ billions, current dollars)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
III. Car — own account										
A. Expenditures on new and used (net) cars										
15. Personal	8.4	9.0	7.8	9.8	12.1	15.2	16.6	17.9	19.9	20.4
16. Residual (business and government)	3.0	3.2	2.4	3.3	4.5	5.6	6.3	7.5	7.9	7.7
17. Subtotal	11.4	12.2	10.2	13.2	16.6	20.8	22.9	25.5	27.8	28.2
B. Expenditures on gasoline										
18. Personal	5.9	7.8	8.6	9.0	9.6	10.4	9.5	10.2	10.6	11.5
19. Residual (business and government)	3.0	4.1	4.2	4.2	4.2	4.0	3.4	3.6	3.5	3.5
20. Subtotal	8.9	11.8	12.9	13.2	13.8	14.4	13.0	13.8	14.0	15.0
C. Other expenditures on car operation										
21. Personal	4.8	5.5	6.0	6.5	6.8	7.3	8.4	9.8	10.9	11.6
22. Residual (business and government)	2.1	2.3	2.5	2.6	2.7	2.7	3.1	3.9	4.1	4.1
23. Subtotal	6.9	7.8	8.5	9.1	9.5	10.0	11.5	13.6	15.0	15.7
24. Total (17+20+23)	**27.2**	**31.8**	**31.6**	**35.5**	**39.9**	**45.2**	**47.3**	**52.8**	**56.8**	**58.8**
IV. Government capital and operating expenditures to support transportation										
A. Total transportation expenditures										
25. Federal	2.4	2.1	2.6	3.0	3.5	3.3	3.4	3.5	3.5	3.4
26. Provincial/local	6.6	7.4	8.4	8.2	8.1	9.1	8.9	9.2	9.4	10.8
27. Road policing and safety	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0
28. Subtotal	9.5	10.0	11.6	11.8	12.4	13.1	13.1	13.6	13.8	15.1
29. Subsidies to common carriers	1.3	1.7	2.0	2.1	1.8	2.0	2.2	2.4	2.5	2.7
30. Total (28–29)	**8.2**	**8.4**	**9.5**	**9.7**	**10.6**	**11.2**	**10.9**	**11.2**	**11.3**	**12.5**

Table 1(2)-1 (cont'd)
RESOURCES DEVOTED TO TRANSPORTATION, 1980–1989
($ BILLIONS, CURRENT DOLLARS)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
V. Deductions to eliminate double counting										
A. Government transportation revenues										
31. Motive fuel taxes	1.7	2.3	2.6	2.7	2.7	3.0	3.6	4.9	5.0	4.9
32. Air transportation tax	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.5
33. Motor vehicle permits	1.2	1.3	1.3	1.3	1.5	1.5	1.6	1.8	1.9	2.0
34. Other air revenues	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5
35. Subtotal	3.3	4.0	4.3	4.5	4.7	5.2	5.9	7.5	7.9	8.0
B. Transport inter-industry requirements and transport margins										
36. Carriers	2.3	2.5	2.4	2.6	3.1	3.4	3.5	3.7	3.9	4.1
37. Business — own account	1.1	1.0	0.9	1.0	1.1	1.2	1.3	1.5	1.5	1.5
38. Consumers — own account	1.2	1.2	1.1	1.2	1.4	1.7	1.9	2.0	2.2	2.3
39. Subtotal	4.6	4.7	4.4	4.8	5.6	6.3	6.8	7.2	7.6	8.0
40. Total deductions (35+39)	**7.9**	**8.7**	**8.7**	**9.3**	**10.3**	**11.5**	**12.7**	**14.7**	**15.5**	**15.9**
VI. Total resources devoted to transportation										
41. Grand total (8+14+24+30–40)	**55.6**	**63.2**	**65.0**	**70.5**	**77.4**	**84.7**	**86.6**	**93.1**	**98.4**	**103.1**
42. GDP at market prices	309.9	356.0	374.4	405.7	444.7	478.0	505.7	551.6	605.9	649.9

Notes and Sources to Table 1(2)-1

I. Transportation services produced by businesses for sale (carrier revenues including government subsidies)

1. ***Air: 1980–1989:*** **Statistics Canada, *Air Carrier Financial Statements/Canadian Civil Aviation*, Catalogue No. 51-206, Table 1 (1980–1981), Table 3 (1982–1987), and Table 3.1 (1988–1989).**

2. ***Rail: 1980–1987:*** **Statistics Canada, *Rail in Canada 1987*, Catalogue No. 52-216, November 1989, Figure 1.2, page 28; *1988–1989:* Statistics Canada, *Rail in Canada 1989*, Catalogue No. 52-216, October 1991, Figure 2.1, page 26.**

3. *Marine: 1980–1989:* Statistics Canada, *Shipping in Canada,* Catalogue No. 54-205, Table 2, line 14 (1980–1984), Figure 8.5 (1985), and Figure 8.3 (1986–1989).

4. *Trucking: 1980–1983:* Statistics Canada, *Trucking in Canada,* Catalogue No. 53-222, Table 7, line 4 (Freight Movers), and Text Table XIV, line 8 (1980–1981), and Text Table I, line 8 (1982–1983) (Household Goods Movers); *1984–1989:* Statistics Canada, *Trucking in Canada,* Catalogue No. 53-222, Figure 2.8, line 4 (1984–1988), Figure 2.26, line 4 (1989).

5 *Intercity bus/urban transit: 1980–1989:* Statistics Canada, *Passenger Bus and Urban Statistics,* Catalogue No. 53-215.

6. *Taxicabs: 1980–1987:* Statistics Canada, *The Input-Output Structure of the Canadian Economy 1987,* Catalogue No. 15-201, February 1991, Table A; *1988:* Statistics Canada, *The Input-Output Structure of the Canadian Economy 1988,* Catalogue No. 15-201, January 1992, Table A.
Note: The figure shown is for GDP in current dollars at factor cost rather than total revenues. However, most purchased inputs for the taxi industry are in principle included in component III.

7. *Pipelines: 1980–1987:* Statistics Canada, *Corporation Financial Statistics,* Catalogue No. 61-207, Table 2B; 1988–1989: Estimates based on unpublished material from Statistics Canada.

II. Transportation services produced on an own account basis — excluding car

9. *Private trucking* — based on published data: *1982–1983:* Unpublished data from Statistics Canada; *1984–1988:* Statistics Canada, *Trucking in Canada,* Catalogue No. 53-222.
Data extrapolated to 1989 (given reduced coverage of 1989 published data) and to 1980 and 1981.

11. *Private marine: 1980–1989:* Statistics Canada, *Shipping in Canada,* Catalogue No. 54-205, Table 2, line 14 (1980–1984), Figure 8.5 (1985), and Figure 8.3 (1986–1989).

12. *Pipelines — own account: 1980–1987:* Statistics Canada, *Corporation Financial Statistics,* Catalogue No. 61-207, Table 2B; *1988–1989:* Estimates based on unpublished material from Statistics Canada.
Estimate is based on difference between value of sales of products and value of raw materials purchases.

13. *Allowance for private air:* See text — estimate for United States private air is from F. Smith, *Transportation in America* (Eno Foundation, Westport, Conn., May 1990), p. 6.

III. Car — own account

A. Expenditures on new and used (net) motor vehicles

15. *Personal: 1980–1989:* Statistics Canada, *National Income and Expenditure Accounts, Annual Estimates, 1980–1991,* Catalogue No. 13-201, August 1992, Table 52, pp. 66–67.

16. *Residual:* The difference between 17 and 15.

17. *Subtotal: 1980–1989:* Statistics Canada, *New Motor Vehicle Sales,* Catalogue No. 63-007, Vol. 63, No. 10, August 1992, Table 9.
Adjusted to include an allowance for dealer margins on used cars which would be included in 15 — assumed to be 10% of line 15.

B. Expenditures on gasoline

18. *Personal:* See item 15.

19. *Residual:* The difference between 20 and 18.

20. *Subtotal:* Quantities of gasoline sold — 1980–1989: Statistics Canada, *Road Motor Vehicles, Fuel Sales,* Catalogue No. 53-218, Table 1.
Average fuel prices — *1980–1989:* Unpublished data from Energy, Mines and Resources. The price of regular unleaded gasoline was used to estimate the total value of gasoline sold.
Gasoline for car use is assumed to be 95% of total road gasoline sales less an allowance for share of light truck use not related to passenger transportation (20% of estimated light truck use).

C. Other expenditures on car operation

21. *Personal:* See item 15.

22. *Residual:* The ratio of residual to personal spending for vehicles and fuel combined multiplied by line 21.

IV. Government capital and operating expenditures to support transportation

25. *Federal government expenditures: 1980–1986:* Statistics Canada, *Federal Government Finance, Revenue and Expenditure, Assets and Liabilities,* Catalogue No. 68-211, Table 2; *1987–1989:* Unpublished data from Public Institutions Division, Statistics Canada.

26. *Provincial/local expenditures:*
Residual derived from total consolidated government expenditures on transportation less federal government expenditures. (Thus, the provincial/local expenditures figure is a consolidation of provincial/local expenditures less transfers from federal government tied to transportation programs.)
Total Consolidated Government Expenditures — *1980–1982:* Statistics Canada, *Consolidated Government Finance,* Catalogue No. 68-202, Table 2; *1983–1989:* Unpublished data from Public Institutions Division, Statistics Canada.

27. *Road policing and safety:*
Royal Commission staff estimates — road policing estimate (see section 5.1.4 of Notes to Chapter 3 in this Volume) approximately doubled to allow for other related spending by non-transport departments on motor vehicle registrations, control and safety.

V. Deductions to eliminate double counting

A. Consolidated government transportation revenues

31. *Motive fuel taxes: 1980–1989:* Statistics Canada, *Public Finance Historical Data, 1965/66–1991/92,* Catalogue No. 68-512, March 1992, Table H1 (Federal) and H3 (Provincial).
With provincial revenues adjusted approximately to remove revenues that would have been generated if standard provincial sales tax rates were applied to motive fuels (since such fuels are generally exempt from provincial retail sales tax).

32. *Air transportation tax: 1980–1983:* Statistics Canada, *Consolidated Government Finance,* Catalogue No. 68-202, Table 1 and unpublished material from Public Institutions Division, Statistics Canada; *1984–1989:* Supply and Services Canada, *Public Accounts,* Volume 2, Transport Canada section.

33. *Motor vehicle permits: 1980–1985:* Statistics Canada, *Consolidated Government Finance,* Catalogue No. 68-202, Table 1 and unpublished material from Statistics Canada; *1986–1990:* Statistics Canada, *National Income and Expenditure Accounts, Annual Estimates, 1980–1991,* Catalogue No. 13-201, August 1992, Table 44, line 15, and Table 45, line 2.

34. Other air revenues: 1980–1989: Supply and Services Canada, Public Accounts, Volume 2, Transport Canada section.

B. Transport inter-industry requirements and transport margins

1980–1989: Statistics Canada, *The Input-Output Structure of the Canadian Economy,* Catalogue No. 15-201.

36. *Carriers:* Based on the ratio of "transportation and storage" and of "transportation margins" used by transport industry to the total output of the transport industry (use Matrix, aggregation "M").

37. and 38. *Business and consumer — own account:* Based on the ratio of transport margins to total values of final sales for "motor vehicles and parts" and "motor fuels and lubricants" (final demand matrix, aggregation "M"), multiplied by 2 as a rough allowance for own account transportation inputs (not counted in transportation margins) into these commodities.

42. *GDP at market prices: 1980–1989:* Department of Finance, *Economic Reference Tables,* August 1992, p. 5.

I. Transportation services produced by business for sale (carrier revenues including direct government subsidies)

The table shows revenues for the major categories of carriers. Sales revenues are used as a measure of total resources devoted to producing these transportation services.

Revenues of travel and ticket agents, and of car and truck rental operations, might also be considered for inclusion in a broad measure of transportation. The data on carrier revenues, however, are generally reported before deducting commission charges of agents; thus a considerable portion of agent commissions is already included in carrier revenues. Much of the revenues of car and truck rental operations, which totalled about $3 billion in 1989, will in principle be captured in the estimate of resources devoted to private trucking and car use in components II and III.

II. Transportation services produced by businesses for their own account — excluding business use of cars

Businesses and governments devote substantial "in-house" resources to transportation in addition to being major customers for the services of transportation carriers (the latter purchases are included in component I).

These in-house transportation activities are divided into:

- private trucking;
  - based on published data; and
  - adjustment for incomplete coverage
- own account marine transport;
- own account pipeline use; and
- allowance for business aircraft.

As set out in the note on sources to Table 1(2)-1, some data are available for Canada on the first three categories of own account transportation activity. The reported data seem very likely, however, to underestimate substantially the total resources devoted to private trucking. An allowance for incomplete coverage of private trucking is thus added, which is equal to 1% of GDP for all years. This adds an amount somewhat higher than the published data for expenditures on private trucking in the later years covered by the table; it is believed to be a conservative allowance. Road diesel sales not accounted for in the published statistics on diesel fuel use by for-hire truck, private truck, and bus are roughly equal to the amount that is accounted for by such sales, and are more than twice the level of reported sales to private trucking alone. This suggests that private trucking activity not covered in the official statistics is likely to be larger than private trucking activity which is covered.

There are no comprehensive data on business use of company-owned aircraft. Aviation gasoline sales data coupled with data on fuel consumption by carriers, suggest a substantial level of aviation activity by other than carriers. The allowance made is .1% of GDP, a level somewhat lower than estimates for the United States.

Data on business and government use of cars are not readily available. This category has been dealt with on the basis of overall data on cars, and is included as part of component III.

III. Own account car expenditures

Travel by car is the predominant means of urban and intercity travel in Canada. (As is the practice throughout this report, car refers to both passenger automobiles and light trucks used for passenger transportation purposes.) Data are available for total consumer expenditure on car purchase and operation including maintenance and repairs, fuel, insurance and licence fees. Data are also available which permit estimates of the total value of new car sales, and of gasoline sales.

The residuals, when one deducts the value of car sales (including net sales of used cars) to consumers from the total value of car sales and deducts gasoline sales for car use to consumers from total gasoline sales for car use, provide estimates of business (including car rental operations) and government expenditures on car purchase and fuel. The "residual" for other car operating expenditures is calculated by applying the average ratio of the residual to consumer expenditure for car purchases and fuel purchases, to consumer expenditures for other car operating costs.

The estimates in the table count investment in new cars in the year of purchase, rather than amortizing the price of the car over its life and include an allowance for cost of capital. The latter approach is followed in deriving the cost estimates of car use in Chapter 3 of Volume 1. The two approaches, however, can be expected to produce quite similar results on average although they could diverge substantially in years of cyclically high or low car sales.

No allowance is made in these estimates (or in the cost analysis in Chapter 3 of Volume 1) for any cost of the driver's time.

IV. Government capital and operating expenditures to support transportation

Governments use resources to build and maintain transportation infrastructure including roads and airports, to provide air and marine navigation and traffic control services, and to control and police road traffic.

For purposes of the table, an estimate of total government investment and operating expenditures related to the provision of transportation is required. This estimate is derived using data on total recorded government spending on transportation, plus an estimate of spending on road policing and related government enforcement and safety activities occurring outside of transport departments. Direct government subsidies to transportation carriers are then subtracted from total government expenditure on transportation. (The subsidies have been included in the value of sales of carrier services in component I.) Component IV does not include expenditures by government to purchase or provide transportation for use by government; such expenditures should be covered in components I and III.

Intergovernmental transfers relating to transportation programs are excluded to avoid double counting. The treatment of government transportation investment follows the practice of public accounts, that is, investment is recorded in the year the expenditure is made rather than amortized over the life of the asset as in the cost estimates of Chapter 3 of Volume 1.

The estimates of expenditures in components I to IV involve some double counting that should be eliminated in order to calculate total resources devoted to transportation.

V. Adjustments to eliminate double counting

The charges, fees and special taxes that governments levy on users of some government-provided transportation facilities, and that cover some of the costs of government transportation services (IV), are included in the prices paid for transportation in components I, II and III. Thus, to add total expenditures on transportation in components I, II and III to government transportation expenditures in component IV, would result in double counting. The table subtracts charges, fees and special taxes that governments levy for use of transportation facilities. These are the infrastructure charges and the special transportation taxes and fees discussed in Chapter 3 of Volume 1, and in Notes to Chapter 3 in this Volume. As in Chapter 3, the amounts of provincial gasoline and other motive fuel taxes in excess of standard rates of general provincial sales taxes are considered to be equivalent to user charges for government-provided transportation facilities for purposes of this table.

A second source of double counting arises because the expenditures in components I to IV include, directly and indirectly, some inputs that are already counted in the sales revenues of common carriers (I). For example, the cost of common carrier services (I) and of own account (II and III) activity includes the cost of gasoline and other fuels, some part of which is the cost of transporting the fuel to where it is sold. Such transportation costs for fuel will already be reflected in (freight) carrier sales revenues. The table thus includes an approximate adjustment, based on Statistics Canada Input-Output Accounts data, to eliminate inter-transportation-industry transportation requirements and transportation margins.

Estimated total resources devoted to transportation (VI) are then calculated as the sum of components I through IV, less adjustments to eliminate double counting (V).

Table 1(2)-2 expresses the dollar estimates from Table 1(2)-1 as percentages of GDP. The 15.9% shown for 1989 in the final line of the table is the basis for the statement in Chapter 1 of Volume 1 that resources equal to about 16% of GDP were devoted to all forms of transportation in that year.

The estimation procedures are viewed as adequate to support the conclusion that a substantial portion of the economy's resources is devoted to providing transportation. For several types of carrier, however, the data used in Table 1(2)-1 and Table 1(2)-2 do not cover small operators and thus tend to under-estimate total transportation provided in the sector. The allowances for lack of coverage of much of private trucking, and of own account aircraft operation, are probably on the low side. The approach would need to be refined before the estimates could be used to draw strong conclusions as to changes in the share of resources devoted to transportation over time, or be used to make precise international comparisons.

Table 1(2)-2
Resources Devoted to Transportation as a Percentage of GDP at Market Prices, 1980–1989 (Percent)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
I. Transportation services produced by businesses for sale (carrier revenues including government payments to carriers)										
1. Air	1.3	1.3	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.2
2. Rail	1.7	1.7	1.7	1.7	1.7	1.6	1.5	1.4	1.3	1.1
3. Marine	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
4. Trucking	1.8	1.7	1.6	1.5	1.6	1.7	1.7	1.7	1.6	1.6
5. Intercity bus/ urban transit	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.6	0.7
6. Taxicabs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7. Pipelines	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
8. Total	**6.3**	**6.3**	**6.1**	**6.0**	**5.9**	**6.0**	**5.9**	**5.7**	**5.5**	**5.3**

Table 1(2)-2 (cont'd)

RESOURCES DEVOTED TO TRANSPORTATION AS A PERCENTAGE OF GDP AT MARKET PRICES, 1980–1989 (PERCENT)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
II. Transportation services produced on an own account basis — excluding car										
Private trucking										
9. Based on published data	1.2	1.1	1.1	1.1	0.9	0.9	0.8	0.8	0.8	0.7
10. Adjustment for incomplete coverage	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
11. Private marine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
12. Pipelines — own account	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2
13. Allowance for private air	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14. Total	**2.7**	**2.7**	**2.6**	**2.6**	**2.4**	**2.4**	**2.2**	**2.2**	**2.1**	**2.0**
III. Car — own account										
A. Expenditures on new and used (net) cars										
15. Personal	2.7	2.5	2.1	2.4	2.7	3.2	3.3	3.3	3.3	3.1
16. Residual (business and government)	1.0	0.9	0.7	0.8	1.0	1.2	1.2	1.4	1.3	1.2
17. Subtotal	3.7	3.4	2.7	3.2	3.7	4.3	4.5	4.6	4.6	4.3
B. Expenditures on gasoline										
18. Personal	1.9	2.2	2.3	2.2	2.2	2.2	1.9	1.8	1.7	1.8
19. Residual (business and government)	1.0	1.1	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.5
20. Subtotal	2.9	3.3	3.4	3.3	3.1	3.0	2.6	2.5	2.3	2.3
C. Other expenditures on car operation										
21. Personal	1.6	1.5	1.6	1.6	1.5	1.5	1.7	1.8	1.8	1.8
22. Residual (business and government)	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.7	0.6
23. Subtotal	2.2	2.2	2.3	2.2	2.1	2.1	2.3	2.5	2.5	2.4
24. Total (17+20+23)	**8.8**	**8.9**	**8.4**	**8.7**	**9.0**	**9.5**	**9.4**	**9.6**	**9.4**	**9.0**

Table 1(2)-2 (cont'd)

RESOURCES DEVOTED TO TRANSPORTATION AS A PERCENTAGE OF GDP AT MARKET PRICES, 1980–1989 (PERCENT)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
IV. Government capital and operating expenditures to support transportation										
A. Total transportation expenditures										
25. Federal	0.8	0.6	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.5
26. Provincial/local	2.1	2.1	2.2	2.0	1.8	1.9	1.8	1.7	1.5	1.7
27. Road policing and safety	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
28. Subtotal	3.1	2.8	3.1	2.9	2.8	2.7	2.6	2.5	2.3	2.3
29. Subsidies to common carriers	0.4	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
30. Total (28–29)	**2.6**	**2.3**	**2.6**	**2.4**	**2.4**	**2.3**	**2.2**	**2.0**	**1.9**	**1.9**
V. Deductions to eliminate double counting										
A. Government transportation revenues										
31. Motive fuel taxes	0.6	0.6	0.7	0.7	0.6	0.6	0.7	0.9	0.8	0.8
32. Air transportation tax	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
33. Motor vehicle permits	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
34. Other air revenues	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
35. Subtotal	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.4	1.3	1.2
B. Transport inter-industry requirements and transport margins										
36. Carriers	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.6	0.6
37. Business — own account	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2
38. Consumers — own account	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
39. Subtotal	1.5	1.3	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.2
40. Total deductions (35+39)	**2.5**	**2.4**	**2.3**	**2.3**	**2.3**	**2.4**	**2.5**	**2.7**	**2.6**	**2.4**
VI. Total resources devoted to transportation										
41. Grand total (8+14+24+30–40)	**17.9**	**17.8**	**17.4**	**17.4**	**17.4**	**17.7**	**17.1**	**16.9**	**16.2**	**15.9**

2. Comparison With Resources Devoted to Health Care

The discussion of resources devoted to transportation in Chapter 1 of Volume 1 also notes that resources equal to 9% of GDP were devoted to health care in Canada. Health and Welfare Canada has estimated that total public and private expenditures, on capital and operating costs of hospitals and other health care institutions, on physicians' and other health professionals' services, and on pharmaceuticals, equalled 8.7% of GDP in 1989 and 9.2% in 1990 (Policy, Planning and Information Branch, "Canadian Health Care Expenditures" by source of funds and by category, unpublished tables, March 1992). These appear to be conceptually comparable with the estimates of total resources devoted to transportation in Tables 1(2)-1 and 1(2)-2. Virtually all health care expenditures, however, would be classified as final expenditures in the National Income and Expenditure Accounts, unlike the case for transportation where, especially for freight transportation, a substantial portion would be classified as intermediate (an input into the production of other goods and services).

3. Value Added by Transportation Carriers

As noted, the estimate of total resources devoted to transportation presented in Table 1(2)-1 is a broad measure of the size of transportation in the economy. A very different measure, to which reference is more frequently made, is the "share of transportation industries in GDP." "Transportation industries," as defined by Statistics Canada, are basically the transportation carriers plus industries producing certain related services. The GDP of these industries is the value added by firms in the industries; that is, the value of their sales less the value of goods and services purchased from firms in other industries. This essentially represents the value of their wages, depreciation, interest and profits.

Table 1(2)-3 shows Statistics Canada data on GDP (at factor cost in constant 1986 dollars) in the transportation sector as percentages of total GDP (at factor cost in 1986 dollars). The percentage for total transportation, 4.8% in 1989, is much less than the Table 1(2)-2 estimate for total resources devoted to transportation. The difference reflects both the fact that the latter estimate included own account transportation activity by businesses, governments and, most importantly, consumers in the form of car travel, and the fact that it included total resources used including resources (for example, fuel) purchased from firms in other industries, as well as resources provided directly by transportation firms.

Table 1(2)-3

Gross Domestic Product at Factor Cost for Transportation Industries, 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
I. GDP at factor cost (billions of dollars at 1986 prices)										
Air	2.3	2.2	2.1	2.3	2.6	2.8	2.9	3.0	3.3	3.3
Rail	3.4	3.4	2.7	2.9	3.7	3.7	3.9	4.1	4.3	4.1
Water	1.2	1.1	1.1	1.3	1.3	1.3	1.3	1.4	1.5	1.5
Truck	4.2	4.3	4.2	4.5	5.3	5.3	5.4	6.0	6.4	6.6
Urban transit	1.7	1.8	1.7	1.7	1.5	1.6	1.6	1.5	1.5	1.5
Interurban bus	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Other transport industries[a]	1.7	1.6	1.5	1.8	2.1	2.2	2.2	2.3	2.3	2.3
Total business sector industries	14.6	14.5	13.6	14.8	16.7	17.0	17.5	18.4	19.5	19.5
Pipeline transport	2.0	1.9	1.9	1.9	2.1	2.1	2.1	2.4	2.8	3.0
Non-business sector industries[b]	2.1	2.1	2.0	2.0	2.0	2.1	1.9	2.0	2.0	2.0
Grand total transport	18.8	18.5	17.5	18.6	20.7	21.2	21.6	22.8	24.3	24.5
Total economy	**382.0**	**397.1**	**382.6**	**395.0**	**418.7**	**438.5**	**451.8**	**470.9**	**491.0**	**506.1**

Table 1(2)-3 (cont'd)

GROSS DOMESTIC PRODUCT AT FACTOR COST FOR TRANSPORTATION INDUSTRIES, 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
II. Percentage shares of GDP for the total economy										
Air	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Rail	0.9	0.8	0.7	0.7	0.9	0.8	0.9	0.9	0.9	0.8
Water	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Truck	1.1	1.1	1.1	1.1	1.3	1.2	1.2	1.3	1.3	1.3
Urban transit	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
Interurban bus	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Other transport industries[a]	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total business sector industries	3.8	3.7	3.6	3.7	4.0	3.9	3.9	3.9	4.0	3.9
Pipeline transport	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6
Non-business sector industries[b]	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Grand total transport	**4.9**	**4.7**	**4.6**	**4.7**	**4.9**	**4.8**	**4.8**	**4.8**	**4.9**	**4.8**

Source: Statistics Canada, *CANSIM*, matrix 4671.

a. Other transport industries include taxicab, other transportation, and highway and bridge maintenance industries. This component was calculated residually given the preceding components and the total for business sector industries.

b. Non-business sector industries include establishments, primarily government-owned, which provide services used by transportation carriers, including airport and port operation, and — where carried out by government departments — highway, street and bridge maintenance.

Note: Components may not add exactly to totals due to rounding.

4. ESTIMATE OF RESOURCES DEVOTED TO INTERCITY PASSENGER TRANSPORTATION

Part A of Table 1(2)-4 shows estimates of the intercity passenger transportation share of the total carrier revenues in component I of Table 1(2)-1, and repeats from Table 1(2)-1 the allowance for use of company-owned aircraft — all of which is assumed to be for intercity passenger purposes. Also shown are two estimates of the intercity share of car use. These shares are intended to correspond to a broad definition of intercity car travel — (a) — all car travel on provincial highways, and a narrower definition — (b) — use of highways for trips extending beyond a single metropolitan or urban area.

The share corresponding to the broad definition (a) is defined using the ratio of estimated car vehicle-kilometres on provincial highways to total car vehicle-kilometres from Table 2(2)-A1, in the Annex to Notes to Chapter 2 in this volume. This ratio — 54.2% — is applied to total own account car expenditures (line 24) from Table 1(2)-1. The estimate for the narrower definition (b) is simply two thirds of the broad estimate — the same ratio as used in Notes to Chapter 2 in estimating car passenger-kilometres corresponding to the narrower definition of intercity travel.

Finally, Table 1(2)-4 includes an approximate allowance for the intercity passenger travel share of government transportation expenditures. For the purposes of this table, the estimate of relevant government transportation expenditures is defined using the ratio of non-government expenditures on intercity passenger travel (the sum of lines 5, 6 and 7 in Table 1(2)-4, or of lines 5, 6 and the value corresponding to line 7 for narrow intercity car use) to total non-government expenditures on transportation (the sum of lines 8, 14 and 24 in Table 1(2)-1). This ratio is applied to government capital and operating expenditures to support transportation net of government transportation charges (line 30 less line 35 from Table 1(2)-1).

A more painstaking, although still approximate, allocation of total government transportation expenditures to intercity passenger transportation was used to estimate government infrastructure costs for purposes of the modal cost comparisons in Chapter 3 of Volume 1 (further discussed in Notes to Chapter 3 in this Volume). However, to estimate an approximate overall share of resources devoted to intercity passenger transportation, the above procedure was considered adequate.

Table 1(2)-4

RESOURCES DEVOTED TO INTERCITY PASSENGER TRANSPORTATION, 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
A. $ billions, current dollars										
Carrier intercity passenger services (including government payments to carriers)										
1. Air	3.2	3.8	3.9	3.8	4.2	4.6	5.0	5.3	6.0	6.6
2. Rail	0.6	0.8	0.7	0.8	0.7	0.9	0.8	0.8	0.9	0.8
3. Ferries	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
4. Intercity bus	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
5. Total	**4.3**	**5.1**	**5.1**	**5.1**	**5.4**	**6.0**	**6.3**	**6.7**	**7.5**	**8.0**
6. Allowance for private air	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6
Own account intercity car										
7. Broad measure (a)	14.7	17.3	17.1	19.2	21.6	24.5	25.7	28.6	30.8	31.9
Government capital and operating expenditures to support intercity passenger transportation net of transportation taxes/charges										
8. Corresponding to broad measure of intercity car (a)	1.7	1.6	1.9	1.8	2.1	2.2	1.8	1.4	1.3	1.7
Total expenditures in intercity passenger transportation										
9. Carrier, air, plus broad intercity car (a)	21.1	24.2	24.5	26.6	29.5	33.2	34.3	37.2	40.1	42.2
10. Carrier, air, plus narrow intercity car (b)	15.6	18.0	18.1	19.6	21.6	24.3	25.1	27.2	29.5	31.0
11. GDP at market prices	309.9	356.0	374.4	405.7	444.7	478.0	505.7	551.6	605.9	649.9

Table 1(2)-4 (cont'd)

Resources Devoted to Intercity Passenger Transportation, 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
B. Percentages of GDP at market prices										
Carrier intercity passenger services (including government payments to carriers)										
1. Air	1.0	1.1	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.0
2. Rail	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
3. Ferries	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4. Intercity bus	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
5. Total	**1.4**	**1.4**	**1.4**	**1.3**	**1.2**	**1.3**	**1.2**	**1.2**	**1.2**	**1.2**
6. Allowance for private air	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Own account intercity car										
7. Broad measure (a)	4.8	4.8	4.6	4.7	4.9	5.1	5.1	5.2	5.1	4.9
Government capital and operating expenditures to support intercity passenger transportation net of transportation taxes/charges										
8. Corresponding to broad measure of intercity car (a)	0.6	0.4	0.5	0.5	0.5	0.5	0.4	0.2	0.2	0.3
Total expenditures on intercity passenger transportation										
9. Carrier, air, plus broad intercity car (a)	6.8	6.8	6.5	6.6	6.6	6.9	6.8	6.7	6.6	6.5
10. Carrier, air, plus narrow intercity car (b)	5.0	5.0	4.8	4.8	4.9	5.1	5.0	4.9	4.9	4.8

Notes and Sources to Table 1(2)-4

Carrier intercity passenger services plus car rental

1. **_Air: 1980–1987:_ Unpublished data from Statistics Canada; _1988–1989:_ Statistics Canada, _Canadian Civil Aviation_, Catalogue No. 51-206, Table 3.1.**

2. **_Rail: 1980–1981:_ Statistics Canada, _Railway Transport: Part II, Financial Statistics_, Catalogue No. 52-208, Table 2; _1982–1986:_ Statistics Canada, _Railway Transport in Canada: General Statistics_, Catalogue No. 52-215, Table 2; _1987–1989:_ Unpublished data from Statistics Canada.**
Passenger revenues of VIA Rail and other intercity rail carriers plus VIA Rail operating subsidy from above sources. Adjusted to include government capital grants to VIA Rail, and to assume that ratio of subsidy (including capital grants) for other intercity passenger operations to passenger revenues is the same as for VIA Rail.

3. *Ferries: 1980–1989:* **Unpublished material from Statistics Canada, and carrier annual reports.**
Revenues from transportation of passengers and passenger vehicles, plus a pro rata share of subsidies.

4. *Intercity Bus:* **Where possible, intercity revenues from all sources, and not just intercity bus establishments, have been collected. Intercity data are found in the operating and income accounts of the four types of bus establishment (i.e. Intercity, Urban, School Bus, Other) in Catalogue No. 53-215 from 1980–1989.**

6. *Allowance for private air:* **See text.**

7. *Own account intercity car:* **54.2% of line 24 from Table 1(2)-1. See text.**

Government capital and operating expenditures to support intercity passenger transportation net of transportation taxes/charges

Net government expenditures (i.e. line 30 to line 35 of Table 1(2)-1) times the ratio of intercity private expenditures from Table 1(2)-4 to total private expenditures from Table 1(2)-1. See text.

Part B of Table 1(2)-4 shows the Part A dollar estimates expressed as percentages of GDP. The 1989 shares, rounded, are 5% for the narrower definition of intercity passenger transportation (b) and 7% for the broad definition (a). This is the basis for the percentages in Chapter 1.

An alternative broad estimate of total costs of domestic intercity passenger transportation may be obtained in Table 3-1(b) in Chapter 3. For 1991, this estimate — $43 billion — is 6.4% of GDP. The basis for this alternative estimate differs in a number of respects from that for the estimate in Table 1(2)-4. The alternative includes an estimate of environmental costs associated with intercity passenger transportation, but excludes the costs of international air travel. The alternative uses an annual stream of costs for capital used in transportation by consumers and governments, rather than expenditures on new capital in the year in question.

NOTES TO CHAPTER 2: ESTIMATES OF INTERCITY PASSENGER TRAVEL

INTRODUCTION

In describing the current situation of Canadian domestic intercity passenger transportation, and in briefly putting this situation in historical and international perspective, the text, charts and tables in Chapter 2 of Volume 1 present estimates for a number of aspects of passenger transportation, particularly when comparing the roles of the different means of transportation. In many cases, it is unfortunately not a question of simply reproducing data from official sources. Rather, Royal Commission staff have developed estimates for various aspects of passenger travel from a variety of sources. Development of the estimates often involves making assumptions that are based in part on judgement rather than solid evidence, and may involve a substantial element of approximation. The sections of these Notes to Chapter 2 are intended to set out the bases for the estimates used in Chapter 2, to report the estimates in fuller detail in a number of the cases, and to provide some additional discussion of conclusions to be drawn from the estimates.

Section 1 — Measures of the Shares of Different Means of Transportation in "Intercity Travel" — deals with the estimates of the current (1990) levels of Canadian domestic intercity passenger transportation provided by car, air, bus, train and ferry. The section refers briefly to charter/tour/cruise travel by bus and ship, which are not included in the basic estimates. Annex 1, at the end of these Notes to Chapter 2, provides a fuller explanation and reporting of estimates of total travel and total highway travel, by car.

Section 2 — Estimates of Domestic Intercity Passenger Transportation Modal Shares, 1930–1990 — explains the basis for, and comments on, the historical estimates of passenger-kilometres of domestic intercity travel by car, air, bus and rail for the period from 1930 to 1990.

Section 3 — International Comparisons of Modal Shares in Passenger Transportation — explains the basis for and comments on comparative estimates of distance travelled by car, airplane, bus and train for Canada, the United States, Japan, France, West Germany and the

United Kingdom. These estimates are for total domestic travel, not just domestic intercity travel, as reasonably comparable international information is only available for total domestic travel.

Sections 2 and 3 do not include travel by ferry. While it can be an important link in intercity travel, it generally accounts for only a fraction of 1% of total intercity distance travelled (passenger-kilometres).

Section 4 — Importance of Long and Short Trips in Domestic Intercity Travel — like Section 1, this section deals with current Canadian domestic intercity passenger transportation. It briefly presents some further information on the relative importance in total domestic travel of trips of different lengths.

1. Measures of the Shares of Different Means of Transportation in "Intercity Travel"

Chapter 2 states that Canadians took over 150 million intercity trips in 1990, of which 134 million were in Canada. The chapter mentions the shares of trips and of total distance travelled for which the different means of passenger transportation account. This section provides a more detailed discussion of data on domestic intercity travel and describes the development of estimates of some aspects of intercity travel for which direct data are not available.

Information on the amount of intercity travel by the different means of passenger transportation helps provide a general understanding of the relative roles of the different means, of changes in these roles over time, and of differences across countries in the roles played by the different means. As is often the case with general descriptive statistics, however, a number of somewhat arbitrary choices have to be made regarding the basis on which to assemble the data. It is not always possible to find a single basis that is fully appropriate for the different purposes for which the statistics may be used. As well, basic data on some aspects of intercity travel, especially travel by car, are scarce. While estimates of total travel by each means are provided, in some cases the estimates are no more than informed guesses. They should be viewed as providing an indication of the broad picture, not as precise measures.

"Intercity" travel may be **defined** either in terms of characteristics of the trip, typically trips in excess of a specified length, or in terms of the means of travel used — air, train (or train other than specified commuter trains), intercity bus (as opposed to urban and suburban transit), specified types of ferries, and car travel involving specified classes of roads. The amount of intercity travel by any means of transportation can be **measured** in terms of number of trips, in terms of distance travelled (for example, passenger-kilometres), or conceivably in terms of total spending on travel by the means. With respect to both the definitions and the measures, it is often difficult to find an approach that treats the different means of transportation in a reasonably comparable manner.

There are further definitional issues to be resolved. Should travel include "cruise" or "tour" type trips? The main estimates generally exclude boat cruises, charter bus trips and "tourist trains"; in other words, the focus is on travel whose main purpose is to get from point A to point B. Supplementary information is provided, however, on some elements of cruise travel in subsection 1.5. If one is assembling data on domestic travel, which is the subject of this section, a further issue is the treatment of the domestic portion of international trips.

As discussed in the section entitled "A Data Detour" of *Getting There: The Interim Report of the Royal Commission on National Passenger Transportation* (pages 56–61), there are two basic sources of data on domestic travel in Canada: Statistics Canada's Canadian Travel Survey (CTS), which asks a sample of Canadians about the intercity trips they have taken over the previous three months, and data reported by carriers on passengers carried. For travel by car, the CTS provides some data, but car data that correspond directly to the carrier data for the public means of travel do not exist. For private car use, information on volume of traffic on highways or, failing that, on fuel consumption and on motor vehicle registrations provides a partial parallel to the carrier data for the public means of passenger transportation.

The CTS provides an estimate of domestic (and international) trips taken in excess of 80 kilometres in one-way distance. The trip is identified by the primary means used. Thus, as noted in the Interim Report, a trip from Victoria to Kingston that involves travel by bus and ferry from Victoria to Vancouver, by airplane from Vancouver to Toronto, and by train from Toronto to Kingston would be recorded as one air trip. Estimates are provided of both numbers of trips and total passenger-kilometres travelled.

The estimates of total travel by the different means of transportation are certainly of interest, but they give an incomplete view of intercity travel in Canada for a number of reasons:

- As illustrated by the Victoria to Kingston example, information on the role of any secondary modes used in the course of a trip is not provided.
- Travel within Canada by residents of other countries is not included.
- Respondents to the CTS may fail to recall some trips, especially shorter car and bus trips.
- Finally, information on trips under 80 kilometres in length would be useful for some purposes. Such trips likely account for a significant portion of the business of the ferry and intercity bus industries, some of the business of the passenger rail industry, and a substantial portion of use of highways by cars.

Table 2(2)-1, which is an update of Table III-1 of the Royal Commission's Interim Report, shows 1990 estimates of domestic intercity trips or of passengers carried, and of passenger-kilometres travelled, from the Canadian Travel Survey and from carrier data or other sources. As indicated earlier, the carrier data, and the alternative car passenger-kilometre estimate, are more inclusive. They are attempts to measure all domestic travel excluding travel within a single urban or metropolitan area and short car trips on secondary rural roads.

Table 2(2)-1
INFORMATION ON DOMESTIC INTERCITY TRAVEL
(FROM ALTERNATIVE SOURCES, 1990)

	Car	Air	Intercity bus	Rail (excluding com-muters)	Intercity ferries	Total
I. Trips (one-way) or passengers carried						
CTS-based estimates one-way trips millions	243	13.1	7.5	1.6	0.7	**266[a]**
percentage	91%	5%	3%	1%	0%	**100%**
Carrier-based estimates passengers carried millions	n/a	14.1	18.2	3.8	23.5	**n/a**
II. Passenger-kilometres						
CTS-based estimates billions	56.7	20.8	2.4	0.6	0.2	**80.7**
percentage	70%	26%	3%	1%	0.3%	**100%**
Carrier plus alternative car estimates billions	135	25.0	3.4	1.4	0.8	**166**
percentage	82%	15%	2%	1%	0.5%	**100%**
III. Implicit Average Trip Length						
CTS-based estimates kilometres	234	1,580	325	403	298	**304**
Alternative estimates kilometres	n/a	1,774	187	368	34	**n/a**

a. **This figure is slightly less than twice the estimate of 134 million domestic round trips referred to in Chapter 2. The latter figure includes travel by other and unspecified means.**

1.1 CANADIAN TRAVEL SURVEY ESTIMATES OF TRIPS AND PASSENGER-KILOMETRES

CTS-based estimates of trips are the CTS survey figures for round trips (Statistics Canada, Catalogue No. 87-504) multiplied by two to obtain one-way equivalent figures for comparison with the carrier-based estimates of passengers carried. The CTS-based estimate of passenger-kilometres is taken from unpublished CTS survey results.

1.2 CARRIER-BASED ESTIMATES — PASSENGERS CARRIED

1.2.1 Air

Statistics Canada, *Air Passenger Origin and Destination, Domestic Report 1990,* Catalogue No. 51-204, August 1991, Table 3, reports 13 million domestic origin-destination (O-D) trips in 1990. This report, based on data from the "Scheduled Air Passenger O-D Survey," records the total number of trips flown between city-pairs on a subset of large domestic carriers. Since it only includes passenger trips on the scheduled services of nine major airlines, the report underestimates the number of total trips. Data on domestic charter activity and O-D trips entirely on smaller airlines should also be considered.

Statistics Canada, *Air Charter Statistics 1990,* Catalogue No. 51-207 reports that in 1990 almost 330,000 trips were taken aboard domestic charters.

In addition, Statistics Canada's unpublished "System Passenger Origin and Destination Survey" showed that in 1990 almost 3 million O-D trips were taken on the smaller regional and local air carriers in Canada. Only a portion of these trips, however, can be considered as additional trips since many of these smaller airlines interline with the carriers counted by the "Scheduled Air Passenger O-D Survey." In an interline arrangement, passengers from one carrier transfer to another carrier and continue their journey. For example, a passenger flying First Air from Iqaluit, N.W.T., to Ottawa then transferring to Air Canada in Ottawa and continuing to Toronto would be counted as a Scheduled O-D Survey passenger from Iqaluit to Toronto because the itinerary includes a flight stage aboard Air Canada's system. A passenger flying First Air from Iqaluit to Yellowknife would not appear in the Scheduled Air Passenger O-D Survey but would be counted by the System O-D Survey, which measures the scheduled O-D traffic within route systems of all Levels 2 to 5 airlines. There are no data on how many trips recorded by the Scheduled Air Passenger O-D Survey involve smaller carriers. Following the approach of an unpublished

Statistics Canada study, one quarter of the System O-D trips for carriers not included in the Scheduled O-D Survey are counted as separate trips. This amounted to over 700,000 trips in 1990.

Adding the domestic charter O-D trips and the allowance for trips on smaller carriers to the reported 13 million O-D trips yields an overall estimate of 14.1 million trips.

1.2.2 Intercity Bus

Bus trips for 1990 were estimated by reducing the 1989 passenger level for the intercity passenger bus industry (Statistics Canada, *Passenger Bus and Urban Transit Statistics*, Catalogue No. 53-215) by 7%, the average annual rate at which passengers carried fell between 1984 and 1989. This results in an estimate of 16 million passengers. In addition, bus operators classified as school bus operators, and as charter and sightseeing bus operators also offer some scheduled intercity bus services. Unfortunately, only vehicle-kilometres are recorded for these firms. In order to derive an estimate of passengers carried by these firms, an assumed occupancy rate of 21 passengers per bus was used. Secondly, passengers were assumed to have an average trip length of 100 km — half that estimated for the intercity passenger bus industry. This yields an estimate of 2 million passengers carried on other scheduled services or 14% of the intercity bus industry figure. The overall estimate of intercity bus passengers is 18.2 million.

1.2.3 Rail

The rail passengers figure is the sum of VIA Rail passengers (Statistics Canada, *Rail in Canada 1990*, Catalogue No. 52-216, Figure 3.10), and unpublished statistics for other intercity railways. Commuter services are excluded. In 1990, about 3.8 million passengers were carried, a significant reduction from 1988, reflecting the elimination of about half of the VIA Rail network.

1.2.4 Intercity Ferries

Intercity ferry passengers carried include all domestic passengers on BC Ferries, Marine Atlantic, Northumberland Ferries, other Atlantic region ferries, Ontario Northland, and the longer St. Lawrence River crossings, primarily those of the Société des Traversiers du Québec. Data were obtained either from annual reports or directly from the carriers. In 1990, these services together transported about 23.5 million passengers.

1.3 CARRIER-BASED ESTIMATES — PASSENGER-KILOMETRES

1.3.1 Air

Domestic air passenger-kilometres are taken from Statistics Canada, *Canadian Civil Aviation 1990*, Catalogue No. 51-206, November 1991, Table 2.2. Data include both scheduled and charter domestic passenger-kilometres of Levels 1 to 4.

1.3.2 Intercity Bus

The bus passenger-kilometres figure is an estimate derived using 1989 data on bus-kilometres for intercity passenger bus operators and for other passenger bus operators that offer scheduled intercity services (for example, school bus, and charter and sightseeing establishments), together with an assumed average occupancy rate (passengers per bus). In 1989, intercity services produced almost 170 million bus-kilometres. Assuming an occupancy of 21 passengers per bus,[1] yields an estimate of over 3.5 billion passenger-kilometres. Bus passenger-kilometres have been falling steadily at about 3% per annum since the mid-1980s; the estimate for 1990 is thus about 3.4 billion passenger-kilometres.

1.3.3 Rail

The rail passenger-kilometres figure is the sum of statistics for VIA Rail (Statistics Canada, *Rail in Canada 1990*, Catalogue No. 52-216, Figure 3.10) and unpublished data on the other intercity railways.

Commuter services are again excluded. In 1990, about 1.4 billion passenger-kilometres were recorded, a significant reduction from 1988.

1.3.4 Intercity Ferries

Ferry passenger-kilometres are calculated using the number of passengers carried on each route and an estimate of the average distance sailed on the route. This yields an estimate for 1990 of about 0.8 billion passenger-kilometres.

1.4 ALTERNATIVE ESTIMATE OF CAR PASSENGER-KILOMETRES

The estimate is simply two thirds of the Royal Commission staff estimate of 205 billion passenger-kilometres for total car travel on highways (including use of small vans and light trucks for passenger transportation purposes). The basis for the total highway travel estimate is described in Annex 1. The estimate of total car travel on highways is itself subject to a considerable range of uncertainty, particularly in the assumption as to the average number of people occupying a car during highway travel. Multiplication by the two-thirds factor makes a very rough allowance for the fact that provincial highways that pass through metropolitan areas are often heavily used for urban travel. Thus, a considerable fraction of total highway use consists of trips that are not intercity but are entirely within metropolitan areas.

The carrier and alternative car estimates are considerably higher than the CTS estimates for all modes except air. Because they give a more complete — although in some cases very approximate — view of the role of the different modes, they receive primary emphasis in most of the following sections of these Notes to Chapter 2.

The 70% estimate from the CTS of the share of the car in intercity passenger-kilometres should be considered a minimum estimate. It seems very likely that a larger fraction of car trips than of trips by other modes, especially air, are missed from the survey due to failure of the respondent to recall all trips taken. Further, as noted earlier, for some purposes there is interest in trips under 80 kilometres in one-way distance, of which the car would be expected to have an overwhelming share, followed by bus. The rough alternative estimates of intercity car passenger-kilometres, when combined with the other carrier-based estimates, result in a car share of 82%. The very approximate nature of the allowance for the intercity share of total highway travel is reflected in the reference in the section "How Canadians Travel," in Chapter 2 of Volume 1, to car travel as accounting for "around 80 percent of all domestic intercity passenger-kilometres travelled in Canada."

1.5 TOUR/CRUISE TRAVEL

As noted, Table 2(2)-1 is intended to cover intercity travel, rather than specialized sightseeing tours or cruises. In part this is because sightseeing tours do not generally provide an effective alternative for people whose main objective is to travel from point A to point B. Some bus group charters, however, may be a substitute for use of public carriers. Data on numbers of tour/cruise passengers and passenger-kilometres tend to be even sketchier than other travel data.

The "carrier-based," and presumably the "CTS-based," estimates in Table 2(2)-1 do include domestic air travel by "charter services" — where charter in this case refers to aircraft operators who sell individual seats in an aircraft flying at times specified by the operator. (The table does not include air travel on small chartered aircraft where the aircraft itself is chartered to take the travellers to a destination on a schedule specified by the travellers.)

The carrier-based estimates in Table 2(2)-1 include little if any travel by "tour trains." Until recently, tour trains have generally been confined to short day trips, but with the Rocky Mountaineer service, and potentially other services in the future, this type of train travel may become more important.

The bus and boat estimates are more substantially affected by the treatment of charter/tour/cruise travel. Some charter/tour/cruise travel by bus and boat is presumably included in the CTS-based estimates (the "ferries" heading should read "boat" as far as the CTS estimates are concerned). For bus, as shown later, the number of bus-kilometres of service provided by operators that specialize in charter services is more than one third the level of bus-kilometres in intercity service by intercity bus operators. As charter services almost certainly operate with higher average occupancy rates, in passenger-kilometre terms they may well equal half or more of the scheduled intercity level. The table shows a set of estimates of non-urban charter activity, together with the assumptions on which the estimates are based.

With about 200,000 passengers,[2] cruise ship operations in Canadian waters may well generate revenues of the same order as intercity ferry operations ($300 million a year). The number of cruise passengers is divided about 90% west coast and 10% inland and east coast. The cruise industry includes excursion boats, with no overnight accommodation, and cruise ships. The passenger and rough revenue estimates given earlier, however, do not include day excursion operations.

Cruise, as opposed to excursion, ships are mainly foreign registered (foreign flag), built and crewed. Most of them are operated by foreign companies although some may be under charter to Canadian companies. The Canadian registered ships are the smaller ones and generally sail on the Great Lakes, St. Lawrence and east coast. Recent changes to legislation permit foreign registered ships above 250 berths to engage in international cruise service but reserve to Canadian registry service by vessels of 250 berths or less.

Table 2(2)-2
INTERCITY SCHEDULED AND CHARTER BUS PASSENGER-KILOMETRES ESTIMATE, 1989
(MILLIONS)

Operator	Intercity scheduled service		Charter (non-urban)[a]	
	bus-km	pass-km[b]	bus-km	pass-km[c]
Intercity bus class 1 and 2	156	3,276	20[d]	692
Other passenger bus[e]	6	126	49	1,711
School bus[e]	5	105	[f]	
Intercity bus class 3[g]	2	42		
Total	**169**	**3,549[h]**	**69**	**2,403**

Source: Derived from data from Statistics Canada, *Passenger Bus and Urban Transit Statistics*, Catalogue No. 53-215, 1989.

a. The charter total is reduced by 25% as a rough allowance for local (urban) activity.
b. Assuming an average load of 21 passengers.
c. Assuming an average load of 35 passengers.
d. Calculated from the proportion of charter revenues to unit toll revenues.
e. School busing not included.
f. Although school bus charters do on occasion range beyond the 80 km threshold, this class of operators has been excluded as constituting primarily local activity.
g. Estimated from 1988 data (Class 3 data were dropped in 1989).
h. This figure, reduced by the recent average annual rate of decrease, is the basis for the estimate of 1990 intercity bus passenger-kilometres in Table 2(2)-1.

2. ESTIMATES OF DOMESTIC INTERCITY PASSENGER TRANSPORTATION MODAL SHARES, 1930–1990

Chart 2-5, in Chapter 2, shows rough estimates of the car, bus, rail and air shares, measured in passenger-kilometres, of Canadian intercity transportation over the last 60 years. As discussed in Section 1 of Notes to Chapter 2, the estimate of passenger-kilometres of intercity travel by car is very rough. The widest margins of uncertainty arise due to lack of good information on the average number of persons occupying cars when they are used for intercity travel, and on the fraction of car travel on highways that is intercity in nature. The estimate of passenger-kilometres of intercity travel by bus is also subject to significant uncertainty. Thus Chart 2-5 and the tables in this section only provide a very general indication of past trends — not precise estimates.

2.1 BASIS FOR ESTIMATES

As will be set out in more detail later, reasonably good data on air and rail passenger-kilometres of travel exist for most or all of the historical period under consideration. For car and bus, however, there are no data that directly measure travel. In these latter cases, the extrapolation backwards from the present is based on other statistical series, such as fuel consumption, which shed some light on the way the total amount of travel by these means has changed over time.

2.1.1 Car

The very approximate backwards extrapolation of the level of inter-city car travel in effect makes use of historical data on gasoline sales, estimates of the fraction used in cars, and estimates of average fuel economy, to produce estimates of changes in car vehicle-kilometres. Then, multiplying by an index of assumed occupancy rates provides estimates of changes in passenger-kilometres of travel. The derivation of the estimates for passenger automobiles is set out in more detail later. Component historical series used are shown in Table 2(2)-3. (The explanation is organized in terms of the columns in the table.)

1. Data on sales of gasoline in Canada taxed for use by road motor vehicles are available for the full period covered. For the period 1977 to 1989, however, the source data do not include gasoline sales in Alberta and/or Saskatchewan for years in which no gasoline taxes were levied. The series shown in the table, however, has been adjusted to include an approximate allowance for sales in these provinces over the periods in which taxes were not levied.

2. In the absence of extended Canadian historical data series on the fraction of gasoline sales for use in automobiles, it is assumed that the Canadian fraction changed in proportion to the corresponding fraction for the United States. Data on total gasoline sales for road motor vehicles, and for automobiles, for the United States are available from 1948 to 1990. As well, closely related data are available for earlier years; this allows an approximate series to be produced for the years prior to 1948.

Table 2(2)-3

SERIES USED TO EXTRAPOLATE BACKWARDS THE 1990 ESTIMATE OF AUTOMOBILE PASSENGER-KILOMETRES

Year	(1) Net sales of gasoline for road motor vehicles — Canada (billions of litres)	(2) Auto gasoline sales as share of road gasoline sales — U.S. (%)	(3) Auto fuel efficiency — U.S. (litres/ 100 km/per vehicle)	(4) Index of vehicle-kilometres ((1 × 2) ÷ 3) (1990=100)	(5) Population per registered auto — Canada (persons per car)	(6) Index of occupancy rate — Canada (1990=100)	(7) Index of passenger-kilometres (4 × 6) (1990=100)
1930	2.1	77.2	15.4	5.7	9.6	148.3	8.4
1932	2.1	76.7	15.4	5.6	11.1	148.3	8.3
1934	2.2	76.2	15.4	5.8	11.2	149.7	8.6
1936	2.4	75.7	15.4	6.4	10.5	149.0	9.5
1938	2.9	75.1	15.4	7.5	9.6	148.3	11.2
1940	3.2	74.6	15.4	8.3	9.2	147.0	12.2
1942	2.8	72.9	15.5	7.0	9.6	146.3	10.3
1944	2.6	68.2	15.7	6.1	10.1	147.0	9.0
1946	4.5	73.8	15.8	11.5	10.0	147.7	16.9
1948	5.2	71.0	15.8	12.5	8.6	145.6	18.2
1950	6.3	69.1	15.8	14.9	7.2	143.6	21.4
1952	7.8	70.3	16.1	18.4	6.3	140.3	25.8
1954	9.2	71.3	16.2	21.8	5.6	138.3	30.2
1956	11.2	72.3	16.4	26.5	5.0	136.2	36.1
1958	12.4	73.8	16.5	30.0	4.7	134.2	40.2
1960	13.7	74.2	16.5	33.2	4.4	132.9	44.1
1962	14.8	74.4	16.4	36.2	4.1	131.5	47.6
1964	16.8	74.0	16.5	40.5	3.8	129.5	52.4
1966	19.4	78.5	16.7	49.3	3.7	127.5	62.8
1968	21.6	79.1	17.0	54.4	3.4	125.5	68.2
1970	24.1	79.2	17.4	59.1	3.2	122.8	72.5
1972	26.9	79.0	17.6	65.2	2.9	120.1	78.4
1974	30.3	77.8	17.5	72.5	2.6	116.8	84.6
1976	32.4	75.9	17.4	76.3	2.6	112.8	86.0
1978	34.7	72.8	16.8	81.2	2.4	109.4	88.8
1980	35.7	71.0	15.2	89.9	2.3	107.4	96.5
1982	31.2	71.1	14.1	84.6	2.3	106.0	89.7
1984	30.4	67.8	13.2	84.0	2.3	104.0	87.3
1986	30.5	66.7	12.9	85.2	2.2	104.0	88.6
1988	32.1	65.5	11.8	95.6	2.1	102.0	97.5
1990	31.8	65.7	11.2	100.0	2.1	100.0	100.0

Sources: *Fuel sales — Canada:* 1930–1944: Dominion Bureau of Statistics, *Highway and the Motor Vehicle in Canada*, Catalogue No. 53-201, 1938 and 1944 editions. 1945–1955: D.B.S., *Motor Vehicle*, Catalogue No. 53-203, 1950 and 1955 editions. 1956–1990: Statistics Canada, *Road Motor Vehicles — Fuel Sales*, Catalogue No. 53-218, various issues.

Auto gasoline share and fuel efficiency — U.S.: 1936–1985: Federal Highway Administration, *Highway Statistics, Summary to 1985*, p. 9 and pp. 229–32. 1986–1990: FHWA, *Highway Statistics*, 1987–1990 editions, Tables MF–21A and VM–1.

Vehicle registrations — Canada: 1930–1975: Statistics Canada, *Historical Statistics of Canada*, 2nd ed., ed. F. H. Leacy (Ottawa: Supply and Services Canada, 1983), Series T147–T150. 1976–1990: Statistics Canada, *Road Motor Vehicle — Registrations*, Catalogue No. 53-219, various issue years.

Population — Canada: 1930–1990: Statistics Canada, *Canadian Economic Observer, Historical Statistical Supplement 1990/1991*, Catalogue No. 11-210, July 1991, pp. 96–97.

Occupancy rate: Royal Commission staff estimates.

3. In the absence of extended Canadian historical data series on average fuel economy for passenger automobiles, it is also assumed that average fuel economy in Canada varied in line with fuel economy in the United States. Data were available from 1936 to 1990 for the United States; the 1936 value was assumed to apply from 1930 to 1935.

   In deriving an estimate of the change over time in intercity vehicle-kilometres, it would be desirable also to allow for any change in the intercity share of total car travel. There are no directly relevant data for Canada or the United States. U.S. data, however, show an approximately constant share for vehicle-miles on interstate highways and main rural roads relative to total automobile vehicle-miles. The estimate makes no allowance for any possible change in the share of intercity driving in total car travel.

4. Column 4 is the product of columns 1 and 2, divided by column 3, and indexed to 1990. It shows automobile vehicle-kilometres over this period.

5. and 6.

   There is also little direct information on average occupancy, but there is reason to believe that the average occupancy rate has fallen as car ownership has become more widespread. Canadian data do exist on the ratio of car passengers to car drivers killed in car accidents for the period 1942 to the present. This ratio has declined fairly steadily since 1942, suggesting that the average occupancy ratio has also declined. While the ratio of car occupant fatalities to car driver fatalities is not necessarily a good indicator of the average level of car occupancy, it seems reasonable to assume that, over time, these two series would tend to move in step. The automobile passenger-kilometre estimates assume that, over the historical period, the occupancy rate maintained a constant proportionate relation to the ratio of total passenger and driver fatalities to driver fatalities. A simple statistical relation between the occupancy rate from car fatalities and the ratio of population to registered automobiles was estimated for the period from 1942 to 1990. Together with information on the ratio of population to registered automobiles for the full historical period (column 5), this was used to create an occupancy index (column 6) for the full historical period.

7. Multiplying the index of vehicle-kilometres (column 4) by the index of occupancy rates provides an overall index of automobile passenger-kilometres. Given the further assumption of no change in the ratio of intercity automobile travel to total automobile travel, this is also an index of intercity passenger-kilometres. Column 7 shows this overall index with 1990 = 100 as the base value.

The overall index in column 7 is used to extrapolate backwards from the estimated level of intercity automobile travel for 1990 (Annex 1) to produce the very rough historical estimates of intercity automobile passenger-kilometres in Table 2(2)-5. A parallel approach is used to extrapolate backwards from the 1990 estimate of intercity passenger travel in light trucks. Again, U.S. data are used to provide indexes of changes in the share of gasoline consumed by light trucks, and of changes in light-truck fuel economy. A number of additional adjustments were made to the published U.S. historical series to produce the estimate for light trucks shown in Table 2(2)-5.

2.1.2 Bus

Intercity bus passenger-kilometres were extrapolated backwards from 1990 using the series shown in Table 2(2)-4.

Table 2(2)-4

SERIES USED TO EXTRAPOLATE BACKWARDS THE 1990 ESTIMATE OF INTERCITY BUS PASSENGER-KILOMETRES

Year	(1) Bus-km (millions)	(2) Average bus capacity (seats)	(3) Index of bus pass-km (1990=100)
1930			8.1
1932			6.9
1934			7.5
1936			10.3
1938			9.4
1940			16.9
1942	82.4	24.6	31.7
1944	84.3	24.9	32.8
1946	136.9	26.9	57.6
1948	173.3	29.1	78.9
1950	168.2	29.4	77.3
1952	165.7	30.3	78.4
1954	150.4	31.2	73.2
1956	142.7	32.7	72.9
1958	130.2	34.3	69.7
1960	137.9	34.9	75.2
1962	142.6	36.3	80.9
1964	148.0	36.8	85.0
1966	170.3	38.1	101.4
1968	177.7	38.7	107.4
1970	173.3	39.3	106.3
1972	172.7	39.5	106.7
1974	172.1	39.8	107.1
1976	181.4	40.1	113.7
1978	189.7	40.4	119.7
1980	201.5	40.7	128.1
1982	196.0	41.0	125.4
1984	180.3	41.3	116.2
1986	172.2	41.6	111.8
1988	156.8	41.9	102.5
1990	152.4	42.0	100.0

Sources: *Bus-km and capacity to 1970:* 1941–1955: Dominion Bureau of Statistics, *Motor Carriers — Freight — Passenger,* Catalogue No. 53-D-20. 1956–1970: Statistics Canada, *Passenger Bus Statistics,* Catalogue No. 53-215. 1974–1989: Statistics Canada, *Passenger Bus and Urban Transit Statistics,* Catalogue No. 53-215.

Notes: Index for 1930–1940 based on linkage to statistics compiled by Gordon D. Campbell, "An Analysis of Highway Finance and Road User Imposts in Canada," (Ph.D. thesis, Purdue University, 1956), Table 32, p. 258.

A constant load factor of 50% of average capacity was assumed throughout the period.

1. Published data on vehicle-kilometres by buses operated by the intercity bus industry were available for the period 1941 to 1990. Data are available for bus operators with annual revenues in excess of $20,000 for years up to 1970 and for bus operators with annual revenues in excess of $100,000 for 1974 and later years.

   These two series were used without adjustment, in spite of the reduction in coverage at the time of the shift from $20,000 to $100,000 and in spite of the tendency to relative underestimation for the earlier years in each series. Due to inflation, the exclusion of operators with revenues under $20,000 or $100,000 presumably involves the exclusion of relatively more, and relatively larger, operators in the early years of the series than in the later years. As data were not published for 1972, the figure for that year is the average of the 1970 and 1974 values.

   No allowance is made for any possible change in the relative importance of scheduled intercity bus service provided by school and charter bus operators not classified in the intercity bus industry. As indicated in Section 1 of these Notes to Chapter 2, in 1990 such operators were estimated to provide 7% of total intercity bus passenger-kilometres.

2. The size of the average bus has tended to become larger over the historical period. Column 2 shows a rough estimate of the average size of intercity buses in use. This was derived from information on the number of buses by number of seats, which is available for certain years over the period.

3. The index of changes in the amount of bus travel (column 3) is the product of columns 1 and 2, with 1990 = 100 as the base. It is assumed that average occupancy as a percent of seating capacity has remained constant over the period (50%).

For the years from 1930 to 1940, for which there are no published data on intercity bus vehicle-kilometres, the index has been extrapolated backwards from 1941 on the basis of estimates of intercity bus passenger-kilometres in a study by Gordon Campbell.[3]

The resulting index for 1930 to 1990 is applied to the 1990 estimate of intercity bus passenger-kilometres (Table 2(2)-1) to produce the rough historical estimate of intercity bus passenger-kilometres in Table 2(2)-5.

2.1.3 Air

Published passenger-kilometre data are available for domestic scheduled air services for the years 1936 to 1990. These data were adjusted by adding an estimate of passenger-kilometres on domestic charter services to produce the series in Table 2(2)-5. Estimated passenger-kilometres on domestic charter services were equal to 8%, on average, of total domestic passenger-kilometres from 1964 to 1990.

Published data on total passenger-kilometres provided by Canadian air carriers are available for 1930 to 1935; the domestic portion was assumed to be equal to 85% for this period based on the portion in the immediately following years.

2.1.4 Rail

Published data exist on total rail passenger-kilometres back to 1910. Unpublished data from Statistics Canada on passenger-kilometres on commuter services from 1970 onwards were used to produce estimates of intercity rail passenger-kilometres. The commuter share pre-1970 was assumed to equal the 9% average share of the early 1970s.

2.2 SUMMARY TABLES ON INTERCITY PASSENGER TRAVEL

The estimates of passenger-kilometres of domestic intercity travel by the different means of intercity passenger transportation, derived as discussed earlier, are presented in Table 2(2)-5. The next three tables present the same information in alternative forms to facilitate various types of analysis. Table 2(2)-6 shows the average annual growth rates for the series by decade and for certain longer intervals. Table 2(2)-7 expresses the estimates as percentage shares of total domestic intercity travel; these percentage shares are also displayed in Chart 2-5 of Chapter 2, Volume 1. Table 2(2)-8 presents the estimates in terms of passenger-kilometres of travel per capita. This per capita table is intended to provide an impression of changes in amount of travel abstracting from overall growth in population. The per capita figures — that is, the estimates of total amounts of domestic intercity travel in Table 2(2)-5 divided by total population — obviously are not estimates of total annual travel or the change in total annual travel, by the average **user** of the mode in question. Only a fraction of the population uses any given mode and this fraction has almost certainly changed substantially over the historical period considered, although there are few direct data on this point. The fraction of the population using the air mode in a year will have risen very substantially. The fraction using cars for intercity travel probably rose somewhat, especially over the first three or four decades of the period; the fraction using intercity rail has almost certainly declined substantially since World War II; and the fraction using intercity bus may well have declined since the 1950s.

Given the very rough nature of the estimates of intercity travel by car and bus, the tables only serve to provide a general sense of the trends in intercity travel over time. They do, however, provide an adequate basis for the following general observations:

- Car travel already accounted for a large share of intercity travel by the 1930s. The absolute amount of car travel, and even more so its share of total travel, fell during World War II. Presumably this was primarily a result of the rationing of gasoline and the fact that the government used rail and bus for very large movements of military personnel. Car rapidly returned to a dominant position after the war, and its share appears to have been relatively stable since — possibly increasing modestly into the 1960s and then declining modestly over the last two decades as air travel has increased dramatically.

Table 2(2)-5
Domestic Intercity Travel in Canada, 1930–1990
(Billions of passenger-kilometres)

Year	"Car" Total	Auto.	Light trucks/ vans	Sched./ charter air	Intercity rail	Intercity bus	Total intercity travel
1930	10.2	9.7	0.5	0.007	3.3	0.4	13.9
1932	10.1	9.6	0.5	0.004	2.0	0.3	12.4
1934	10.5	10.0	0.5	0.009	2.1	0.3	13.0
1936	11.7	11.1	0.6	0.012	2.4	0.5	14.5
1938	13.7	13.0	0.7	0.014	2.4	0.4	16.5
1940	15.0	14.2	0.8	0.059	3.0	0.8	18.8
1942	12.6	11.9	0.7	0.104	6.8	1.1	20.6
1944	11.2	10.4	0.8	0.2	9.4	1.1	21.9
1946	20.8	19.6	1.2	0.3	6.4	2.0	29.3
1948	22.5	21.1	1.5	0.4	4.8	2.7	30.4
1950	26.7	24.9	1.9	0.6	3.8	2.6	33.8
1952	32.1	29.9	2.2	0.9	4.3	2.7	40.0
1954	37.5	34.9	2.6	1.2	3.9	2.5	45.1
1956	44.9	41.8	3.0	1.6	4.0	2.5	52.9
1958	49.8	46.6	3.2	2.0	3.4	2.4	57.5
1960	54.7	51.1	3.6	2.7	3.1	2.6	63.0
1962	59.0	55.2	3.9	3.4	2.8	2.8	68.0
1964	65.7	60.8	5.0	3.7	3.7	2.9	76.0
1966	77.4	72.8	4.6	5.1	3.5	3.4	89.5
1968	84.2	79.1	5.1	6.5	3.5	3.7	97.8
1970	90.1	84.1	6.0	8.8	3.1	3.6	105.7
1972	98.3	90.9	7.5	9.9	2.8	3.6	114.6
1974	107.6	98.1	9.5	13.9	2.5	3.6	127.6
1976	110.8	99.7	11.2	14.5	2.4	3.9	131.6
1978	116.3	102.9	13.4	16.3	2.5	4.1	139.2
1980	127.5	111.9	15.7	21.0	2.7	4.4	155.5
1982	118.5	103.9	14.6	18.9	2.1	4.3	143.8
1984	117.1	101.2	15.8	19.4	2.3	4.0	142.8
1986	119.2	102.7	16.4	21.9	2.2	3.8	147.0
1988	131.6	113.0	18.6	24.6	2.3	3.5	162.0
1990	135.0	115.9	19.1	25.0	1.4	3.4	164.8

Sources: *Car and light truck:* Index of automobile passenger-kilometres (Table 2(2)-3) applied to 1990 level from Annex 1. Similar approach for light trucks. See subsection 2.1.1 of text.

Air: 1930: *Canada Year Book 1931,* p. 698. 1931–1935: *Canada Year Book 1936,* p. 702. 1936–1945: M. C. Urquhart and K. Buckley, *Historical Statistics of Canada,* 1st ed. (Toronto: Macmillan, 1965), p. 551, Series 241. 1946–1975: Statistics Canada, *Historical Statistics of Canada,* 2nd ed., ed. F. H. Leacy (Ottawa: Supply and Services Canada, 1983), series T200. 1976–1987: Statistics Canada, *Air Carrier Operations in Canada,* Catalogue No. 51-002, October–December issues. 1988–1990: Statistics Canada, *Canadian Civil Aviation,* Catalogue No. 51-206, Table 2.3, and text.

Total rail passenger-kilometres: 1930–1945: M. C. Urquhart and K. Buckley, *Historical Statistics of Canada*, 1st ed. (Toronto: Macmillan, 1965), p. 535, Series 118. 1946–1975: Statistics Canada, *Historical Statistics of Canada*, 2nd ed., ed. F. H. Leacy (Ottawa: Supply and Services Canada, 1983), series T45. 1976–1987: Statistics Canada, *Rail in Canada 1987*, Catalogue No. 52-216, November 1989, p. 32. 1988–1990: Statistics Canada, *Rail in Canada 1990*, Catalogue No. 52-216, July 1992, Figure 1.6.

Intercity rail passenger-kilometres: 1970–1981: Statistics Canada, *Railway Transport: Part IV, Operating and Traffic Statistics*, Catalogue No. 52-210, Table 1. 1982–1990: Unpublished data from Transportation Division, Statistics Canada, and text.

Bus: See Table 2(2)-4 and text.

Note: Due to rounding, components may not total exactly.

Table 2(2)-6
Average Annual Growth Rates per Decade and for Longer Periods — Domestic Intercity Travel in Canada, 1930–1990
(percent per annum)

	"Car"						
	Auto.	Light trucks/ vans	"Car" subtotal	Sched./ charter air	Intercity rail	Intercity bus	Total intercity travel
1930–1940	3.9	4.9	3.9	23.1	–1.1	7.6	3.1
1940–1950	5.8	8.9	6.0	26.4	2.6	13.0	6.1
1950–1960	7.5	6.7	7.4	15.9	–2.2	–0.3	6.4
1960–1970	5.1	5.4	5.1	12.6	0.0	3.5	5.3
1970–1980	2.9	10.0	3.5	9.0	–1.4	1.9	3.9
1980–1990	0.4	2.0	0.6	1.8	–6.3	–2.4	0.6
1930–1960	5.7	6.8	5.8	21.7	–0.2	6.6	5.2
1960–1990	2.8	5.7	3.1	7.7	–2.6	1.0	3.3
1930–1990	4.2	6.3	4.4	14.5	–1.4	3.8	4.2

Source: Table 2(2)-5.

Table 2(2)-7

DOMESTIC INTERCITY TRAVEL IN CANADA, 1930–1990

(PERCENTAGE SHARES OF TOTAL PASSENGER-KILOMETRES)

	"Car"						
	Auto. (%)	Light trucks/ vans (%)	"Car" subtotal (%)	Sched./ charter air (%)	Intercity rail (%)	Intercity bus (%)	Total intercity travel (%)
1930	69.9	3.6	73.4	0.05	23.8	2.7	100.0
1932	77.5	4.0	81.6	0.03	15.8	2.5	100.0
1934	77.1	4.1	81.2	0.07	16.1	2.6	100.0
1936	76.3	4.1	80.4	0.08	16.3	3.3	100.0
1938	78.3	4.3	82.6	0.08	14.7	2.6	100.0
1940	75.5	4.3	79.7	0.3	15.8	4.1	100.0
1942	57.8	3.5	61.2	0.5	33.0	5.2	100.0
1944	47.7	3.5	51.2	0.7	43.0	5.1	100.0
1946	66.8	3.9	70.8	0.9	21.7	6.7	100.0
1948	69.4	4.8	74.2	1.4	15.6	8.8	100.0
1950	73.5	5.6	79.0	1.8	11.4	7.8	100.0
1952	74.8	5.6	80.3	2.2	10.8	6.7	100.0
1954	77.5	5.7	83.2	2.6	8.7	5.5	100.0
1956	79.1	5.7	84.8	3.0	7.5	4.7	100.0
1958	81.0	5.5	86.5	3.5	5.9	4.1	100.0
1960	81.1	5.7	86.7	4.3	4.9	4.1	100.0
1962	81.2	5.7	86.9	5.0	4.1	4.0	100.0
1964	80.0	6.5	86.5	4.8	4.8	3.8	100.0
1966	81.4	5.1	86.5	5.7	4.0	3.9	100.0
1968	80.8	5.2	86.1	6.6	3.6	3.7	100.0
1970	79.5	5.7	85.3	8.4	2.9	3.4	100.0
1972	79.3	6.5	85.8	8.6	2.4	3.2	100.0
1974	76.9	7.5	84.3	10.9	1.9	2.9	100.0
1976	75.7	8.5	84.2	11.0	1.8	2.9	100.0
1978	74.0	9.6	83.6	11.7	1.8	2.9	100.0
1980	71.9	10.1	82.0	13.5	1.7	2.8	100.0
1982	72.3	10.1	82.4	13.2	1.5	3.0	100.0
1984	70.9	11.1	82.0	13.6	1.6	2.8	100.0
1986	69.9	11.2	81.0	14.9	1.5	2.6	100.0
1988	69.8	11.5	81.2	15.2	1.4	2.2	100.0
1990	70.3	11.6	81.9	15.2	0.8	2.1	100.0

Source: Table 2(2)-5.

Table 2(2)-8
Domestic Intercity Travel per Capita in Canada, 1930–1990
(passenger-kilometres per person)

	"Car"							
	Auto.	Light trucks/ vans	"Car" subtotal	Sched./ charter air	Intercity rail	Intercity bus	Total intercity travel	Population ('000s)
1930	952	48	1,000	0.7	324	37	1,362	10,208
1932	914	47	961	0.4	187	30	1,178	10,510
1934	932	49	981	0.8	195	32	1,209	10,741
1936	1,010	54	1,064	1.1	215	43	1,324	10,950
1938	1,162	64	1,226	1.2	219	39	1,484	11,152
1940	1,246	70	1,316	5	261	68	1,651	11,381
1942	1,023	61	1,085	9	585	92	1,771	11,654
1944	873	63	936	13	786	93	1,830	11,946
1946	1,596	94	1,690	21	517	159	2,387	12,292
1948	1,644	114	1,758	33	371	209	2,370	12,823
1950	1,813	137	1,949	45	281	192	2,467	13,712
1952	2,068	154	2,221	62	298	184	2,765	14,459
1954	2,286	168	2,454	76	256	163	2,949	15,287
1956	2,601	189	2,790	97	247	154	3,288	16,081
1958	2,728	186	2,914	117	199	139	3,369	17,080
1960	2,859	201	3,060	151	173	143	3,527	17,870
1962	2,968	208	3,177	184	148	148	3,657	18,583
1964	3,151	257	3,407	190	190	150	3,937	19,291
1966	3,637	229	3,866	254	177	172	4,469	20,015
1968	3,819	248	4,067	313	169	176	4,725	20,701
1970	3,948	284	4,232	415	146	170	4,963	21,297
1972	4,167	342	4,509	454	127	166	5,256	21,802
1974	4,386	426	4,812	621	111	163	5,706	22,364
1976	4,334	486	4,820	632	102	168	5,722	22,993
1978	4,377	571	4,947	693	105	173	5,918	23,517
1980	4,653	652	5,305	872	112	181	6,470	24,043
1982	4,228	594	4,822	770	86	174	5,851	24,583
1984	4,052	634	4,686	778	94	158	5,716	24,978
1986	4,052	648	4,700	862	88	150	5,800	25,353
1988	4,363	717	5,080	951	87	135	6,252	25,909
1990	4,357	718	5,075	940	53	128	6,195	26,603

Source: Table 2(2)-5.

- Rail was the dominant intercity public carrier in the 1930s, although it was almost certainly much less important than private use of car even then. During World War II, rail's share may have approached the share of the car, but by the 1950s rail's share was almost certainly below its share in the 1930s, and by the 1960s air had overtaken rail as the public carrier with the largest share of domestic passenger-kilometres. Rail's share fell below that of intercity bus by the 1970s, and has continued to decline with a further sharp drop in 1990 reflecting the reductions in VIA Rail routes. The level of rail passenger-kilometres has shown a declining trend throughout the post-war period.
- Domestic intercity travel by air has grown in a manner typical of a successful new technology (or series of new technologies). It showed high growth rates from a very small base in the early decades and growth rates only moderately higher than the growth of intercity travel as a whole in the most recent period.
- Abstracting from the bulge in domestic intercity bus travel during the special conditions of World War II, the bus share in domestic intercity travel appears to have increased substantially from the 1930s to around 1950. The share has subsequently displayed a downward trend, although the rate of decline has been more gradual than for the rail share. For the 1950s through the 1970s, the decline in the bus share reflected slower growth in travel by intercity bus than in total intercity travel, rather than an absolute decline in the amount of bus travel. During the 1980s, however, there was a decline in total bus passenger-kilometres.
- The total and per capita amounts of domestic intercity travel, taking all modes together, have increased very substantially over the last 60 years — more than quadrupling in per capita terms according to the estimates used here. The increase in per capita travel, however, appears to have slowed markedly in recent years.

2.3 EARLIER ESTIMATE OF HISTORICAL TRENDS IN INTERCITY PASSENGER-KILOMETRE SHARES

A set of reasonably comprehensive estimates of intercity modal shares is contained in *Canadian Transportation Economics* by A. W. Currie, published in 1967. These estimates apparently apply to a definition of intercity travel that is similar to that which underlies the estimates presented in these Notes. Little detail on methodology or data sources is provided. Table 2(2)-9 compares Currie's estimates of intercity modal shares with those in Table 2(2)-7.

Table 2(2)-9
Comparison of Estimates of Historical Modal Shares in Domestic Intercity Travel (Passenger-Kilometres)

	Currie	Table 2(2)-7	Currie	Table 2(2)-7	Currie	Table 2(2)-7	Currie	Table 2(2)-7
Year	**1928**	**1930**	**1951**	**1952**	**1957**	**1958**	**1964**	**1964**
Car	60	73	72	80	83	86	85	86
Airplane	—	—	3	2	4	4	5	5
Bus	2	3	11	7	5	4	5	4
Train	38	24	15	11	8	6	5	5

Sources: A.W. Currie, *Canadian Transportation Economics* (Toronto: University of Toronto Press, 1967), p. 299 and Table 2(2)-7.

The two sets of estimates show broadly similar trends, although Currie does estimate a smaller share for car and a higher share for rail, with the differences relative to the estimates developed here diminishing from the 1930s through the 1960s. Given the lack of information on Currie's assumptions, it is not possible to identify the source of the differences. It is possible that the assumption used here, that the intercity share in total car travel was approximately constant over the period at the 1990 level, results in an upward bias in the estimates of the car share for the earlier part of the period. This assumption does receive some support from the fact that U.S. data show little change in the ratio of car travel on highways to total car travel over the historical period considered. It is quite possible, however, especially given the rather rudimentary state of the intercity highway network in much of Canada prior to the 1950s, that use of cars for intercity travel, as a fraction of total car travel, in fact increased over the first three decades of the period covered by our historical estimates. If so, the share of car travel in the estimates in this section is somewhat high for those decades and especially at the beginning of the period.

3. International Comparisons of Modal Shares in Passenger Transportation

Chart 2-6 and Table 2-2 in Chapter 2 of Volume 1 present approximate comparisons of the shares of car, bus, train and airplane in total domestic travel by these means for Canada, the United States, Japan, France, West Germany, Italy and the United Kingdom for selected years from 1965 to 1988. The comparative material is used to draw general conclusions as to the prevalence of the dominant role of the car, of the decline in the share of train, and of the rise in the share of air travel in countries whose geography is such that airplanes are attractive as a means of domestic travel.

The footnotes to Table 2-2 warn the reader that the data presented may not be fully comparable across the countries, and thus that small differences in the shares of a mode between two countries may reflect differences in definitions or in data estimation procedures rather than genuine differences in travel patterns. Further, while for purposes of this Royal Commission it would have been preferable to compare shares in domestic intercity travel, reasonably comparable data are only available for total domestic travel, which is the total of urban commuting, other short urban and rural trips, and intercity travel. Thus, the table and chart deal with total domestic travel by these modes. The chief difficulty in measuring domestic intercity travel is to identify the intercity portion of car travel; there is also a grey area in the definition and measurement of urban or rural travel versus intercity travel by bus and train. In Sections 1 and 2 of these Notes to Chapter 2, the rough assumption is made that intercity car travel amounts to two thirds of total car travel on provincial highways. It was judged, however, that there was not sufficient information to make even a rough assumption for the non-North American countries.

This section first sets out the data sources and, where necessary, the assumptions used in developing the estimates. It then briefly discusses the overall results and provides some supplementary information.

3.1 THE ESTIMATES

3.1.1 Canada

Car

The estimates for car (passenger automobiles plus light trucks used for passenger transportation purposes) are based on the estimate for 1990 of total passenger-kilometres of travel by car in Annex 1, Table 2(2)-A1. This estimate is extrapolated backwards using the index of total intercity travel in Table 2(2)-3.

That index was constructed for use as an index of total car travel; it was used earlier as an index of intercity travel by car, given the assumption that the intercity share of total car travel has been constant over time.

Urban and Intercity Bus

An estimate of urban bus travel was added to the estimate of passenger-kilometres of intercity bus travel (Table 2(2)-5). Data on vehicle-kilometres of travel by urban buses are available in Statistics Canada's *Urban Transit,* Catalogue No. 53-216, for 1965 and 1970, and *Passenger Bus and Urban Transit Statistics,* Catalogue No. 53-215, for the later years.

For urban buses, an average occupancy rate of 25% was assumed — approximately the same average occupancy rate as is implicit in the U.S. estimates of urban bus passenger-kilometres. Allowing for some increase in the size of an average bus, this implied an average number of passengers per urban bus of 10.5 in 1965, rising to 12 by 1988.

Note that urban rail transit — subways, light rail systems — have been excluded because of difficulties in obtaining data on rail transit systems for some countries. Obviously, for purposes of comparing total travel, it would be preferable to include this means of transportation. The concluding discussion will refer to supplementary data for certain countries.

Intercity and Commuter Rail

This series includes all train travel for intercity and commuter purposes; it thus includes the separate commuter train systems in Toronto and Montreal. The data for 1965 through 1975 are from Statistics Canada, *Historical Statistics of Canada*, 2nd edition, edited by F. H. Leacy, Supply and Services Canada, Ottawa, 1983, series T45, and for the later years are from Statistics Canada, *Rail in Canada*, 1987, Catalogue No. 52-216.

Domestic Scheduled Air

To enhance international comparability, the data on domestic air in Canada and the other countries are taken from a common source — the International Civil Aviation Organization (ICAO). For 1965 and 1970, they are available in the United Nations *Statistical Yearbook*, 1970, and for the later years are available in ICAO, *Civil Aviation Statistics of the World*, using the latest editions in which data for the year in question are shown. The ICAO data for Canada are slightly lower than the series shown in Table 2(2)-5, because the ICAO does not include data on small airlines.

3.1.2 United States

Car

Estimates of total vehicle-kilometres of travel by passenger automobiles and light trucks in the United States are made by the U.S. Federal Highways Administration (FHWA), and published in U.S. Department of Transportation, FHWA, *Highway Statistics* (for 1988), and *Summary to 1985* (for 1985 and earlier years). Average occupancy rates for passenger automobiles of 2.1 for 1965, 2.0 for 1970, 1.9 for 1975, 1.8 for 1980, 1.7 for 1985, and 1.5 for 1988 have been used. (Estimates from U.S. Nationwide Personal Transportation Study in U.S. Department of Transportation, *National Transportation Statistics*, July 1990.) For light trucks, occupancy of 1.3 was assumed for all years.

Bus

Estimates of intercity bus passenger-kilometres are available for all the years of interest (ENO Foundation, *Transportation in America*, 8th edition, 1990). Estimates of urban bus passenger-kilometres are available for 1980 and later years (U.S. Department of Transportation, *National Transportation Statistics, 1988*, for 1988; and American Public Transit Association, *Transit Fact Book*, 1988 edition, for 1980 and 1985). Urban bus passenger-kilometres were extrapolated to earlier years using data on number of passengers (APTA, *Transit Fact Book*).

Intercity and Commuter Rail

Estimates of rail passenger-kilometres were taken from the ENO Foundation's *Transportation in America*, 8th edition, 1990.

Air

ICAO data, sources as for Canada.

3.1.3 Japan

Car

Japanese official statistics contain estimates of car travel based on a sample survey of vehicle users. The data for 1965 through 1980 were taken from *Historical Statistics of Japan,* 1987, Vol. 2, Chapter 8, and for later years from the *Japan Statistical Yearbook,* 1991, Chapter 8.

Bus

Data on passenger-kilometres are published in the same sources used for car; they are derived from a Ministry of Transport survey of bus operators.

Rail

Passenger-kilometres of travel are measured directly and published in the same sources as the car data.

Air

ICAO data, sources as for Canada.

3.1.4 France, West Germany, Italy and the United Kingdom

Car

Data on passenger-kilometres of travel within the country's territory by vehicles registered in the country are published in European Conference of Ministers of Transport, *Statistical Trends in Transport 1965–1988,* Paris, 1992, page 51. The definition of "car" is believed to be similar to that for Canada and the United States, that is, to include passenger automobiles, vans and light trucks used for passenger transportation.

Bus

Same source as for cars (page 52). The average occupancy rates for bus differ sharply among the European countries, ranging from 11 in the United Kingdom to 20 in France. Given the lack of good data on bus occupancy and on bus passenger-kilometres, in most countries, it may be appropriate to treat these passenger-kilometre estimates with some caution.

Rail

Same source as for cars (page 31). The data refer to all traffic (both residents and non-residents) on the national rail networks of the countries in question. Independent urban railways, and some other small railways, are not included.

Air

ICAO data, sources as for Canada.

3.2 SUMMARY TABLES AND GENERAL OBSERVATIONS

Estimates of passenger-kilometres for the different means of transportation are shown in Table 2(2)-10. Table 2(2)-11 shows these same data expressed as modal shares for each country (this table is included as Table 2-2 in Volume 1, and was the basis for Chart 2-6). Table 2(2)-12 shows the data in per capita terms. Overall generalizations regarding the dominant role of the car, the declining role of rail, and the increasing role of air have already been noted. Certain further points may be mentioned, some of which also draw on supplementary data available for some of the countries.

Car

In terms of per capita travel by car, by air, and in total, Canada occupies an intermediate position between the United States, and western Europe and Japan.

Table 2(2)-10

DOMESTIC PASSENGER-KILOMETRES TRAVELLED BY EACH MODE, SELECTED COUNTRIES, 1965–1988 (BILLIONS OF PASSENGER-KILOMETRES)

Year	1965	1970	1975	1980	1985	1988
1. Car (autos, light trucks, and vans)						
Canada	198.2	253.9	300.9	337.9	310.7	341.3
United States	2,619.1	3,208.5	3,581.5	3,828.8	4,229.3	4,600.6
Japan	54.6	211.6	264.5	328.3	398.0	556.0
France	198.0	304.7	374.8	452.5	494.4	554.3
West Germany	262.5	349.6	403.3	466.5	475.8	550.5
Italy	81.2	211.9	279.3	324.0	373.7	465.4
United Kingdom	199.0	263.0	294.0	361.0	402.7	471.3
2. Urban and intercity bus						
Canada	6.2	7.2	8.4	10.4	10.5	10.5
United States	74.2	71.8	72.3	80.1	74.1	73.2
Japan	83.9	100.8	98.7	108.8	102.0	109.0
France	25.3	25.2	28.9	38.0	37.0	43.2
West Germany	39.4	48.6	58.7	65.6	54.0	53.2
Italy	28.6	32.5	42.8	58.2	66.7	77.2
United Kingdom	59.0	53.0	55.0	45.0	42.0	41.0
3. Intercity and commuter rail						
Canada	4.3	3.7	2.9	3.3	3.0	3.2
United States	28.3	17.5	16.3	17.7	18.2	20.3
Japan	258.7	290.0	319.6	316.2	334.7	368.8
France	38.3	41.0	50.7	54.7	62.1	63.3
West Germany	39.7	38.5	38.6	40.5	42.7	41.0
Italy	26.5	32.5	36.3	39.6	37.4	43.3
United Kingdom	30.1	30.4	30.3	30.3	29.7	34.3
4. Air (domestic scheduled services)						
Canada	4.2	8.0	13.9	19.9	18.7	22.2
United States	93.6	171.8	218.6	326.4	424.3	521.3
Japan	3.6	8.4	18.0	29.0	32.8	39.5
France	0.8	2.6	6.0	8.2	11.3	15.8
West Germany	0.4	1.1	1.6	2.1	2.4	2.8
Italy	0.6	1.4	2.2	2.9	4.7	5.3
United Kingdom	1.8	2.1	2.1	2.7	3.4	4.4
5. Total						
Canada	212.9	272.8	326.1	371.5	342.9	378.7
United States	2,815.3	3,469.7	3,888.6	4,253.1	4,745.9	5,215.4
Japan	400.9	610.9	700.7	782.2	867.6	1,073.3
France	262.4	373.5	460.4	553.3	604.8	676.6
West Germany	341.9	437.8	502.1	574.7	574.9	647.5
Italy	136.9	278.3	360.6	424.7	482.5	591.3
United Kingdom	289.9	348.5	381.4	439.0	477.8	551.0

Royal Commission staff calculations based on data from Statistics Canada, the European Conference of Ministers of Transport (ECMT), and a number of U.S. and Japanese sources; see text.

Table 2(2)-11
MODAL SHARES OF TOTAL DOMESTIC PASSENGER TRAVEL IN PASSENGER-KILOMETRES, SELECTED COUNTRIES, 1965–1988
(PERCENT)

Year	1965	1970	1975	1980	1985	1988
1. Car (autos, light trucks, and vans)						
Canada	93	93	92	91	91	90
United States	93	92	92	90	89	88
Japan	14	35	38	42	46	52
France	75	82	81	82	82	82
West Germany	77	80	80	81	83	85
Italy	59	76	77	76	77	79
United Kingdom	69	75	77	82	84	86
2. Intercity bus and urban transit						
Canada	3	3	3	3	3	3
United States	3	2	2	2	2	1
Japan	21	17	14	14	12	10
France	10	7	6	7	6	6
West Germany	12	11	12	11	9	8
Italy	21	12	12	14	14	13
United Kingdom	20	15	14	10	9	7
3. Intercity and commuter rail						
Canada	2	1	1	1	1	1
United States	1	1	**	**	**	**
Japan	65	47	46	40	39	34
France	15	11	11	10	10	9
West Germany	12	9	8	7	7	6
Italy	19	12	10	9	8	7
United Kingdom	10	9	8	7	6	6
4. Air (domestic scheduled services)						
Canada	2	3	4	5	5	6
United States	3	5	6	8	9	10
Japan	1	1	3	4	4	4
France	**	1	1	1	2	2
West Germany	**	**	**	**	**	**
Italy	**	1	1	1	1	1
United Kingdom	1	1	1	1	1	1

Source: Table 2(2)-10.

** **indicates a share of less than 0.5%.**

Table 2(2)-12

DOMESTIC TRAVEL BY MODE, PER CAPITA, 1965–1988

(THOUSANDS OF PASSENGER-KILOMETRES PER CAPITA)

Year	1965	1970	1975	1980	1985	1988
1. Car (autos, light trucks, and vans)						
Canada	10.1	11.9	13.3	14.1	12.3	13.2
United States	13.5	15.6	16.6	16.8	17.7	18.8
Japan	0.6	2.0	2.4	2.8	3.3	4.5
France	4.1	6.0	7.1	8.4	9.0	9.9
West Germany	4.5	5.8	6.5	7.6	7.8	9.0
Italy	1.6	3.9	5.0	5.7	6.5	8.1
United Kingdom	3.7	4.7	5.3	6.4	7.1	8.3
2. Urban and intercity bus						
Canada	0.32	0.34	0.37	0.43	0.42	0.40
United States	0.38	0.35	0.33	0.35	0.31	0.30
Japan	0.85	0.97	0.88	0.93	0.84	0.89
France	0.52	0.50	0.55	0.71	0.67	0.77
West Germany	0.67	0.80	0.95	1.07	0.88	0.87
Italy	0.55	0.60	0.77	1.03	1.17	1.34
United Kingdom	1.09	0.96	0.98	0.80	0.74	0.72
3. Intercity and commuter rail						
Canada	0.22	0.17	0.13	0.14	0.12	0.12
United States	0.15	0.09	0.08	0.08	0.08	0.08
Japan	2.63	2.80	2.85	2.70	2.77	3.00
France	0.79	0.81	0.96	1.01	1.13	1.13
West Germany	0.68	0.63	0.62	0.66	0.70	0.67
Italy	0.51	0.60	0.65	0.70	0.65	0.75
United Kingdom	0.56	0.55	0.54	0.54	0.52	0.60
4. Air (domestic scheduled services)						
Canada	0.21	0.38	0.61	0.83	0.74	0.86
United States	0.48	0.84	1.01	1.43	1.78	2.13
Japan	0.04	0.08	0.16	0.25	0.27	0.32
France	0.02	0.05	0.11	0.15	0.21	0.28
West Germany	0.01	0.02	0.03	0.03	0.04	0.05
Italy	0.01	0.03	0.04	0.05	0.08	0.09
United Kingdom	0.03	0.04	0.04	0.05	0.06	0.08
5. Total						
Canada	10.8	12.8	14.4	15.4	13.6	14.6
United States	14.5	16.9	18.0	18.7	19.9	21.3
Japan	4.1	5.9	6.3	6.7	7.2	8.7
France	5.4	7.4	8.7	10.3	11.0	12.1
West Germany	5.8	7.2	8.1	9.3	9.4	10.5
Italy	2.6	5.2	6.5	7.5	8.4	10.3
United Kingdom	5.3	6.3	6.8	7.8	8.4	9.7

Table 2(2)-12 (cont'd)
DOMESTIC TRAVEL BY MODE, PER CAPITA, 1965–1988
(THOUSANDS OF PASSENGER-KILOMETRES PER CAPITA)

Year	1965	1970	1975	1980	1985	1988
Population (thousands)						
Canada	19,644	21,297	22,697	24,043	25,165	25,909
United States	194,303	205,052	215,973	227,722	238,492	245,057
Japan	98,275	103,720	111,940	117,060	121,049	122,783
France	48,758	50,772	52,705	53,880	55,170	55,884
West Germany	58,619	60,651	61,829	61,566	61,024	61,418
Italy	51,987	53,661	55,830	56,434	57,141	57,452
United Kingdom	54,218	55,421	55,901	56,330	56,618	57,065

Source: Table 2(2)-10.

Estimated car travel per capita is substantially higher in the United States than in Canada (18,800 pass-km as compared with 13,200 pass-km, in 1988). However, per capita travel by all means in the United States exceeds per capita travel in Canada by an even larger proportional amount; thus the share of car travel in Canada is slightly higher than in the United States in recent years (90% versus 88%, in 1988). While the error range in the car figures is such that one cannot be certain that the Canadian car share really is slightly larger, it seems likely that this is the case. This is the counterpart of the fact that the U.S. domestic air travel share is clearly very much larger than in Canada.

As noted in Chapter 2, Volume 1, the car share in the western European countries is now approaching the share in North America, but the dominant position of the car is much more recent in western Europe. Japan has the smallest car share, but it is growing rapidly and surpassed rail in the 1980s.

Bus

The larger share of bus in Canada than in the United States appears to be due mainly to a larger share of urban bus travel. Intercity bus travel is estimated to account for 0.9% of total domestic travel in

Canada compared with 0.7% in the United States in 1988. (Estimated intercity bus passenger-kilometres per capita are actually slightly higher in the United States (150 pass-km) than in Canada (135 pass-km), although this difference is probably within the error margins of the estimates.) However, using similar bus occupancy assumptions for the two countries, the estimated share of urban bus passenger-kilometres in total travel for Canada is more than twice the share for the United States (1.9% versus 0.7%), and per capita urban bus passenger-kilometres are about 75% higher (270 pass-km versus 150 pass-km). There is reason to believe that Canadian urban bus average occupancy ratio may be substantially higher than U.S. occupancy.[4] If this is the case, the Canadian bus share could be one percentage point or more higher, and of course the contrast with the United States would be even more striking.

Inclusion of estimates of passenger-kilometres for subway and light rail system travel in the urban transit estimates does not change the conclusion that there is much greater use of urban transit in Canada than in the United States. Again, in the absence of official estimates of occupancy rates (or of passenger-kilometres) for Canada, occupancy rates in Canada equal to those implied in U.S. passenger-kilometre data are assumed and applied to Canadian subway and light rail vehicle-kilometre data (Statistics Canada, *Passenger Bus and Urban Transit Statistics,* Catalogue No. 53-215). This yields an estimate of 3.7 billion pass-km of subway/light rail travel for Canada, or roughly half the urban bus passenger-kilometre estimate of 7 billion in 1988. In the United States, subway and light rail passenger-kilometres of 18.9 billion are also equal to roughly half the 36 billion U.S. urban bus passenger-kilometres.

In the United Kingdom, subway and light rail passenger-kilometres are estimated to equal 16% of total bus passenger-kilometres, or 1.2% of total domestic passenger-kilometres (U.K. Department of Transport, *Transport Statistics Great Britain 1979–1989,* London, HMSO, 1990). If this figure is typical of the other western European countries, it suggests that exclusion of subway and light rail urban transit from the tables, while a significant omission in terms of covering the role of urban public transit, does not result in any very significant distortion of the estimated share of the car in total domestic travel.

Train

While train travel has decreased substantially as a share of total travel in all the countries considered, there are also major differences in its role among the countries. Whether considered in terms of share, or in passenger-kilometres per capita, train is clearly much more important in Japan than in the other countries. It is somewhat more important in France than in West Germany, Italy or the United Kingdom. In turn, train travel is several times as important in these west European countries as in Canada and, in 1988, was 50% higher — in passenger-kilometres per capita — in Canada than in the United States. Commuter rail accounts for somewhat more than half of the U.S. rail passenger-kilometres in these estimates (45 pass-km compared with 37 pass-km for intercity rail in 1988). In 1988, commuter rail passenger-kilometres in Canada were 22 per capita, while after the VIA Rail cuts intercity rail in Canada is estimated to be 52 passenger-kilometres per capita.

Air

The differences among countries in air travel's share of total domestic travel appear to reflect, most importantly, differences in geography — with air travel having higher shares in the less compact countries. Including international air travel provides a useful additional perspective on the role of air. Table 2(2)-13 repeats, for 1988, the estimates of domestic scheduled air passenger-kilometres in total and in per capita terms, and the domestic modal shares from Tables 2(2)-10 to 2(2)-12. It also shows ICAO data on international air travel, both scheduled and non-scheduled ("charter"), and the sum of domestic and international air travel. The international air travel passenger-kilometres are added to total domestic passenger-kilometres for all modes to produce an "alternative" measure of total travel. Finally, modal shares are shown using the same passenger-kilometre estimates as in the earlier tables for car, bus and train, the sum of domestic and international travel for air, and expressing the modal figures as percentages of the alternative measure of total travel (including air).

Table 2(2)-13

IMPACT OF INCLUDING INTERNATIONAL AIR TRAVEL WITH DOMESTIC TRAVEL, 1988

	Canada	U.S.	Japan	France	Germany	Italy	U.K.
Air travel (billions of passenger-kilometres)							
Domestic scheduled (Table 2(2)-11)	22.2	521.3	39.5	15.8	2.8	5.3	4.4
International scheduled	24.0	153.3	44.6	32.0	31.3	13.9	78.6
International non-scheduled	8.1	8.1	0.3	0.2	0.1	0.8	34.5
Total air travel	**54.4**	**682.7**	**84.4**	**48.0**	**34.2**	**19.9**	**117.6**
Total domestic travel (Table 2(2)-11)	378.2	5,215.4	1,073.3	676.6	647.5	591.3	551.0
Alternative total travel[a]	410.4	5,376.8	1,118.2	708.8	678.8	605.9	664.2
Air travel per capita (thousands of pass-km per person)							
Domestic scheduled (Table 2(2)-11)	0.86	2.13	0.32	0.28	0.05	0.09	0.08
International scheduled	0.93	0.63	0.36	0.57	0.51	0.24	1.38
International non-scheduled	0.31	0.03	0.00	0.00	0.00	0.01	0.61
Total air travel	**2.10**	**2.79**	**0.69**	**0.86**	**0.56**	**0.35**	**2.06**
Total domestic travel (Table 2(2)-11)	14.6	21.3	8.7	12.1	10.5	10.3	9.7
Alternative total travel[a]	15.8	21.9	9.1	12.7	11.1	10.5	11.6
Shares of Total Travel (percent)							
Excluding international air (Table 2(2)-11)							
Car	90	88	52	82	85	79	86
Bus	3	1	10	6	8	13	7
Rail	1	**	34	9	6	7	6
Air	6	10	4	2	**	1	1
Including international air							
Car	83	86	50	78	81	77	71
Bus	3	1	10	6	8	13	6
Rail	1	**	33	9	6	7	5
Air	13	13	8	7	5	3	18

Sources: Tables 2(2)-10 to 2(2)-12 and ICAO data.

** **indicates a share of less than 0.5%.**

a. **domestic for all modes plus international air.**

The international air travel data are not for travel by residents of the countries in question, but rather are for international travel provided by carriers that are resident in the country in question. These data only provide a reasonable approximation of international air travel by residents of the country if international air travel services provided to residents by foreign carriers approximately equal international air travel services provided to non-residents by carriers of the country. For most of the countries shown, net exports or imports of passenger air services are believed to be relatively small compared with total international air travel by residents. It may be the case, however, that net exports of air services result in the figure for the United Kingdom giving a somewhat exaggerated impression of international air travel by U.K. residents, and that net imports of air services result in the figure for Italy being an underestimate of international air travel by residents of Italy. Nevertheless, for the countries shown, the estimates of international air travel provided by carriers of the country give an approximate impression of international air travel by residents of the country.

The United States has, by a substantial margin, the highest levels of domestic air travel in terms of passenger-kilometres per capita and in terms of percentage share of total domestic travel. But in per capita terms it has a lower level of international air travel than the United Kingdom or Canada, and a similar level to France and West Germany. The United States has the highest level of total air travel per capita, but Canada and the United Kingdom are not too far behind.

Inclusion of international air travel in total travel of course reduces the shares of all the other modes. Whereas, when only domestic travel was considered (Table 2(2)-11), car travel was estimated to account for a slightly larger share of total travel in Canada than in the United States; car accounts for a somewhat smaller share of total travel in Canada than in the United States if international air travel is included in the total.

4. Importance of Long and Short Trips in Domestic Intercity Travel

Chart 2-2 in Chapter 2, Volume 1, shows the number of trips in Canada in 1990 by categories of one-way distance from 80–159 kilometres to over 1,600 kilometres, as reported in the Canadian Travel Survey (CTS). Chapter 2 mentions that, in 1990, 76% of intercity trips taken were between 80 and 320 kilometres in one-way distance, but also notes that trips over 320 kilometres in one-way distance accounted for more than 60% of intercity passenger-kilometres travelled.

This brief note provides estimates that compare the shares in number of trips, and in passenger-kilometres, for trips in the different length categories (Table 2(2)-14). Both the shares of trips, and the shares of passenger-kilometres, are based on Canadian Travel Survey data for 1990. Calculation of the shares of passenger-kilometres requires use of unpublished data from the survey on average trip length in the different length categories. Estimates of both types of share are of course subject to the limitations of the CTS data discussed in Section 1 of these notes; in particular it is quite possible that recall problems by respondents result in some relative underestimation of shorter trips.

The total number of trips, and total passenger-kilometres of travel, are consistent with the numbers reported in the "CTS-based" estimates in Table 2(2)-1, allowing for the fact that Table 2(2)-1 counts one-way trips while Table 2(2)-14 (and Chart 2-2) count round trips, and for the fact that Table 2(2)-1 excludes trips by means other than car, air, bus, rail and ferries.

Longer trips of course account for a much larger share of total passenger-kilometres than of numbers of trips. In particular, trips over 800 kilometres in one-way distance account for 39.2% of passenger-kilometres but only 6.3% of total trips, and trips over 1,600 kilometres in one-way distance account for 26.5% of passenger-kilometres of intercity travel but only 2.6% of the number of trips.

Table 2(2)-14

DOMESTIC INTERCITY TRAVEL BY LENGTH OF TRIP, 1990

(SHARES IN NUMBER OF PERSON-TRIPS AND IN PASSENGER-KILOMETRES OF TRAVEL)

	Person-trips		Average round-trip distance	Passenger-kilometres	
	('000s)	(%)	(km)	(millions)	(%)
Trips — one-way distance					
80–159 km	62,278	46.5	219	13,650	16.8
160–319 km	39,587	29.6	427	16,897	20.8
320–799 km	20,420	15.3	930	18,984	23.3
800–1,599 km	4,954	3.7	2,079	10,297	12.7
1,600–3,199 km	2,192	1.6	4,299	9,424	11.6
3,200 km or more	1,401	1.0	8,656	12,127	14.9
Not stated	2,999	2.2			
Total	133,831	100.0	608	81,375	100.0

Source: **Statistics Canada, *Touriscope: Domestic Travel 1990*, Catalogue No. 87-504, October 1991, p. 27, and unpublished Canadian Travel Survey data.**

Note: **Component percentage shares may not sum exactly to 100% due to rounding.**

ENDNOTES

1. The occupancy rate is based on information from D. Ward's *Profile of the Intercity Bus Industry* (Transport Canada, May 1990), p. 5, and material provided to the Royal Commission by several large intercity bus firms. Ward judges typical occupancies to be about 18 passengers per bus in Canada, but, based on the occupancies recorded by the large firms, we judge that a somewhat higher assumption is appropriate. In our estimate, the system average number of passengers has been assumed to be 21, which is an occupancy rate of 50% or an average of 42 seats per bus.

2. Derived from Dennis Ward, "The Cruise Industry," Transport Canada, TP9163, April 1988. The estimate in this source of 157,000 passengers for 1987 is extrapolated forward at a 4% annual growth rate, and an allowance of 20,000 for inland waters cruise passengers is added.

3. Gordon D. Campbell, "An Analysis of Highway Finance and Road User Imposts in Canada," (Ph.D. thesis, Purdue University, Lafayette, Indiana, 1956).

4. Personal communication with officials of the Canadian Urban Transit Association.

ANNEX 1

CAR TRAVEL — TOTAL AND HIGHWAY

No direct data on total vehicle-kilometres or passenger-kilometres of travel by car exist, but approximate estimates of vehicle-kilometres may be derived in two ways:

- using statistics on sales of gasoline for road use coupled with estimates of average fuel consumption per kilometre; or
- using statistics on the total stock of passenger motor vehicles coupled with estimates of average annual distance travelled per vehicle.

Using both approaches, this Annex first develops estimates of vehicle-kilometres of travel for both "passenger automobiles" and for "light trucks" (four-wheel vehicles, other than passenger automobiles, under 4,500 kg in laden weight, such as, pickups, minivans and 4-wheel drive vehicles) used for passenger transport. Separate data on the amount of travel on provincial highways by these classes of vehicle are then considered. Finally, assumptions as to the number of occupants per vehicle are introduced in order to arrive at rough estimates of the number of passenger-kilometres of travel by car in total and on highways.

A1.1 TOTAL TRAVEL — VEHICLE-KILOMETRES

Gasoline Sales Plus Fuel Economy

Sales of gasoline taxed for use in road motor vehicles totalled 31.8 billion litres in 1990 (Statistics Canada, *Road Motor Vehicles — Fuel Sales, 1990*, Catalogue No. 53-218). Unpublished National Energy Board studies for the mid-1980s suggest that 65% of sales are for passenger automobiles, with the remainder being consumed in other vehicles, such as light trucks, non-diesel heavier trucks and buses, and motorcycles. Fragmentary evidence suggests that about 80% of this remaining 35% of sales, or 8.9 billion litres, is for light trucks.

Statistics Canada's *Fuel Consumption Survey*, Catalogue No. 53-226, which was last conducted for 1988, provides what are believed to be quite reliable estimates of average fuel economy for passenger automobiles and light trucks for the period covered by the survey. These estimates are 12.0 litres per 100 kilometres for passenger automobiles in 1988, and 16.6 litres per 100 km for light trucks in 1987. While there may have been some improvement in average fuel economy since 1988, these estimates are used. Applied to the gasoline sales estimates, they suggest total travel in 1990 of 172.5 billion vehicle-kilometres for passenger automobiles, and 55 billion vehicle-kilometres for light trucks.

Stock of Cars Plus Average Annual Use

Personal-use passenger automobiles sampled by the Fuel Consumption Survey were driven an average of 17,400 kilometres in 1988, while light trucks were driven an average of 18,200 kilometres. The stock of vehicles to which these average distances should be applied is less than the figures appearing in Statistics Canada's *Road Motor Vehicles — Registrations* (Catalogue No. 53-219). During sampling for the fuel consumption surveys it was found, for 1983, that about 8% of registered passenger automobiles had been scrapped, 2% of registrations were duplications, and another 10% were in existence and operable but out of service in dealers' hands, in storage or under repair.[1] Passenger automobile registrations for 1990 were 12.6 million. Applying the estimate of average annual kilometres driven (17,400 for passenger automobiles) to 80% of the registrations level (or 10.1 million vehicles) suggests 175.6 billion vehicle-kilometres of travel by passenger automobiles in 1990, compared with the estimate of 172.5 billion vehicle-kilometres derived using gasoline sales. A rounded estimate of 175 billion vehicle-kilometres of travel for 1990 is used.

Motor vehicle registration figures are believed to include most light trucks, as defined earlier, in the "trucks" sub-category of "commercial

1. E. Lawrence, *Fuel Consumption Data Book*, Technical Memorandum TMSE 9102, Transport Canada, March 1991, pp. 111–15.

vehicles." There were 3.9 million "trucks" registered in 1990, of which 500,000 are estimated to be heavy trucks,[2] suggesting 3,400,000 light trucks. Assuming that, as for passenger automobiles, the number of light trucks in use is only about 80% of the number of light truck registrations, suggests that the 18,200 average annual kilometres of use figures should be applied to about 2,700,000 light trucks in use, yielding an estimate of 49 billion vehicle-kilometres. This compares with the estimate of 55 billion vehicle-kilometres derived using fuel sales data. A rounded estimate of 50 billion vehicle-kilometres for 1990 is used. Further, it is assumed that 80% of this amount, or 40 billion vehicle-kilometres, were for private passenger transport, with the remainder for freight use.

A1.2 HIGHWAY TRAVEL — VEHICLE-KILOMETRES

The estimates are based on the study for the Royal Commission by Nix, Boucher and Hutchinson in Volume 4 of this Report, which uses provincial highway traffic count data. With the modification discussed in Notes to Chapter 3, subsection 5.1.1 of this Volume, it is estimated that travel on provincial highways by passenger automobiles was about 97.5 billion vehicle-kilometres in 1990 and 100 billion vehicle-kilometres in 1991. Travel by light trucks in use for passenger transportation purposes is estimated to be 19 billion vehicle-kilometres in 1990 and 20 billion in 1991.

A1.3 PASSENGER-KILOMETRES OF TRAVEL

There is very little information on the average number of occupants per passenger automobile or light truck overall or in different types of use. Estimates for the United States from the Nationwide Personal Transportation Survey (NPTS) indicate an overall occupancy rate of 1.5 for 1990, with average occupancy ranging from 1.1 for work trips, through 1.5 for shopping trips, 1.7 for other family/personal trips, to 1.8 for social/recreational trips. Canadian vehicle ownership per

2. See Appendix A of Fred P. Nix, Michel Boucher and Bruce Hutchinson, "Road Costs," in Volume 4 of this Report.

capita or per household is somewhat lower than in the United States, and it is reasonable to assume that average occupancy is somewhat higher. Average occupancies for passenger automobiles of 1.8 persons in highway driving, and 1.5 persons in other (primarily urban) driving, are assumed. For light trucks, given the predominance of pickup trucks with fewer seats than cars, average highway occupancy of 1.5 persons and average other occupancy of 1.2 are assumed.

These occupancy assumptions, when combined with the vehicle-kilometre estimates, yield the estimates of passenger-kilometres of highway and total travel in 1990 shown in Table 2(2)-A1.

Table 2(2)-A1
ESTIMATES OF VEHICLE- AND PASSENGER-KILOMETRES: CAR, 1990

	Veh-km (billion)	Pass-km (billion)
Passenger automobile		
Highway	97.5	176
Other	77.5	116
Total	175	292
Light truck in passenger transportation use		
Highway	19	29
Other	21	25
Total	40	54
Both ("car")		
Highway	116.5	205
Other	98.5	141
Total	215	346

These estimates are used as the basis for a number of other estimates in Sections 1, 2 and 3 of the Notes to Chapter 2. In Section 1, two thirds of the highway total of 205 billion passenger-kilometres, or a rounded 135 billion passenger-kilometres, is used as a rough estimate of intercity car travel. In Chapter 3 of Volume 1, 210 billion passenger-kilometres is shown as the estimate of total passenger-kilometres of car highway travel for 1991. In Section 3, the 346 billion estimate of total car travel for 1990 (rounded to 350 billion) is used in calculating the 1988 Canadian figure for the international comparison of total travel by the different means of transportation.

NOTES TO CHAPTER 3: COSTING METHODOLOGY AND DERIVATION OF COST ESTIMATES

INTRODUCTION

Chapter 3 presents estimates of Canadian (average and total) domestic intercity passenger modal costs and average modal costs for four illustrative routes. Chapter 18 includes projections of system total and illustrative route-specific average costs to the year 2000.

These modal estimates encompass:

- infrastructure;
- environmental costs;
- accident costs;
- transportation taxes and fees; and
- vehicle and carrier operations.

The cost estimates are split into the portion of the cost paid by the users or travellers and the portion of average cost paid by the taxpayer, by other travellers on other routes and by society in other than financial terms, for example, through suffering the effects of pollution.

1. UNDERSTANDING THE TABLES

The tables in Volume 1, Chapters 3 and 18 are intended to portray the costs of domestic passenger transportation in Canada including environmental and accident "costs," currently borne by the public, and the cost and financial implications, to users and taxpayers, of the Royal Commission's recommendations. Table 3(2)-1 reproduces the illustrative system-average costs from Table 3-1 of Volume 1.

To help the reader understand what the estimates in Table 3(2)-1 cover, Table 3(2)-2 provides a hypothetical expansion of the portion of a table showing results for a particular means of travel. This table could illustrate average costs per passenger-kilometre, total costs in millions of dollars, or current and projected costs per trip on a specific route. It could apply to the 1991 cost estimates of Volume 1, Chapter 3 or it could apply to the scenario projections of Volume 1, Chapter 18. The numbers used have no significance; they are intended purely to help explain the meaning of the table components.

Table 3(2)-1

Illustrative System-Wide Average Annual Costs of Intercity Domestic Travel (cents per passenger-kilometre)

	Car			Bus		
Type of cost	**Users**	**Others**	**Total**	**Users**	**Others**	**Total**
Infrastructure	0.0	2.1	2.1	0.0	0.3	0.3
Environmental	0.0	0.6	0.6	0.0	0.2	0.2
Accident	3.7	0.1	3.8	0.4	0.0	0.4
Special trans. tax/fee	1.2	–1.2	0.0	0.3	–0.3	0.0
Vehicle/Carrier	10.9	0.0	10.9	8.4	0.2	8.6
Total	**15.8**	**1.6**	**17.4**	**9.1**	**0.4**	**9.5**
	Airplane			**Train**		
Type of cost	**Users**	**Others**	**Total**	**Users**	**Others**	**Total**
Infrastructure	2.2	3.4	5.6	2.9	0.0	2.9
Environmental	0.0	1.0	1.0	0.0	0.6	0.6
Accident	0.1	0.0	0.1	0.2	0.0	0.2
Special trans. tax/fee	0.6	–0.6	0.0	0.4	–0.4	0.0
Vehicle/Carrier	14.4	0.0	14.4	7.4	32.8	40.2
Total	**17.3**	**3.8**	**21.1**	**10.9**	**33.0**	**43.9**
	Ferry			**All intercity travel**		
Type of cost	**Users**	**Others**	**Total**	**Users**	**Others**	**Total**
Infrastructure	0.0	4.7	4.7	0.2	2.2	2.4
Environmental	0.0	2.0	2.0	0.0	0.6	0.6
Accident	0.1	0.0	0.1	3.3	0.1	3.4
Special trans. tax/fee	0.9	–0.9	0.0	1.1	–1.1	0.0
Vehicle/Carrier	24.1	11.6	35.7	11.2	0.2	11.4
Total	**25.1**	**17.4**	**42.5**	**15.8**	**2.0**	**17.8**

Note: **In order to illustrate smaller components, averages are shown to the nearest tenth of a cent. In general, cost estimates are approximate and are not accurate to this level of precision. See text.**

Table 3(2)-2
COST TABLES ILLUSTRATION: HYPOTHETICAL EXAMPLE
(DOLLARS)

Type of Cost	Costs borne by:					Total costs
	Users	Others				
		Travellers	Government		Public	
			Federal	Provincial		
Infrastructure						
Links	25		–6			19
Terminals	15		3			18
Control			2			2
Environmental					24	24
Accident	4			1		5
Special trans. tax/fee						
Fuel taxes	16		–9	–7		0
Licence fees	1		–1			0
Vehicle/Carrier	333	–35		3		301
Total	**394**	**–35**	**–11**	**–3**	**24**	**369**

The key element of the sample expansion is the column "others," which identifies four categories of cost sustainers and funds providers or recipients: travellers, federal government, provincial government and the public. Also, the infrastructure row is subdivided in this example into links, terminals and control; and the special transportation tax/fee row, into fuel taxes and licence fees. Of course, other categories might apply.

Starting with infrastructure, in terms of airplane travel, the $25 shown for links in the users column could indicate a traveller payment of Air Transportation Tax. This exceeds, by $6, the $19 total cost of air navigation support paid by the federal government as shown in the total column. Thus, the $6 is shown as negative, being a net revenue gain to the federal government. For terminals, $15 in landing fees represents an under-recovery of airport costs by $3. In the column others/government/federal, the traffic control cost of $2 is shown as not recovered, by a specifically designated payment.

In the environmental row, a cost to the public of $24 is shown. This represents a valuation estimate of the physical effects of environmental damage experienced by members of the public. At present, no transactions related to these costs occur.

The treatment of accident costs is more interesting analytically. The traveller, through her or his fare via the carrier's insurance cost, is shown as paying $4 and the provincial government pays $1, in medicare. Were this means of travel a road vehicle, the accident cost imposed on the occupants of other vehicles and not fully compensated by the travellers and their insurance would be included under users. This is based on the view that incurring the risk of such costs is part of the "price" paid when one travels by road. An alternative approach would be to separate out accident costs to other travellers and include them as a further "others" sub-category.

Special transportation taxes and fees, from the point of view of others, are government revenues, and are represented by negative costs of $9 in fuel taxes and $1 in licence fees paid by the traveller to the federal government (actually paid by the carrier from the traveller's fare). The $7 under provincial fuel taxes, a negative cost to provincial governments, represents the traveller's share of this tax; this is an estimate of the amount that exceeds the provincial sales tax that applies generally.

The vehicle/carrier cost of $333 under users may be viewed as the balance (on average) of what a traveller pays toward his or her total fare that is attributable to cost items other than those represented in the rows above it in the matrix.

Viewing the other elements of the vehicle/carrier row, travellers are shown as receiving a $35 "cross subsidy,"[1] and the provincial government is shown as paying a subsidy of $3, presumably direct, toward vehicle/carrier costs.

The total row indicates that travellers pay an average fare of $394. Because the average total cost of the hypothetical trip is $369, the average traveller appears to pay $25 more than the costs concerned — if one does not subtract the $35 cross subsidy to other travellers. Although the federal and provincial governments have net financial gains of $11 and $3 respectively, this does not balance a $24 cost to the public for environmental damage.

As mentioned, Table 3(2)-1 and the tables of Chapters 3 and 18 use a more condensed format in which the "others" columns, the "infrastructure" and "special transportation tax/fee" rows are not subdivided. The expanded, illustrative table shows the possible components of a single entry in the condensed format.

2. Costing Basis

Among the modes, the consistency of costing basis was limited by the structure of the data available for each mode. With the exception of the car, and with it vans and light trucks, costing and cost estimates were confined to public unit toll travel. Private airplane and boat transportation were not included. Chartered aircraft (true charters where the aircraft is leased generally with crew, fuel and supplies — not low priced travel, with tickets, that may be advertised as charter), bus and boat travel were also excluded where the data allowed.

In the case of bus, this was an important exclusion. It is estimated that 2.6 billion bus passenger-kilometres[2] were on domestic-origin, non-urban, non-school chartered service. This compares with the estimated 3.3 billion passenger-kilometres for scheduled domestic intercity bus services, which are the subject of the cost and other bus references of Volume 1.

Where possible, the costs presented are for domestic origin and destination travel. In some cases the domestic portion of international trips have been included; for the automobile, rail and bus, all travel within Canada was included. For air, international flights that originate or terminate in Canada and overflights of Canadian airspace were excluded; however, it was not possible to exclude domestic flights (separate ticket coupon) that were part of what was essentially an international trip.

3. Costing Principles

In general, the analysis is intended to produce an estimate of long-run average costs for the industry. Thus, all costs, including those of head office, were attributed to services they presumably support. Unless there was evidence that joint costs were attributable to less than the total product mix, these costs (for example, for VIA Rail stations) were allocated or attributed to services primarily on the basis of volume of use.

The ways in which density, speed, stage or journey length affected costs were considered and incorporated in developing cost estimates for types of routes.

An opportunity-cost-of-capital rate of 10% real (10% plus inflation) was used for all operators and modes. This figure is recommended for use throughout the federal government[3] as a social discount rate, and, when adjusted for inflation, is very close to the cost-of-capital rate for CP as calculated by the National Transportation Agency.

Wherever practical, capital costs of equipment and infrastructure (depreciation and cost of capital) were treated on a current value basis.[4] For most equipment and infrastructure this amounted to replacement value costing. Essentially, depreciation and the 10% real cost of capital, applied to the replacement cost of the remaining capital investment, were taken as representative of the full opportunity cost of invested capital. Also included as a capital charge was the opportunity cost of capital invested in the land occupied by road, track, airport and port infrastructure wherever the magnitude of this cost was believed to be substantial — primarily airport property.

Applying a common rate of capital cost to estimates of the replacement value of the capital stock in use helps make cost estimates for the different modes comparable. In particular, these cost estimates are not affected by differences in the extent to which a given entity is debt financed or may have received what might be viewed as equity capital at no charge from governments.

4. Data and Cost Development

The system average or typical cost estimates that follow were developed from the data available, with gaps filled on the basis of engineering costing, essentially aggregating the costs of the inputs, and on quoted ticket prices.

Statistics Canada publications were the primary sources of data for the system-wide costs. For costing purposes, Statistics Canada provided special aggregations of data. Data were also obtained from provincial authorities; Transport Canada; the Transportation Association of Canada; Canadian air, bus, ferry and railway carriers; and published studies. The key source of data for the carrier costs on the illustrative routes provided in Volume 1 was the industry. The response of the airline, railway, ferry and bus companies to requests for detailed cost, revenue, traffic and market data was most gratifying. In some cases, however, data were provided on a confidential basis. Respecting this confidentiality limits the specificity or extent of detail that can be reported for some of the cost estimates.

Most of the costs were estimated for 1989 or the organizations' fiscal year 1989–90, but some 1990 and 1991 data were used, and in some cases it was necessary to use pre-1989 data. The estimates were adjusted approximately to 1991 cost and price levels.

Costs were intended to represent normal 1991 conditions, but many of the input data were, as has been noted, from other recent years. Where there were reasonable grounds to suggest changes that had occurred to 1991, such changes were incorporated, and all estimates were converted to 1991 prices.

The illustrative 1991 costs used are not an estimate of actual 1991 levels; 1991 was an unusual year with some major carriers suffering large losses. The 1991 year carried surprises and anomalies that are not expected to persist. An attempt was made to represent the longer-term trend. All costs are in 1991 prices, but essentially represent a "normal" recent year.

The system-average costs by mode in Chapter 3 were estimated in cents per passenger-kilometre (¢/pass-km). The estimates of total costs by mode for 1991 were obtained by multiplying these system-average costs by the Royal Commission's estimates of total passenger-kilometres in that year.

5. Infrastructure Costs

5.1 CAR

5.1.1 Costs of Highway Construction and Maintenance

Estimates are based on the report to the Royal Commission by Nix, Boucher and Hutchinson,[5] in Volume 4 of this report. The study estimates the total costs for deterioration and maintenance of the provincial paved highway system, based on estimates published by the Transportation Association of Canada as well as Canadian models of highway-lifecycle costs. The study's estimates, by necessity, are very approximate. This is due primarily to uncertainty in the causes and attribution of road wear, but also in part to uncertainty in the spending estimates. The absence in Canada of data on highway traffic by vehicle weights and axle configurations particularly contributes to these uncertainties.

An important unresolved technical question is the extent of interaction between pavement deterioration due to climate and deterioration due to wear. The report effectively assumes there is no such interaction, as do these notes.

It is possible that deterioration identified by Nix et al. as being separately caused by climatic conditions is in fact the joint result of climate and traffic, and that the traffic contribution is therefore underestimated. Research to date has not adequately explored this relationship, and it remains an important issue for research into the design of a correct cost attribution and pricing regime.

The tentative allocation of costs to vehicle classes in the Nix et al. report provides the basis for the estimates of infrastructure costs in Table 3(2)-1, but with two important modifications:

- Nix et al. allocated all common costs (including those parts of pavement deterioration dependent on climate rather than wear, common annual maintenance items, and administrative costs) according to vehicle-kilometres by vehicle class. Royal Commission staff calculations have instead allocated these costs according to vehicle-kilometres weighted by "passenger-car-equivalent" units (PCEs), with an average heavy truck representing 2.5 PCEs, and an average bus, 2 PCEs.
- The report estimated total traffic wear on the provincial highway systems as 158 billion vehicle-kilometres, about 43 billion of which was on the "middle 30%" of paved two-lane rural highways. This seems high based on the evidence presented (from counting vehicles using each class of highway in some provinces), and an annual average daily traffic (AADT) of 2,000 vehicles instead of 3,000 has been assumed for these highways, thereby reducing the estimate for this sub-network to about 28 billion vehicle-kilometres and the total for the provincial network to 144 billion vehicle-kilometres.

The resulting estimated costs by class of road are shown in Table 3(2)-3. While costs per route-kilometre to build highways to higher standards are greater, such highways tend to have high traffic volumes over which those costs are spread. Therefore, costs per passenger-kilometre are lower on the higher quality and higher traffic density highways.

Table 3(2)-3
ESTIMATED CONSTRUCTION AND MAINTENANCE COSTS BY CLASS OF HIGHWAY (1989 CENTS PER VEHICLE-KILOMETRE)

Road class	Annual average daily traffic (number of vehicles)	Costs by vehicle type		
		Car/ light truck	Heavy truck	Bus
Expressway	12,000	0.47	2.62	1.06
Other paved highways:				
Densest 10%	6,000	0.71	3.99	1.56
Medium 30%	2,000	1.77	9.79	3.71
Least dense 60%	700	4.77	21.38	9.77
Average highway	—	1.46	5.48	3.00
Cents per pass-km	—	0.83	—	0.14
Cents per pass-km, in 1991 prices	—	0.91	—	0.15

The costs as estimated are identical for cars and light trucks. The final two rows (in ¢/pass-km) for car and light truck costs represent averages combined in proportion to their passenger-kilometres, using the standard assumptions of average occupancies of 1.8 passengers per car and 1.5 passengers per light truck, giving a combined average of 1.76. The estimates of costs per passenger-kilometre for buses assume average occupancy of 45% of 47 seats, or 21.15 passengers per bus.

5.1.2 Cost of Highway Capital

While depreciation (pavement deterioration) is included in the estimates, the cost of capital for highway infrastructure must be added. The Royal Commission staff estimates of highway cost of capital are quite speculative. Very little information is available to allow estimation of the size of the highway capital stock. A study by Lall, in Volume 4 of this report,[6] updating earlier work for the Canadian Transport Commission and Transport Canada,[7] suggests the entire road network stock amounted to about $52 billion in 1988. Updated only by inflation, this would have amounted to about $59 billion in 1991. The proportion of this that is for intercity or extra-urban highways can only be guessed.

The paved provincial highway network to which the estimates of Nix et al. apply, consists of about 140,000 two-lane kilometres, of a total of 880,000, or 16%. This relatively small proportion, however, includes all of the costly provincial expressways[8] and highways through urban areas, and all paved rural highways, which are of higher quality and cost than unpaved provincial or municipal roads or than municipal streets. For illustrative purposes, it is guessed that the paved highways are 40% to 60% of the total capital stock; that is, $24 billion to $35 billion.

The amount of these costs that is attributable to car and light truck traffic must be estimated next. The allocation by PCEs attributes 59% of common highway costs to passenger cars, and 15% to light trucks. It is assumed that about 80% of light truck use is for passenger travel, so the total proportion of highway cost for cars and light trucks in passenger use is estimated at 70%. Applying the same proportion to the capital costs, the costs attributed to cars and light trucks would amount to $16 billion to $25 billion.

Then this cost must be converted to an annual amount. The assumption throughout these cost estimates has been that the appropriate (opportunity-cost) rate with which to calculate the annual cost attributable to capital investment is 10% per year. The highway cost of capital attributed to passenger cars would therefore amount to $1.6 billion to $2.4 billion.

Finally, the cost per passenger-kilometre can be estimated by averaging the annual capital cost over total travel of 210 billion passenger-kilometres. These very rough computations suggest the value is in the range of 0.8¢/pass-km to 1.12¢ pass-km. As this is of the same order of magnitude as the earlier estimate of the highway deterioration/maintenance cost per passenger-kilometre, and relies on such rough reasoning, the capital charge is incorporated by simply doubling the deterioration/maintenance cost for each class of vehicle and type of highway.[9]

In consequence, the cost for cars of road infrastructure is estimated as $0.91 \times 2 = 1.82$¢/pass-km.

5.1.3 Land Costs

A difficulty in allowing for land costs is that if they are included in the accounts of transport authorities at all, they are likely to be based on historical purchase prices, which do not adequately represent current values. More particularly, they do not represent the value the land would have if liberated for other use. This is essentially an argument that the appropriate value to include is the "opportunity cost," that is, the value of the land in alternative use.

An attempt to estimate the opportunity cost of highway land is described in Annex 1 to these Notes. Using simple assumptions, it is estimated that the 137,236 route-kilometres of provincial highways in Canada in 1990 used some 475,000 hectares of land (or 1.17 million acres, about 1,800 square miles). If valued entirely as farmland, this had a value of some $580 million. If the alternative use included residential development of about 1% of the land, at an average value of $370,000 per hectare, the cost amounted in 1990 to $2.4 billion.

Converting this latter amount to an annual rate, using 10% per year as the opportunity-cost rate for capital assets, as indicated earlier, then allocating land cost among vehicle types according to PCE-km, and finally averaging the car cost over 210 billion passenger-kilometres, the resulting estimate is 0.08¢/pass-km. Given the uncertainty in this estimate, particularly in forecasting alternative use of the land, it is incorporated in the highway infrastructure costs as a rounded 0.1¢/pass-km.

5.1.4 Costs of "Control"

In addition, an amount is added for the "control" costs of infrastructure, consisting of the police enforcement costs and driver/vehicle enforcement and control programs for cars, analogous to the air traffic control and navigation systems in other modes. Some sparse evidence suggests police traffic-control costs amounted in 1987 to about \$450 million per year.[10] Vehicle and driver registration fees amount to about \$64 per vehicle per year,[11] or about \$850 million per year. It is guessed for illustrative purposes that these fees just balance the provincial expenses on police traffic services and the other relevant program costs — that is, that the control component of infrastructure costs amounts to about \$64 per year in 1990 prices, or 0.36 cents per vehicle-kilometre (¢/veh-km) over an average 17,600 kilometres per vehicle per year. Converted to 1991 prices, and averaged over 1.76 passengers per vehicle, this amounts to 0.22¢/pass-km.

Total infrastructure costs for cars, including construction and maintenance, land and control are finally estimated as 1.82 + 0.1 + 0.22 = 2.14¢/pass-km.

5.1.5 Car "User-Borne" Infrastructure Costs, from Road Tolls

The only significant road tolls in Canada are those for the Coquihalla Highway in British Columbia.[12] Revenues were \$18.4 million in fiscal year 1988–89, \$21.2 million in 1989–90,[13] and \$32.9 million in 1990–91.[14]

Separate estimates of revenues from passenger cars and trucks are not available, but a rough guess is sufficient for present purposes. It can be guessed that the total from cars and privately used light trucks would have been about \$20 million in 1991.

Because national highway traffic in 1991 is estimated at 210 billion passenger-kilometres, these Coquihalla tolls would have amounted to about 0.01¢/pass-km, clearly not sufficiently large to appear in the system-average car infrastructure costs per passenger-kilometre of Table 3(2)-1.

5.2 BUS

5.2.1 Highway Construction and Maintenance Costs

The highway infrastructure costs for buses are shown in Table 3(2)-3. They were obtained from the estimates of Nix et al. and modified to allocate all common components by PCE-km with an intercity bus comprising two PCEs. The traffic estimates for bus by type of highway are even more approximate than those for cars and heavy trucks.

The costs per vehicle-kilometre in Table 3(2)-3 are divided by an average occupancy of intercity buses of about 21 passengers, obtained from an average load factor of 45% for an average 47-seat bus, from the investigation of bus carrier costs by Royal Commission staff and consultants.

The weighted average cost for all road types amounts to 0.146¢/pass-km in 1991 prices (rounded in Table 3(2)-3 to 0.15¢/pass-km).

Capital charges are added to this cost following the same reasoning as for car infrastructure costs: that it seems legitimate as a first approximation to **double** the estimated road deterioration costs to allow for charges on the remaining capital value of the road structures. The total costs therefore become 0.146 × 2 = 0.292¢/pass-km.

5.2.2 Land Costs

Opportunity costs of highway land attributable to buses can be estimated as for cars, allocating the total opportunity costs, estimated at $240 million per year, according to PCE-km. Intercity buses contribute only some 0.2% of total PCE-km. Their share of land costs would then be about $0.5 million per year. Averaged over total bus travel of 3.3 billion passenger-kilometres, this would amount to 0.02¢/pass-km.

Total bus infrastructure "way" costs, including land, are thus rounded to 0.3¢/pass-km. Costs of traffic control for buses are assumed to be too unimportant to change this rounded total.

5.3 COMPARISON OF COSTS AND REVENUES FOR HEAVY TRUCKS

The procedures to identify highway infrastructure costs for cars/light trucks and buses also produce estimates for "heavy trucks" (the class heavy truck refers to any truck with a gross vehicle weight rating over 4.5 tonnes, though the maximum permitted nationally is 62.5 tonnes).[15] The report for the Royal Commission on road construction and maintenance costs provided its interpretations of the relationships between costs and truck axle configurations, axle weights and gross vehicle weights.[16] It allocated common components of costs arising from deterioration due to climate together with central costs of administration on the basis of vehicle-kilometres driven. Its methods provide an estimate of 1989 costs for the provincial highway systems for an average heavy truck of 3.82¢/veh-km, or about 4.17¢/veh-km in 1991 prices.[17]

The Royal Commission staff modifications to those estimates included allocating all common components of costs by PCE-kilometres, with an average heavy truck being 2.5 PCEs. The allocation procedure can then be reduced to the following formula, based on gross vehicle weight (GVW) and equivalent-standard-axle loads (ESALs)[18] as well as PCEs:

Cost per vehicle-kilometre in 1989 ¢
= 0.0235(GVW) + 1.5602(ESALs) + 1.037(PCEs)

The average heavy truck above consists of 23.3 tonnes GVW, with 1.5 ESALs, and 2.5 PCEs. Its costs then become 5.48¢/veh-km, or approximately 6¢/veh-km in 1991 prices. To allocate fully all highway costs, as was done earlier for passenger cars/light trucks, a cost of the invested capital should also be included. A preliminary approximation, in the absence of a confident estimate of the stock of highway capital, suggests this would be of a broadly similar order to the construction and maintenance cost, about 4¢ to 6¢/veh-km in 1991 prices.[19] The total cost for the average truck then becomes 10¢ to 12¢/veh-km.

Average truck revenues have been estimated using schedules of registration fees for trucks obtained from the provincial governments of Nova Scotia, New Brunswick, Ontario and Saskatchewan, together with a function relating truck fuel consumption to gross weight obtained from a study of road user costs and revenues for Transport Canada.[20] The fuel tax rate is the Canadian average estimated for diesel fuel in 1991 of 13.1¢ (net of normal sales taxes).

For the average heavy truck, the registration fee is approximately $1,000 per year and the fuel tax rate approximately 6¢/veh-km. The revenue from such a truck would be less than the fully-allocated costs of 10¢ to 12¢/veh-km for a truck travelling more than about 20,000 kilometres per year; and for such a truck travelling 100,000 kilometres per year, the excess of cost over revenue would be $3,000 to $5,000.

Similar computations can be made for some typical truck configurations suggested in the report to the Royal Commission by Nix et al., as follows:

Configuration	Gross weight (tonnes)	Average cost (¢/veh-km)	Registration fee per year ($)	Average fuel tax (¢/veh-km)
Straight truck (T3)	25	11–14	1,000	6.1
Tractor-semitrailer (3-S2)	39	15–19	1,700	7.1
B-double (3-S3-S2)	62	20–26	3,000	9.6

Revenues would be substantially outweighed by costs for each of these types of trucks if they are used for more than about 20,000 kilometres per year. Using the upper bounds of the cost estimates, the cost for the 25-tonne straight truck used for 50,000 kilometres per year would outweigh revenues by about $3,200; while if the tractor-trailer and tractor-double-trailer trucks were used for 100,000 kilometres per year their costs would outweigh revenues by approximately $10,000 and $13,000 respectively.[21]

Marginal costs would, of course, be lower than the above fully allocated average costs. The research report to the Royal Commission included an initial exploration of the manner in which costs of pavement construction, reconstruction and resurfacing vary with use, which suggests that marginal costs of heavy truck use would be very much lower.[22] Once the common cost elements allocated by PCEs — such as the climate-induced deterioration and administration costs — were ignored, marginal costs would also be more than proportionally less for trucks with lower axle weights (for example, for the double-trailer truck than for the straight truck in the these examples). Similarly, once those common elements are ignored, marginal costs would be less on high-volume roads. A pricing regime designed both to be efficient and to recover the fully allocated costs would need a thorough investigation of the relationships between average and marginal costs.

5.4 AIR

Unit costs for airport and air navigation services (ANS) were developed by Sypher : Mueller International Inc.[23] from financial data for expenditures associated with airport and aviation infrastructure. Transport Canada expenditures are shown in Table 3(2)-4; related revenues (excluding the Air Transportation Tax) are also included. Some of the costs for, and revenues from, airport property are not attributable to the provision of airport services, and were excluded from the present cost analysis. Costs, as calculated here, are more comprehensive, particularly in including the economic cost of invested capital.

Airport output statistics and cost and revenue data were provided by Transport Canada on a site-by-site basis. The ANS costs were assembled at the national level and were treated as a network, while airport costs were developed on a site-by-site basis. Enroute ANS services provided for the benefit of international flights that do not land in Canada are budgeted separately by Transport Canada, and are almost exactly recovered from specific fees.

Table 3(2)-4
TRANSPORT CANADA AIR PROGRAM EXPENDITURES AND REVENUES, 1989–90 ($ MILLIONS)

Expenditures	Aviation	Airports	Total
Operating	559	363	922
Capital	230	209	439
Total	**789**	**572**	**1,361**

Revenues	Aviation	Airports	Total
Enroute/Other ANS	30	—	30
Landing fees	—	128	128
General terminal	—	89	89
Airline space rental	—	50	50
Other airline revenues	—	18	18
Commercial/Industrial	—	186	186
Total	**30**	**471**	**501**

Source: Data from Transport Canada, *1989–90 Estimates: Part III, Expenditure Plan* (Ottawa: Supply and Services Canada, 1989).

5.4.1 Airport Cost Allocation

The Royal Commission developed the infrastructure cost attributable to commercial aviation at each of the 98 airport facilities in which Transport Canada has a significant interest. The 98 airports were divided into four groups for which data with varying degrees of cost detail were available.[24]

Group I — Lester B. Pearson International Airport (Toronto) and Vancouver Airport: These are the two largest airports in Canada, both in terms of facilities and operations, and are the only sites in Canada that are currently operating at, or near, capacity. As such they have certain distinct asset utilization characteristics and hence cost functions.

Group II — Remaining major federal airports (MFAs): The other six MFA sites (Calgary, Edmonton, Winnipeg, Ottawa, Montreal and Halifax) have facilities roughly the same size and all play a similar role in the national transportation system.

Group III — Sites processing or capable of annually handling 200,000 enplaned/ deplaned (E/D) passengers: These sites have a minimum level of airfield and terminal facilities that in most cases is adequate to handle volumes of up to a million passengers. The facilities and operations of airports in this group, and their cost behaviour, are generally similar.

Group IV — Remaining Transport Canada airports: These facilities are generally small and provide limited services. They have been further subdivided to segregate, in Group IVb, those airports that might be considered "outliers" because of remoteness and/or because the primary orientation may not be toward serving scheduled commercial carriers.

Groups III and IV are referred to as Federally Dependent Airports (FDAs). Fourteen of the airports in Group III used to be accounted for as MFAs; therefore, more detailed data are available for these ex-MFAs. Excluded from these airport groupings were the hundreds of community airports located across Canada. Because these airports are small, do not provide scheduled services, and only limited financial data is available for them, these sites were not included in this study. These airports, however, are an essential link to many small communities.

Direct operating costs, excluding depreciation, were gathered for each site. The cost allocation methodology and data sources and detail varied by airport group. For MFAs, total direct operating costs and operating costs by profit centre were available; this allowed easy removal of costs that were not to be attributed to users. Costs associated with state and military aircraft, as estimated by Transport Canada, were removed from site operating expenses. Also, emergency response service (ERS) costs were attributed strictly to the commercial passenger services and not to other users, such as the Department of National Defence and general aviation.

Costs associated with concession/groundside facilities and industrial areas were available from detailed costing studies that were performed in 1988–89, which allocated a portion of site costs to each of these profit centres. For the 14 ex-MFAs, total direct operating costs and costs associated with concession/groundside facilities and industrial areas were available for 1987–88 from Transport Canada's Financial Projection System, which also allocated a portion of site costs to each of these areas or profit centres.

The direct total operating costs and industrial costs for the remaining FDAs were extracted from Transport Canada's Statement of Revenue and Expenses. Because the financial data recorded for the FDA sites were minimal, a proxy of 10% was used to remove costs associated with concession/groundside facilities. It was further assumed that the industrial profit centre was operated on a break-even basis, and as such, expenses should equal revenue generated. Data were available on industrial rentals, which then served as a proxy for the costs associated with this area.

The Transport Canada allocation of corporate overhead to operating sites was not adopted. No overhead costs were allocated to the eight MFA sites, as they may be considered self-sufficient. These sites have a full complement of management and administrative functions and do not rely on headquarters for support. Therefore, all departmental overhead costs were allocated among the directly managed sites on the basis of direct airfield and terminal operating and maintenance costs.

Airfield costs have been allocated to commercial aviation traffic and to general aviation traffic[25] (other than for-hire transportation) at each airport on the basis of aircraft weight. At congested sites such as the Toronto (Pearson) and Vancouver airports, a movement-based allocation might be argued to be superior, because each movement imposes approximately the same time demands on the facilities and services capacity. A movement-based allocation, however, would be difficult to defend for uncongested airports, since this method assumes that each movement causes the same amount of "wear and tear" on airport assets, regardless of size. A weight base also may be argued to be related to willingness to pay (and to "Ramsey" pricing[26]) and is a more widely accepted and defensible practice for fee setting.

Terminal costs have been measured in relation to the number of passengers enplaned and deplaned. Terminal costs were allocated solely to commercial aviation with the assumption that general aviation makes only minimal use of the terminal building.

Capital infrastructure was included in the cost base on a current replacement value basis (escalated historical cost).[27] As a cross check, the replacement cost based on facility size, for terminal and runway assets, and current construction costs were calculated for a number of sites.

The replacement value was then divided by the 30-year average life of assets on an airport site to determine the annual allocation of past capital investment (depreciation). For ANS assets a 20-year life was used. The opportunity cost of capital component was calculated by multiplying capital replacement value by 50% to get average depreciated value, and then by a real interest rate of 10%.

For the airport system, four basic cost groups were used:

1. Total Commercial Airfield Costs = Commercial Airfield Operations and Maintenance (O&M) Costs + Commercial Airfield Overhead Costs + Commercial Airfield Capital Costs;

2. Total Commercial Terminal Costs = Commercial Terminal O&M Costs + Commercial Terminal Overhead Costs + Commercial Terminal Capital Costs;

3. Total General Aviation (ga) Instrument Flight Rules (IFR) Costs = ga IFR Airfield O&M Costs + ga IFR Airfield Overhead Costs + ga IFR Airfield Capital Costs; and

4. Total ga visual flight rules (VFR) Costs = ga VFR Airfield O&M Costs + ga VFR Airfield Overhead Costs + ga VFR Airfield Capital Costs.

Terminal costs were allocated to the commercial users on the basis of enplaned passengers, and airfield costs at each airport were allocated to commercial users, ga IFR users, and ga VFR users on the basis of their respective weight landed.

A summary of the cost allocation procedure is shown in Table 3(2)-5. Included here are all operations expenses and revenues, net of expenses and revenues attributable to activities that take place on the airport property but do not directly relate to the services Transport Canada provides to the airline and other aviation users of the facilities. Exclusions include industrial developments on the airport property, parking, and retail and refreshment concessions.

5.4.2 Air Navigation Services Cost Allocation

Air navigation costs include the cost of air traffic control, flight service stations, and the provision of radio navigation aids. The cost of ANS was divided between local ANS costs and enroute ANS costs. Local ANS costs are the costs of services provided at each airport (for a 50 km radius) while enroute costs are the costs of services provided while an aircraft is between airports.

Operating costs for both local and enroute facilities were derived from data provided by Transport Canada. The data were available in a form that separated local from enroute services and isolated domestic and international enroute services. The international services (polar and oceanic) are near full cost recovery. Thus, both revenues and expenses were excluded from the calculations, leaving a reasonably accurate picture of the costs and revenues of domestic enroute services. These data were also available from Part III of the 1989–90 Estimates,[28] although the detail required to allocate costs to international enroute services for area control centres and flight service stations was not available. As with the airport costing exercise, these accounts represent only direct operating costs and exclude depreciation.

Overhead costs were extracted from Transport Canada's *Proposed New Cost Recovery Policy: Phase II Discussion Paper* (TP 10041). For ease of allocation, overhead comprised ANS regulation costs, ANS safety costs, ANS branch overhead, and an allocated share of Transport Canada's corporate overhead.

Table 3(2)-5

COST ALLOCATION FOR AIRPORTS, RANKED BY ENPLANED/DEPLANED PASSENGERS

(THOUSANDS OF 1991 DOLLARS UNLESS OTHERWISE STATED)

Oper-ator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./ overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
I.												
TC	Toronto	Ont.	20,269,180	53,833	45,310	32,917	40,231	118,412	87,192	6	2	89
TC	Vancouver	B.C.	8,840,180	20,845	15,802	13,413	20,120	49,275	38,065	6	1	109
	Subtotal		29,109,360	74,678	61,112	46,330	60,351	167,687	125,257	6	1	198
II.												
TC	Montreal	Que.	8,761,049	49,990	36,915	44,536	50,222	131,480	55,641	15	9	286
TC	Calgary	Alta.	4,549,797	13,983	10,301	8,015	20,610	38,838	24,732	9	3	147
TC	Winnipeg	Man.	2,459,932	10,883	6,347	5,505	5,964	17,737	11,498	7	3	93
TC	Edmonton Int.	Alta.	2,072,354	10,608	8,594	4,286	5,455	18,303	10,922	9	4	77
TC	Halifax	N.S.	2,338,372	10,101	8,264	4,351	3,024	15,613	8,531	7	3	83
TC	Ottawa	Ont.	2,711,415	9,495	2,763	3,573	9,660	15,931	12,667	6	1	66
	Subtotal		22,892,919	105,060	73,185	70,267	94,935	237,901	123,991	10	5	751

Table 3(2)-5 (cont'd)

COST ALLOCATION FOR AIRPORTS, RANKED BY ENPLANED/DEPLANED PASSENGERS

(THOUSANDS OF 1991 DOLLARS UNLESS OTHERWISE STATED)

Operator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
III.												
TC	Victoria	B.C.	759,878	1,843	2,259	0	2,230	4,501	1,831	6	4	124
TC	Quebec	Que.	733,774	3,542	4,487	1,822	1,916	8,155	2,882	11	7	204
TC	St. John's	Nfld.	702,264	4,306	6,423	1,611	1,480	9,467	2,445	13	10	193
TC	Regina	Sask.	654,249	3,284	5,069	3,161	2,153	10,239	2,859	16	11	317
TC	Saskatoon	Sask.	642,765	2,898	4,229	1,241	897	6,293	2,794	10	5	276
TC	Thunder Bay	Ont.	591,975	2,764	4,202	1,068	1,030	6,202	2,111	10	7	374
N	Kelowna	B.C.	395,436	1,544	2,529	16	1,395	3,945	1,042	10	7	53
TC	Moncton	N.B.	293,483	2,712	3,692	724	710	5,062	992	17	14	296
TC	Windsor	Ont.	283,108	1,747	2,403	804	1,471	4,571	1,277	16	12	302
TC	Prince George	B.C.	275,340	2,132	3,259	1,537	1,877	6,578	710	24	21	247
TC	London	Ont.	255,643	2,463	3,119	1,137	1,039	5,116	941	20	16	540
TC	Saint John	N.B.	245,801	2,486	3,872	1,130	544	5,516	1,292	22	17	130
TC	Sault Ste. Marie	Ont.	245,400	1,854	2,816	17	3,308	6,147	600	25	23	135
N	Sudbury	Ont.	236,508	1,442	2,036	1,407	411	3,677	377	16	14	444
TC	Fredericton	N.B.	207,475	2,116	2,820	354	636	3,802	760	18	15	90
TC	Charlottetown	P.E.I.	205,610	2,415	3,526	693	2,573	6,768	654	33	30	115
TC	Yellowknife	N.W.T.	192,044	2,389	3,641	841	2,465	6,916	376	36	34	133

Table 3(2)-5 (cont'd)

COST ALLOCATION FOR AIRPORTS, RANKED BY ENPLANED/DEPLANED PASSENGERS

(THOUSANDS OF 1991 DOLLARS UNLESS OTHERWISE STATED)

Operator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./ overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
TC	Timmins	Ont.	191,673	1,481	2,267	154	2,288	4,709	463	25	22	57
TC	Sydney	N.S.	182,456	2,382	3,889	669	889	5,441	588	30	27	62
TC	Whitehorse	Y.T.	123,659	1,928	2,644	2,891	2,295	7,300	247	59	57	907
	Subtotal		7,418,541	47,728	69,180	21,279	31,606	120,404	25,242	16	13	4,997
IVa.												
TC	Deer Lake	Nfld.	165,292	1,453	2,418	0	1,194	3,618	402	22	19	24
TC	Kamloops	B.C.	138,478	1,294	1,950	0	3,383	5,342	496	39	35	64
TC	Prince Rupert	B.C.	131,357	1,049	1,663	1,364	3,739	6,750	179	51	50	34
N	Rouyn/ Noranda	Qué.	117,036	982	1,531	1,216	462	3,169	233	27	25	90
TC	Val d'Or	Que.	114,128	2,262	3,461	23	2,339	5,836	430	51	47	45
TC	Lethbridge	Alta.	110,717	1,269	1,809	194	2,247	4,220	196	38	36	190
N	Bagotville	Que.	107,245	186	68	421	237	305	10	3	3	667
TC	North Bay	Ont.	104,411	1,596	1,754	1,563	2,008	5,081	364	49	45	446
TC	Grand Prairie	Alta.	103,214	1,296	1,941	1,260	3,518	6,583	340	64	60	260
N	Hamilton	Ont.	96,909	1,038	1,085	592	537	1,985	203	20	18	606
N	Castlegar	B.C.	95,926	607	956	809	595	2,267	0	24	24	184
N	Campbell River	B.C.	93,352	546	695	25	762	1,484	170	16	14	40
N	Cranbrook	B.C.	90,452	916	1,528	0	2,526	4,061	276	45	42	37
TC	Fort McMurray	Alta.	90,094	1,109	1,557	614	6,305	8,398	261	93	90	184

Table 3(2)-5 (cont'd)

COST ALLOCATION FOR AIRPORTS, RANKED BY ENPLANED/DEPLANED PASSENGERS

(THOUSANDS OF 1991 DOLLARS UNLESS OTHERWISE STATED)

Operator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./ overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
TC	Terrace	B.C.	89,699	1,070	1,747	1,040	2,336	5,102	177	57	55	54
TC	Penticton	B.C.	84,612	1,073	1,657	0	1.025	2,691	408	32	27	97
TC	Mont Joli	Que.	79,586	1,499	2,452	1,522	2,788	6,748	301	85	81	38
TC	Stephenville	Nfld.	65,602	1,833	2,959	209	4,008	7,182	284	109	105	17
TC	Baie Comeau	Que.	58,725	946	1,321	643	802	2,702	165	46	43	163
N	Sarnia	Ont.	49,500	751	1,194	532	1,059	2,729	117	55	53	130
TC	Smithers	B.C.	47,800	587	882	1,310	1,601	3,667	195	77	73	190
TC	Williams Lake	B.C.	36,400	551	831	819	1,221	2,796	114	77	74	124
TC	Yarmouth	N.S.	34,900	1,234	1,832	582	1,171	3,548	131	102	98	117
TC	Quesnel	B.C.	30,300	498	764	387	537	1,640	89	54	51	110
N	Kenora	Ont.	26,200	444	706	358	158	1,198	82	46	43	66
N	Charlo	N.B.	24,276	1,025	1,602	608	189	2,380	197	98	90	71
	Subtotal		2,186,211	27,114	40,365	16,092	46,747	101,482	5,820	46	44	4,047
IVb.												
TC	Sept Iles	Que.	151,255	2,478	3,756	1,403	2,980	8,098	536	54	50	123
TC	Fort St. John	B.C.	137,004	1,737	2,828	0	2,992	5,828	432	43	39	49
TC	Gander	Nfld.	124,728	7,842	12,482	2,634	2,524	17,628	2,267	141	123	117
N	Thompson	Man.	109,705	706	977	1,284	637	2,832	300	26	23	112
N	Goose Bay	Nfld.	80,151	6,742	5,803	5,977	20,552	32,175	609	401	394	251
TC	Inuvik	N.W.T.	76,305	1,365	2,025	2,729	2,950	7,642	182	100	98	105
TC	Wabush	Nfld.	74,248	1,655	2,630	1,037	1,437	5,086	282	69	65	68

Table 3(2)-5 (cont'd)

Cost Allocation for Airports, Ranked by Enplaned/Deplaned Passengers (Thousands of 1991 dollars unless otherwise stated)

Operator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
TC	Iqaluit	N.W.T.	64,852	1,564	1,377	4,410	1,182	6,932	334	107	102	46
TC	Sandspit	B.C.	40,347	853	1,205	1,029	815	3,036	189	75	71	26
TC	Iles de la Madeleine	Que.	39,959	487	810	614	218	1,640	119	41	38	8
TC	Port Hardy	B.C.	39,782	714	1,051	1,710	3,187	5,830	172	147	142	165
TC	Churchill	Man.	34,692	2,656	4,234	3,951	1,368	9,524	239	275	268	65
TC	Kuujjuaq	Que.	30,200	1,621	2,522	1,691	768	4,950	165	164	158	84
N	Red Lake	Ont.	29,800	187	107	523	708	818	111	27	24	697
TC	Norman Wells	N.W.T.	27,402	927	1,453	856	1,261	3,528	122	129	124	105
TC	Hay River	N.W.T.	26,070	806	1,274	1,696	1,276	4,216	93	162	158	51
TC	The Pas	Man.	21,863	1,029	1,567	511	411	2,464	80	113	109	87
TC	Fort Smith	N.W.T.	19,650	525	836	1,218	1,336	3,361	59	171	168	48
TC	Kapuskasing	Ont.	18,300	312	477	2,256	1,125	3,681	100	201	196	210
TC	Fort Nelson	B.C.	14,200	863	1,265	2,605	1,781	5,329	112	375	367	451
TC	St. Anthony	Nfld.	13,500	517	827	1,217	407	2,370	41	176	173	132
N	Schefferville	Que.	9,800	185	261	369	247	846	32	86	83	51
N	Wemindji	Que.	6,200	178	302	803	468	1,572	39	254	247	1
TC	Earlton	Ont.	4,500	213	287	165	142	564	24	125	120	74
N	Eastmain	Que.	4,300	188	302	470	272	1,040	17	242	238	6
TC	Abbotsford	B.C.	4,100	856	565	1,486	2,810	4,177	132	1,019	986	887
TC	Gore Bay	Ont.	500	137	145	326	274	582	8	1,163	1,147	245
TC	Muskoka	Ont.	500	167	160	107	76	287	23	573	528	159

Table 3(2)-5 (cont'd)

COST ALLOCATION FOR AIRPORTS, RANKED BY ENPLANED/DEPLANED PASSENGERS

(THOUSANDS OF 1991 DOLLARS UNLESS OTHERWISE STATED)

Operator	Site	Prov.	1988 E/D passengers	1988–89 total operating expenses excluding deprec.	Approx. aviation oper./ overhead costs (1991)	Attrib. airfield capital cost (1991)	Attrib. terminal capital cost (1991)	Attrib. comm. aviation (airlines) cost (1991)	Revenue from comm. aviation (airlines) (1991)	Full cost per E/D pass. ($)	Deficit per E/D pass. ($)	Cost attrib. to general aviation (1991)
N	North Battleford	Sask.	500	108	114	518	715	1,119	5	2,238	2,229	274
N	St. Leonard	N.B.	500	350	496	505	186	1,087	7	2,174	2,160	200
N	Swift Current	Sask.	500	70	76	332	685	889	7	1,778	1,764	247
TC	Wiarton	Ont.	500	186	179	421	237	608	10	1,216	1,195	364
N	Yorkton	Sask.	500	125	104	378	489	755	8	1,510	1,494	278
TC	Baker Lake	N.W.T.	0	895	1,488	1,161	305	2,947	10	#	#	16
TC	Cambridge Bay	N.W.T.	0	880	1,454	1,038	375	2,868	49	#	#	4
TC	Coral Harbour	N.W.T.	0	1,007	1,685	865	234	2,780	0	#	#	12
TC	Eureka	N.W.T.	0	22	37	64	15	116	0	#	#	1
N	Fort Resolution	N.W.T.	0	172	275	115	69	449	0	#	#	28
TC	Fort Simpson	N.W.T.	0	503	783	602	194	1,543	24	#	#	80
TC	Nanisivik	N.W.T.	0	509	857	1,063	369	2,288	8	#	#	3
N	Resolute Bay	N.W.T.	0	3,554	4,842	1,572	465	6,857	95	#	#	95
TC	Tofino	B.C.	0	46	61	2,116	559	2,523	1	#	#	219
TC	Tuktoyuktuk	N.W.T.	0	341	567	200	75	837	1	#	#	16
TC	Watson Lake	Y.T.	0	883	1,249	1,219	571	2,824	43	#	#	414
	Subtotal		1,206,413	47,161	65,794	55,246	59,747	176,526	7,087	146	140	6,673
	Total		**62,813,444**	**301,741**	**309,637**	**209,214**	**293,386**	**804,001**	**287,397**	**13**	**8**	**16,666**

Similar to airport capital assets, the value used in the cost base was replacement cost. The replacement value was determined by reviewing the current asset base and known major capital expenditures (such as the current programs of radar modernization and microwave landing systems), and estimating what it would cost to replace these navigation aids. The replacement cost for local and enroute facilities was divided by a factor of 20, which represents the average number of years in the life of ANS capital assets. A cost of capital component was calculated using an interest rate of 10%.

For ANS, as for airports, four cost groups were used:

1. Total Local Commercial and General Aviation (ga) IFR Costs = Local Commercial and ga IFR O&M + Local Commercial and ga IFR Overhead + Local Commercial and ga IFR Capital Costs;
2. Total Local Flight Service Station (FSS) Costs = Local FSS O&M + Local FSS Overhead + Local FSS Capital Costs;
3. Total Enroute Commercial and ga IFR Costs = Enroute Commercial and ga IFR O&M + Enroute Commercial and ga IFR Overhead + Enroute Commercial and ga IFR Capital Costs; and
4. Total enroute VFR Costs = Enroute VFR O&M + Enroute VFR Overhead + Enroute VFR Capital Costs.

Local air navigation services costs were therefore allocated:

	$ millions (1991)	
	Local	Enroute
Commercial	137	344
General Aviation IFR	16	15
General Aviation VFR	118	75

Local costs were allocated to users based on each user's tower arrivals and FSS arrivals. Enroute costs were allocated to users on the basis of domestic total kilometres flown by each group. The resulting cost functions are:

Commercial	= \$42.54/movement + \$0.15/km
ga IFR	= \$41.16/movement + \$0.15/km
ga VFR	= \$82.69/movement + \$1.01/km

Alternatively, the cost attributed to commercial aviation can be allocated on the basis of passengers and passenger-kilometres. To do this, it was first necessary to divide the total among domestic and international services. Cost attributable to overflights that do not land in Canada has already been excluded. For the balance that takeoff and/or land in Canada, to allocate the attributed \$137 million local air navigation services cost, enplanements plus deplanements are estimated as:

Domestic	24 million × 2 × 1.2 stages →	58 million E/D
Canadian international carriers		13 million E/D
Foreign carriers (assume)		15 million E/D
		86 million E/D

This amounts to \$1.60 per passenger per takeoff or landing (1/2 stage).

Enroute costs attributable to commercial aviation of \$344 million may be allocated on the basis of airplane-kilometres under Canadian enroute control, estimated from data on movements and assumptions as to controlled flight length. Itinerant movements in 1990 (Statistics Canada Catalogue No. 51-206, Table 7.1) for commercial carriers are:

	Movements	Distance
Domestic	3,387,000	800 kilometres
Trans-border	256,000	300 kilometres under Canadian control
Other international	64,000	1 000 kilometres under Canadian control

With the domestic operation accounting for 2.71 billion of a total of 2.85 billion airplane-kilometres, or a share of 95%, enroute costs attributable to commercial domestic operations are $327 million. Allocating over 25 billion domestic passenger-kilometres gives a unit cost of 1.4¢/pass-km.

5.4.3 Air Infrastructure Cost (Excluding Land Occupancy)

The final product was the set of cost functions that estimate the unit costs of airport and aviation infrastructure in Canada. By applying the commercial carrier cost model, it was possible to calculate an average cost per passenger from any origin to any destination in Canada.

To calculate the average infrastructure costs applicable to a typical trip, the airport cost function and the corresponding air navigation cost function are used. As an example, consider a trip to Saskatoon from Halifax of approximately 3 500 km, in a B-727 or A320 aircraft with 136 seats, operating at a (system-average) load factor of 0.675, via one intermediate stop (change of flights) at Toronto. The trip thus has two stages, which means two takeoffs and two landings at three airports.

The attributed commercial airlines' costs at Saskatoon, Toronto and Halifax from Table 3(2)-5 give a per passenger airport cost of:

Halifax	$ 7
Toronto (two movements)	$12
Saskatoon	$10
	$29

Total navigation costs would be:

$6.40 + 3 500 km at 1.4¢ = $55[29]

Not including cost attributable to investment in land, total costs per passenger of air infrastructure services are estimated at $84. Including $20 for the opportunity cost of land in use at the airports, total infrastructure cost becomes $104 per passenger (use of unrounded intermediate data would yield $105).

5.4.4 Cost of Land Used for Airports

One can only speculate about the extent and type of development that would take place if the airports were removed from their current sites. Unique mixes of types of use are likely at each of the sites.

An attempt to estimate the opportunity costs of airport land is described in Annex 2 to these Notes. For the nine major airports, potential values as farmland, or in industrial, commercial or residential development are considered.

The areas of land occupied by these airports are very large, and in a number of cases are in locations that would be advantageous for development if the airports were abandoned (or relocated). The areas concerned, however, are so large that they would add substantially to the land available, and could probably only be sold for development at prices below those currently attained for equivalent land.

Indications of potential values of the land at these airports is provided in Table 3(2)-6, based on the following assumptions (described further in Annex 2):

- The sites at Edmonton, Mirabel and Halifax airports are valued as farmland.
- At Calgary, Winnipeg and Ottawa airports, the sites are valued at 25% of the current price for light industrial land.
- For Vancouver and Dorval airports, the available land is valued at 50% of the current price for light industrial land.
- For Toronto (Pearson) airport, the site area is valued at 50% of the current price for residential land.

Table 3(2)-6

OPPORTUNITY COSTS OF LAND AT MAJOR AIRPORTS, 1991

Airport	Estimated land values ($ millions)
Vancouver	500
Calgary	200
Edmonton	8
Winnipeg	130
Toronto (Pearson)	750
Ottawa	440
Montreal (Dorval)	400
Montreal (Mirabel)	10
Halifax	1
Total (rounded)	**2,500**

The value of those nine major airports is therefore estimated at about $2.5 billion. For the 20 next most important airports, it is assumed that the average value per hectare is half that of these nine airports, excluding Pearson and Vancouver. Their total value would be about $400 million. For all remaining airports, the value of the land is assumed to be negligible.

The total capital value estimated therefore is about $2.9 billion. At a real rate of return of 10%, the annual cost is $290 million per year. Averaged over a total of about 63 million enplaned/deplaned (E/D) passengers at all airports in 1988, the total land value would then amount to $4.60 per passenger. For the illustrative system-wide costs in 1991, this is rounded up to $5 per E/D passenger, or $10 per stage. Averaged over the representative air trip (1.6 stages) of 1 478 km, it amounts to 1.08¢/pass-km (rounded to 1¢/pass-km for system average).

5.5 RAIL

The Royal Commission's intercity railway carrier costing is described in Volume 4 of this report.[30] The cost of infrastructure services is shown but there was no cost analysis beyond acceptance of the price

VIA Rail pays the freight railways for track use. Infrastructure payments, including some station rents and incentive payments, which amount to 2.9¢/pass-km, represent only a relatively small proportion of VIA Rail's costs — about 7%. On the per passenger-kilometre basis, however, they are somewhat higher than the estimate of car infrastructure costs and much higher than the estimate of bus costs. Rail track costs are also discussed in the Notes to Chapter 6 in this volume, but without focus on the costing methodology.

The charges VIA Rail pays for track use are closer to being based on a marginal cost concept than on the fully allocated average cost concept used in costing infrastructure for all the other means of passenger transportation.

Payments by VIA Rail to the freight railway track owners for track use and other related services, such as dispatching, signals and communications, are negotiated among the parties — including the Minister of Transport's representative. Should agreement not be reached, however, the fall-back position is long-term avoidable cost as defined by regulations administered and interpreted by the National Transportation Agency. The relationship between CN and CP charges to VIA Rail, and the additional cost that the passenger operation actually imposes on the freight railways, have formed the topic of review by the Canadian Transport Commission and the National Transportation Agency (most recently, the NTA's 1988 *VIA Rail Costing Review*), and a variety of studies by, and for, interested parties including the provincial governments.

The applicable regulations (essentially, the CTC's Costing Order, R-6313) in effect interpret avoidable cost in this case as being long-run variable cost, with respect to track use, including the variable portions of maintenance expense and of capital-related costs — depreciation and cost of capital. Capital-related costs are based on depreciated original cost, historical asset lives, the cost of capital for CP computed in nominal dollars, and an estimated relationship between track maintenance operating expenditures and gross tonnage. As already noted, this differs from the estimate of allocated total cost, with capital treated on a replacement value basis, that was used for the other modes.

It may be of interest to observe that, for rail freight, infrastructure costs generally and the cost of the capital invested in the track infrastructure are much more important relative to total costs than they are for passenger transportation. The 1989 balance sheets for CN and CP[31] show a combined "ways and structures" property investment of over $10 billion at original cost (over $8 billion of it track and roadway), with accumulated depreciation of approximately $3 billion. At a nominal cost of capital of 15% (10% real plus 5% inflation), $7 billion of invested capital represents an annual cost of invested capital of over $1 billion. This equals 20% of 1989 gross freight revenues.

Allocating a pro rata share of this rough estimate of an infrastructure capital charge using the industry rule of thumb — 1 pass-km = one freight tonne-km — would only suggest an $11 million allocation to passenger costs — the equivalent of 0.4¢/pass-km — in 1989. This may be viewed as an indication of the maximum understatement of passenger rail infrastructure costs relative to costs for other modes, as VIA Rail payments would, in principle, already include a capital charge related to a portion of the capital implicitly allocated to it on this pro rata basis.

5.6 FERRY

The infrastructure provided for marine ferries not included in vehicle/carrier cost estimates comprises the navigation services and regulatory activities provided by Transport Canada. The amounts of these services provided for the ferries cannot be distinguished readily, as the services are provided jointly for all shipping. Analyses published as part of the development of Transport Canada's cost-recovery policy do not yet provide an allocation of costs to each type of user, but do distinguish attributable costs in 1990–91 for a number of programs.[32] Programs assumed to be used (or provided) in part for ferries are the following (costs include allowances for depreciation and costs of capital):

	Total costs, 1990–91 $ millions
Vessel traffic services	17.46
Short-range navigation aids	272.98
Safety and public communication	14.53
Ship safety	32.66
Emergencies	25.05
Total	362.70

It is reasonable for illustrative purposes, and in the absence of information on the use of these services by ferries, to allocate the services among various types of commercial shipping according to ship-kilometres travelled in Canadian waters. Using Transport Canada's estimate that ferries account for 11.84%, the amount of the total cost thus attributable to ferries is $42.94 million.

This amount is then distributed between freight and passenger ferry traffic as are the other ferry cost items, according to automobile-equivalent-unit kilometres. The passenger portion is estimated as $35.4 million.

Averaging this cost over the total (non-commercial) passenger-kilometres in 1990 produces a (rounded) 4.5¢/pass-km. When inflated to 1991 dollars, this amounts to 4.7¢/pass-km, which appears in Table 3.1 of Volume 1.

6. Environmental Damage Costs

6.1 EMISSIONS OF AIR POLLUTANTS AND GREENHOUSE GASES

Derivations of costs of emissions are described in the Notes to Chapter 7 in this volume. System-wide averages estimated there (in Table 7(2)-7) are the following (in 1991 prices):

Means of Travel	Costs (¢/pass-km)
Bus	0.246
Car	0.577
Train	0.642
Airplane	0.921
Ferry	1.972

6.2 NOISE

While noise can be an important component of nuisance from all modes, its effects are localized, and greatest in residential locations exposed to high traffic volumes. Most of the noise from intercity passenger travel by road vehicles, trains and ferries is generated away from areas of dense habitation, but airplane noise is a very substantial nuisance close to major airports.

Derivation of an estimate of the cost of airplane noise is also briefly described in the Notes to Chapter 7 in this volume. Valued at $1.00 per passenger-trip system-wide, this noise cost becomes 0.07¢/pass-km over the representative trip of 1 478 km. This is included in the system-average environmental cost for airplane travel in Table 3-1 of Volume 1 and Table 3(2)-1.

No costs are included for noise in any of the other modes, partly because research has not provided comparable estimates for intercity travel by the other modes, and partly because it is expected that such costs would be very small in relation to the other cost estimates and their ranges of uncertainty.

7. Accident Costs

The derivation of costs of damage in accidents is described in the Notes to Chapter 8 in this volume. Minimum losses per victim are estimated, from research on road accidents, as \$330,000 per fatality and \$10,000 per person injured, in 1990 prices. The alternative value of the losses per fatality, adopted recently by Transport Canada after researching individual willingness to pay for risk reductions, amounts to \$1.5 million, in 1991 prices. That value has been adopted in the costing by mode that follows, together with \$10,000 per person injured, where relevant.[33]

7.1 CAR ACCIDENT COSTS

The value for the social losses in all road accidents based on the Transport Canada values per casualty, together with estimates of other property damage losses, is estimated in Chapter 8 at about \$14 billion, in 1991 prices.

To be compatible with the estimates of infrastructure costs, an estimate is needed of the amount of these losses that takes place on the paved provincial highway system. National road accident statistics show that some 65% of deaths and 30% of injuries were on roads with speed limits greater than 60 km/h. Those injuries and property damage accidents occurring on highways, however, are likely to be much more severe than the average (occurring at higher average speeds), and therefore to cost substantially more than the average.

The statistics also fail to show what proportion of highway accidents involves passenger vehicles. Strictly, deductions should be made for the losses attributable to non-passenger vehicles. The most important other group of vehicles is heavy trucks, because of their over-involvement in severe casualties. Available statistics show them to be involved in about 3% of all accidents, and about 9% of deaths. But no information is available to determine responsibility for those accidents and casualties.

The simple assumption is made that 55% of the total accident damage cost is on highways and attributable to passenger vehicles, or a total of about $7.7 billion per year. Given its uncertainty, this figure is rounded to $8 billion. Averaged then across 210 billion total passenger kilometres by these vehicles, this would amount to about 3.8¢/pass-km. This figure appears in Table 3-1 of Volume 1 as the "total accident" cost for car travel.

Of this total amount, there is a proportion of health care costs for road accident victims that is not recovered from motor vehicle insurers, but borne instead by others. This is estimated in the Notes to Chapter 8 in this volume as about $300 million in total in 1990. Using the earlier assumption, 55% or $165 million of this would be attributed to highway passenger traffic. Averaging this over 210 billion passenger kilometres and inflating gives 0.082¢/pass-km in 1991 prices, which appears (suitably rounded) in the relevant cell in Table 3-1 of Volume 1.

The remainder of the 3.8¢/pass-km in losses is user borne, or 3.7¢/pass-km in the rounded figures of Table 3-1.

It should be noted that these estimates may conceal a large element of non-monetary cost, which is borne by the victims of accidents without compensation. (Monetary costs include loss of earnings as a result of death or injury.) Of the amounts estimated earlier to be borne by users, the largest part is borne in costs of accident insurance and the deductible amounts of damage claims paid personally by vehicle owners. However, being based on "willingness to pay," the estimates include a large portion that would represent non-monetary damage in accidents — remembering that monetary damage losses sum to only about $9.5 billion in 1991 prices. The other $4.5 billion can be characterized as representing instead the emotional losses. If 55% of these occur in highway accidents, they amount to about \$2.5 billion. These losses are probably not compensated fully, if at all, by those responsible for the accidents, or their insurance companies. The amount concerned is unknown, as the extent of compensation from insurance companies or directly from responsible owners/drivers is not recorded.[34]

It should be further noted that some part of those emotional losses are actually borne by non-users of motor vehicles — essentially pedestrians and bicyclists — in highway accidents (it being assumed that their monetary losses are compensated from insurance and health care systems). As these groups constitute about 15% of all road accident fatalities, they might account for 15% of the total emotional losses. The amount might be substantial compared with many of the component costs borne by non-users in Table 3-1. If total emotional losses were as great as \$2.5 billion, and if 15% of that was borne by non-users of motor vehicles it would be close to \$400 million. The amount is more likely some fraction of this. Any estimate would be entirely conjectural, however, so this cost has not been distinguished in the tables, and remains within the estimate of user-borne accident costs.

7.2 BUS ACCIDENT COSTS

The fatality rate in passenger operations is estimated in the Notes to Chapter 8 in this volume, from the (very sparse) information available on intercity bus accidents from Transport Canada, as 2.0 per billion passenger-kilometres. If Transport Canada's guidance of \$1.5 million per death avoided is applied to these, a total of \$3 million per billion passenger-kilometres, or 0.3¢/pass-km is obtained.

The accident statistics also show that the ratio of injured victims to fatalities was about 38 (265 injured versus 7 killed in the sample of jurisdictions and years considered). Applying Transport Canada's cost of \$10,000 per injured victim, the ratio of injury cost to fatality cost would be 0.20. Adding the injury cost to the fatality cost produces a combined cost of 0.36¢/pass-km.

Finally, an approximate allowance for property damage can be made, in the absence of statistics on the incidence of property damage accidents involving intercity buses, from the observation that the total costs estimated for property damage in road accidents amounts to about two thirds of the total costs of injuries. Adding this proportion would bring the system-average bus accident costs up to 0.4¢/pass-km.

Of this cost, some small amount would be borne by non-users, for similar reasons as for car accident costs. The amounts would probably be similar in proportion — about 2% of accident costs, or in this case only 0.008¢/pass-km. The relevant cell in Table 3-1 therefore shows 0.0¢/pass-km.

7.3 AIRPLANE ACCIDENT COSTS

For levels 1 and 2 carriers, the average fatality rate over the decade to 1990 is estimated in the Notes to Chapter 8 in this volume as 0.13 deaths per billion passenger-kilometres. At $1.5 million per fatality, that amounts to only 0.0195¢/pass-km.

The uncertainty of the fatality rate is underlined, however, by the fact that if the Nationair crash at Jeddah in 1991 is included the decade's fatality rate would change to 0.60 per billion passenger-kilometres, in which case, the cost would be about 0.09¢/pass-km.

The cost of injuries and property damage should be added to these costs. In air crashes, injuries are not numerous enough compared with fatalities to make much difference to the estimated cost. No estimates of the extent and costs of property damage in passenger aircraft accidents in Canada are available, but the price of passenger-carrying airplanes suggests that it could be significant. On the other hand, the average cost is unlikely to be as much as that estimated for the victims; at Transport Canada's value of $1.5 million per person, even the most expensive modern airplane is worth less than its passengers.

In summary, it is concluded that the true cost of airplane accidents is unlikely to exceed 0.1¢/pass-km, which is the value used in the illustration.

As with bus accident costs, the amount of these air accident costs borne by non-users is expected to be so small that the relevant cell of Table 3-1 appears as 0.0¢/pass-km.

7.4 TRAIN ACCIDENT COSTS

The estimates in the Notes to Chapter 8 in this volume show the rate of all fatalities involving passenger trains over the decade to 1990 as 13.8 per billion passenger-kilometres. The great majority of these deaths were to motor vehicle users at grade crossings or people walking on the rail lines (including suicides). The question arises whether their costs should be attributed as a social cost of rail transport. In nearly all such cases, the railway is not legally at fault; though the deaths would clearly not have occurred in the absence of the trains. This issue is not resolved here, but for the illustrative costs, none of the costs of these other victims has been attributed to the train.

Deaths to passengers and rail employees in passenger operations, which are therefore assumed to be attributable to train travel, occurred at a rate of 1.16 per billion passenger-kilometres over the decade. Valued at Transport Canada's average of $1.5 million, the cost of these deaths amounts to 0.17¢/pass-km, in 1991 prices. To this should be added the costs of those passengers and employees injured in these accidents.

In the absence of details of the numbers injured in passenger operations during the decade, some indication of the long-term relationship between numbers killed and injured can be gained from the statistics for all main-line railway accidents, which show a ratio of 27 injured for each death (976 injured compared with 36 killed over the decade). Using Transport Canada's road accident costs of $10,000 per average injured victim, this would add $270,000, or 18%, to each $1.5 million in costs of fatalities. This would raise the estimated system-average accident cost to 0.20¢ per pass-km.

The amount borne by non-users is again not zero, but expected to be so small that the relevant cell of Table 3-1 appears as 0.0¢/pass-km.

7.5 FERRY ACCIDENT COSTS

The fatality rate in ferry operations is estimated in the Notes to Chapter 8 in this volume as 0.5 deaths per billion passenger-kilometres. It is assumed that injuries are insignificant compared with deaths, as most deaths are by drowning (and given the differences in the average costs per victim injured and killed).

Valued at Transport Canada's cost of $1.5 million per person killed, the accident costs amount to 0.075¢/pass-km, which is quoted in Table 3-1 as 0.1¢/pass-km. Once again, the non-user portion is not zero, but negligible in Table 3-1.

8. VEHICLE/CARRIER COSTS AND SPECIAL TRANSPORTATION TAXES/FEES

8.1 CAR

As described in Volume 1 of this report, the term "car" is used as a shorthand reference for all private passenger vehicle use, most of which is in passenger cars, but with a significant proportion being in light trucks (30 billion passenger-kilometres, of a total on the "highway" system of 210 billion, or about 14%). Light trucks are mostly pickup trucks and passenger vans — defined as under 10,000 lb. (4 550 kg) laden weight, but nearly all under 6,000 lb. (2 725 kg) laden. Their cost characteristics are somewhat different from those of passenger cars; therefore, it is necessary to estimate costs for an average vehicle, blending costs for cars and light trucks in proportion to their use.

A report for the Royal Commission provided estimates of the costs of vehicle ownership and operation separately for cars and light trucks. Of these costs, insurance costs are included within user-borne accident costs, and vehicle licence costs and fuel taxes are included as special taxes/fees. Vehicle/carrier costs consist of the remaining costs of vehicle ownership and use. Costs for maintenance, depreciation and cost of capital are shown in Table 3(2)-7.[35] Estimates summarized in this table were provided for 1990 and are inflated to 1991 prices in the final column. The combined average figures weight the use of cars and light trucks by their total passenger-kilometres.

Table 3(2)-7

AVERAGE UNIT COSTS: CARS AND LIGHT TRUCKS

	$/veh per year (1990)	¢/veh-km (1990)	¢/pass-km (1990)	¢/pass-km (1991)
Cars				
Maintenance	409	2.3	1.3	1.4
Depreciation	1,230	7.0	3.9	4.1
Cost of capital	1,020	5.8	3.2	3.4
Light trucks				
Maintenance	409	2.3	1.5	1.6
Depreciation and cost of capital	2,030	11.3	7.5	7.9
Average passenger vehicle				
Maintenance	409	2.3	1.3	1.4
Depreciation and cost of capital	2,210	12.6	7.2	7.5

The cost of fuel is estimated for mid-1991 from a national average price (weighted by sales) of 55¢/L of gasoline, together with approximate average highway fuel consumption of 9 L/100 km for cars and 12 L/100 km for light trucks, together with average highway car occupancy of 1.8 passengers and light truck occupancy of 1.5 passengers. The cost for cars is 55/(100/9) = 4.95¢/veh-km, and 4.95/1.8 = 2.75¢/pass-km, and for light trucks 55/(100/12) = 6.6¢/veh-km, and 6.6/1.5 = 4.4¢/pass-km. Combined in proportion to passenger-kilometres driven, the blended average "car" fuel cost is 2.95¢/pass-km.

From this cost of fuel, the amount paid as special tax is deducted, and then appears as part of the "special tax/fee" item in the system average cost table instead of as a "vehicle/carrier" cost component. The relevant amount of tax is defined to be the amounts of provincial and federal taxes on gasoline in excess of the normal amounts of sales taxes charged in the jurisdictions concerned. The calculation is documented in Table 3(2)-8.

The federal excise tax of 8.5¢/L is included as part of the special charge for use of transport, but not the federal GST. Quebec's defined provincial excise tax is included without adjustment. In all other provinces, a motive fuel tax is charged instead of the normal provincial sales tax. Subtracting the amount that could have been charged as provincial sales tax leaves the component of the special charge for use of transport. The total of these charges averaged 17.8¢/L in 1991, when weighted by fuel use by province. Using the assumption of 9 L/100 km for cars, this special tax is therefore 1.6¢/veh-km, or 0.89¢/pass-km. For light trucks using 12 L/km it is 2.14¢/veh-km or 1.42¢/pass-km. The blended average for car is 0.95¢/pass-km. When combined with licence fees, which average 0.22¢/pass-km (see subsection 5.1.4), the total special transportation tax/fee for cars is thus rounded to 1.2¢/pass-km.

It is estimated that the net amount of fuel cost to be included in vehicle/carrier cost is, therefore, 2.95–0.95 = 2.0¢/pass-km. Total vehicle/carrier cost is the sum of the amounts estimated earlier for maintenance, depreciation and cost of capital, and fuel, or 1.4+7.5+2.0 = 10.9¢/pass-km (rounded) at 1991 prices.

Table 3(2)-8

FUEL TAX RATES PER LITRE: 1991 AVERAGE

	British Columbia	Alberta	Saskat-chewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	New-foundland	Canada Average
Federal Excise											
Gasoline	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	**8.5**
Road diesel	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	**4.0**
Aviation turbo	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	**4.0**
Locomotive	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	**4.0**
Provincial Special Tax — In Excess of the Standard Sales Tax Rate											
Gasoline	7.3	8.4	7.6	7.3	9.4	11.9	7.3	8.0	7.2	7.5	**9.3**
Road diesel	7.8	8.5	7.3	8.1	9.0	10.5	8.3	10.5	7.6	9.0	**9.1**
Aviation turbo	1.5	5.0	5.1	3.9	0.2	3.0	−1.4	−2.5	−2.7	−3.4	**1.8**
Locomotive	1.5	9.0	13.1	11.7	2.0	3.0	0.9	−3.1	9.0	−3.7	**5.5**
Total Special Taxes — Federal plus Provincial											
Gasoline	15.8	16.9	16.1	15.8	17.0	20.4	15.8	16.5	15.7	16.0	**17.8**
Road diesel	11.8	12.5	11.3	12.1	13.0	14.5	12.3	14.5	11.6	13.0	**13.1**
Aviation turbo	5.5	9.0	9.1	7.9	4.2	7.0	2.6	1.5	1.3	0.6	**5.8**
Locomotive	5.5	13.0	17.1	15.7	6.0	7.0	4.9	0.9	13.0	0.3	**9.5**

8.2 INTERCITY BUS

To generate the system-average costs of intercity passenger bus in Table 3-1 and the illustrative route examples of Tables 3-2, 3-3, 3-4 and 3-5, a simple method based on published data[36] was used.

	($ millions)
For classes 1 and 2:	
Taking operating expenses minus	316.4
bus depreciation expense	− 14.4
equals:	302.0
Attributing an estimated 75% to intercity	× 75%
passenger unit toll services gives:	227
Adding approximate average replacement-value-based depreciation and cost of capital ($32,000 multiplied by 1,273 buses)	+ 41
equals the total for classes 1 and 2	268
For total activity:	
Prorating for the intercity unit toll services of operators other than classes 1 and 2 (an additional 273 million pass-km or 8.3%) results in:	290
Allowing for a reduction in the level of activity from 1989 to 1991, in line with the long-term trend (2 years at –2.9%) provides:	274
Inflating 1989 dollars to 1991 dollars (2 years at 4.5%) gives a final total of:	299

This figure, $299 million, is the total to be found under users in Table 3-1(b). Divided by the estimate of 3.3 billion passenger-kilometres, it implies a system-average users cost of 9¢/pass-km.

The special tax/fee for bus travel consists of fuel tax and vehicle licence fees. Fuel use is estimated by Royal Commission staff to average 0.405 L/bus-km, or 0.019 L/pass-km with average occupancy of 45%. Federal and provincial special taxes on diesel fuel, in excess of normal sales taxes, averaged 13.1¢/L in 1991. The average fuel tax was therefore 0.25¢/pass-km.

Provincial vehicle licence fees for intercity buses average about $500 per year,[37] or less than $0.5 million in total for about 1,000 buses engaged in intercity scheduled services in Canada. Averaged over 160 000 km per bus per year, the fee is less than 0.6¢/veh-km and at 45% occupancy is therefore 0.015¢/pass-km. Adding together fuel tax and licence fees gives a rounded average of 0.3¢/pass-km.

In considering the possible relaxation of economic regulation of the intercity bus industry (discussed in Chapter 13 of Volume 1), it was desirable to assess the importance of cross subsidization across different route types under the current regulatory regime. For this purpose, a much more detailed study of intercity bus carrier costing was undertaken; this study by Lake et al. is included in Volume 4 of this report.[38]

Two cost formulas were developed to reflect the differences between the major, large-scale carriers and the small-scale, often remote carriers. These formulas were based on cost and statistical data made available to Royal Commission staff on a confidential basis by various bus operators. For the study of cross subsidization within the intercity scheduled bus industry, the formulas were applied to a sample of actual routes, and the results examined as reported in Lake et al.

This method introduced output units into the costing, which allowed the cost characteristics of different types of routes to be captured. The usual measure used by the bus industry for cost analysis is the bus-mile.[39] However, for the analysis of cross subsidization, cost categories were attributed according to a notion of the relationship to bus-miles: using bus hours to reflect the different time to distance ratios of some services, and a per-passenger element to reflect costs that are variable with the volume of traffic (number of passengers) but not with distance travelled. For most cost categories, there was insufficient consistency among the accounting definitions used by the various carriers to justify basing an estimate on averages. Rather, cost components from different sources were blended to achieve unit costs that appeared to represent a typical or normal level of cost.

Replacement value based depreciation and cost of capital charges for buses were included in the bus-hour cost:

Cost of new bus (1989–1990)	$260,000
Average life	10 years
Cost of 5-year-old bus	$100,000
End of life salvage	$20,000
Depreciation	straight line
Real cost of capital	10%

This results in an ownership cost per year for a new bus (assumed for the large-scale operations) of $38,000, and for a five-year-old second-hand bus (assumed for the small-scale operations) of $22,000. The unit cost reflecting bus time was calculated per scheduled bus hour. This made calculation of the cost for specific services easier, because the cost includes an idle or utilization factor. Analysis indicated that there are between three and a half and five buses owned for every one actually moving and carrying passengers on scheduled service at an average point in time. Overall, it was estimated that, for every hour that a bus is moving with passengers, it has spent or will spend more than three and a half hours in terminals, in a garage, or available for service. This factor was calculated using bus inventory, bus mileage and an estimate of average schedule speed of 40 or 50 mph (65 to 80 km/h). It only provided a rough approximation, but data required to make more dependable estimates were not available.

The calculated cost per passenger included a cost for terminals that represents terminal charges or rent (based on data from carriers that rent terminals). Some carriers own all of the terminals they use, some do not own any. Most of the large carriers own some terminals and pay charges or rent for the shared or exclusive use of others. The owners of at least one major carrier own a terminal that is treated as a separate profit centre, charging the bus operation for its use.

The data were combined in an effort to present a reasonable approximation of the industry cost structure without disclosing data for any single contributor. It proved impossible to mask fully the costs of one or more of the large carriers; thus, only the qualitative conclusions, and not the specific cost estimates have been included in the study. The estimates could be used without endangering confidentiality, however, to develop differentials by which costs calculated for types of routes — used in the sample route tables of Chapters 3 and 18 of Volume 1 — differed from the system-average costs and fares outlined at the start of this section and presented in Table 3-1 of Volume 1.

8.3 AIRPLANE

The unit-cost development was based on an analysis of system data designed to allow some recognition of factors that contribute to differences in costs of different types of flights.

The analysis, however, does not consider network size or configuration, or a number of other reasons why marginal cost, or the cost of domestic services isolated from international operations, might depart markedly from the unit-cost estimates.

The estimates are based on 1989 data and a 1989 industry; in the case of the Level 1 carriers some modifications were made as later data became available. It may be noted that several of the carriers included in the data for independent jet carriers were, as of 1991, no longer operating. Developing an estimate of total air carrier costs for domestic services from the costs for a typical domestic air journey, however, avoids any biases that this might have created.

The air service costing was based on data provided by Statistics Canada, supplemented with information provided by airlines. These were allocated according to operational relationships, making use of a number of earlier studies.[40] This process benefited from the comments of Air Canada, Canadian Airlines International and the Air Transport Association of Canada.

The airlines' cost data do not separate freight from passenger operations. To the extent that passenger seats and (belly) freight capacity are jointly produced, separation for the present analysis was arbitrary. Because the purpose of the exercise was to develop passenger costs, and because freight carried by carriers represented approximately 10% of revenue, costs for Level 1 were reduced by 5%, presuming that one half of the freight was carried in belly space. Freight was not considered for carriers other than Level 1.

Air services available to passengers in Canada vary from single-engine charter float-planes to trans-Atlantic and trans-Pacific direct flights in B-747 aircraft with more than 450 seats. Scheduled carriers, Levels 1 to 3, account for 97% of Canadian carrier costs. The costing was performed separately for the Level 1 carriers (Air Canada and Canadian Airlines International), a sample of independent jet carriers (Nationair, Quebecair, Soundair, Worldways, Canada 3000, Execair, Holidair and Vacationair) and a sample of turboprop connectors or commuter carriers (Air Alliance, City Express, Ontario Express, Air Atlantic and Air Ontario).

Instead of the more conventional, strictly time-based approach, expense data were adjusted to remove aircraft depreciation expense and rentals, supplemented by a replacement value aircraft capital recovery charge at an interest rate of 10%, and attributed to four output units:

- seat-kilometres;
- seat-stages;

- passenger (same airplane) flights; and
- passenger trips.

The cost allocation for the Level 1 carriers for 1991 (1989 data adjusted to 1991 cost levels) is shown in Table 3(2)-9 on the following page. The table is based on costs of all passenger services, international and domestic. Treatment of the other carrier categories is briefer.

Although recent years have seen considerable fluctuation, an average load factor of 67.5% was taken — from Air Canada and Canadian Airlines International (PWA Corporation) annual reports — as representative of sustainable performance in this regard. Revenue passenger-kilometre, seat-kilometre, passenger-flight, revenue-passenger and other intermediate output units such as average stage,[41] flight and trip lengths (as estimated from Statistics Canada data, data provided by the airlines and airlines' annual reports[42]) allowed estimates of the necessary output units.

Unfortunately, the data did not always appear consistent. This imprecision, however, was not greater than that of the overall costing exercise and should not compromise the results. The uncertainty included average flight length and passenger-trip length; Statistics Canada counts flight coupons and hence overestimates trips where there are changes of planes. Estimates of an average 1.15 aircraft stages per flight and 1.16 flights per passenger trip[43] were based on data from Statistics Canada Catalogue No. 51-206, Table 2.3 and airline data; the Statistics Canada's Canadian Travel Survey[44] reported the 23 million passengers handled.

Flight-crew costs are allocated on the basis of flying hours. The literature (cited earlier) included regressions of Canadian airlines' turbojet flight time against distance. The regression selected (Moloney, 1985) was the most comprehensive. Flight-time estimates were calculated as a constant of 0.4006 hours per stage plus 0.0020 hours per mile. It is further noted that crew costs vary with aircraft type; smaller airplanes (that typically operate on shorter stages) generally have higher crew

Table 3(2)-9

COST ALLOCATION, PASSENGER SERVICE, LEVEL 1 AIR CARRIERS, 1989 (1991$)

		Seat-km			Seat-stages			Passenger flights			Passenger trips		
Output Units (millions)		75,000			46			27			23		
	Expense	**Allocation**	**Total**	**Per unit**	**Allocation**	**Total**	**Per unit**	**Allocation**	**Total**	**Per unit**	**Allocation**	**Total**	**Per unit**
Air Operations													
Fuel	1,062.1	72%	764.7	0.01023	28%	297.4	6.52						
Flight crews	327.1	73%	238.7	0.00319	27%	88.3	1.94						
Landing, insur.	516.0				100%	516.0	11.32						
Air Maintenance													
Labour	206.6	44%	90.9	0.00122	56%	115.7	2.54						
Materials, other	425.5	44%	187.2	0.00250	56%	238.3	5.23						
In-Flight Services													
Cabin crews	287.5	57%	163.9	0.00219	43%	123.6	2.71						
Food, supp, other	428.1	50%	214.1	0.00286	40%	171.2		10%	42.8	1.60			
Terminal	942.0							60%	565.2	21.12	40%	376.8	16.38
Marketing	1,043.0										100%	1,043.0	45.35
Air Capital	512.8	44%	225.6	0.00302	56%	287.2	6.30						
Total	**5,750.6**			**0.02521**			**36.55**			**22.72**			**61.73**

costs per seat-stage and seat-kilometre. The analysis did not allow for this.

Fuel was attributed to flight hours, with a small allowance for taxiing. Cabin-crew costs were allocated on the basis of flying hours plus 40 minutes per stage. Maintenance cost and the physical wear of a turbojet airplane are attributed partially to cycles (takeoff, pressurization, de-pressurization, landing) and partially to flying hours. A figure of 40% attributable to cycles (Aviation Planning Associates, 1983) yields estimates of 44% attributable to seat-miles and 56% to seat-stages.

Because most airplane accidents occur at takeoff or landing, insurance, with landing fees, was attributed entirely to these activities. For terminal costs, the only data found that matched the definition used here were old (Bajwa and Shurson, 1981). These were escalated using an approximate construction cost index.

The cost aggregate termed "marketing" includes travel agents' commissions that are generally paid as a percentage of revenue. Using this would introduce a further output unit; however, at the basic level (cost to the agent), passenger-trips would seem a reasonable variable. General and administrative cost, presumably relating to corporate administration, was allocated to all of the preceding items.

Computations for levels 2 and 3 are similar. To convert costs per seat-mile into figures appropriate for comparisons, an average load factor of 67.5% was applied to the Level 1 data. For the connectors/commuters it was estimated as 56%, and for the independent (charter) jet carriers where load factor data were not available, 80% was assumed. It is noted that, perhaps more than any other parameter, the assumption of a uniform load factor distorts route and service comparisons.

System-average costs are calculated by service type as shown in Table 3(2)-10.

Table 3(2)-10
AIR CARRIER AVERAGE UNIT COSTS (IN 1991 DOLLARS)

	Passenger-kilometre ($)	Passenger-stage ($)	Passenger-flight ($)	Passenger-trip ($)
Level 1	0.0373	54.15	22.72	61.73
Commuter	0.0961	39.50	8.73	17.28
Charter jet	0.0467	62.81	10.91	13.97

As an example, the computed average per-passenger cost for a trip from Saskatoon to Halifax (Level 1 carrier) with a change of airplanes in Toronto would be:[45]

3 500 km	at $ 0.0373	$130.55
2 stages	at $54.15	108.30
2 flights	at $22.72	45.44
1 trip	at $61.73	61.73
		$ 346.02

8.3.1 System-Average Domestic Air Trip, 1991

Statistics Canada and the airlines do not keep cost and revenue data for domestic travel. It would not be logical to attempt to keep accounts under that structure; domestic, Canada–United States and international services are operated as an integrated network. The cost characteristics of the different services are, however, quite different. The overseas international services with long average flight and stage lengths, using larger aircraft, differ particularly. To estimate domestic-system-average and system-total costs, a typical trip of 1 478 air kilometres was defined as indicated by Statistics Canada's and other available data. It is noted that these data on flight characteristics are for all airlines (Levels 1 to 3) and for domestic services in isolation; however, the system-average-cost estimate is based on Level 1 carrier cost factors.

Computed carrier cost	1 478 kilometres	at $0.037	$55
	1.6 stages	at $54	86
	1.4 flights	at $23	32
	1 trip	at $62	62
			$235

This yields an average cost of 15.9¢/pass-km to which another $20, or 1.4¢/pass-km, Air Transportation Tax may be added — for a total of 17.3¢/pass-km. The average ticket yield was, however, estimated to be $222 for a trip of this length[46] (15¢/pass-km), or $242 (16.4¢/pass-km) with the Air Transportation Tax. These estimates suggest that the airlines are operating at a loss of 0.9¢/pass-km if one includes a return on capital invested in aircraft.

While these estimation methods are not precise, in the short run it is true that losses are being incurred. It is not, however, reasonable to expect such a condition to persist for very long. To model a more representative steady state condition, it was assumed that the difference will ultimately be made up through price increases averaging approximately 6%.

Special tax/fee costs for air travel consist only of the applicable fuel tax. Royal Commission staff estimate that average fuel consumption for domestic air services is 0.103 L/pass-km. The special tax rate applicable to aviation turbo fuel was 5.8¢/L in 1991. The average tax was therefore 0.6¢/pass-km.[47]

8.4 RAILWAY PASSENGER

For practical purposes, when one considers the cost of railway passenger services in Canada, one may limit the consideration to VIA Rail. VIA Rail accounts for 95% of the industry's passenger-kilometres, and the other carriers' unit costs are of the same general order as VIA Rail's. As well, since VIA Rail is exclusively a passenger carrier, no separation of freight from the passenger operations is required in analyzing its data.

The Royal Commission's intercity rail-carrier costing is described in Volume 4 of this report.[48] For the most part, the service costing was based upon VIA Rail's 1990 year-end results. Data for 1989 were available and were used in circumstances where the substantial service rationalization that occurred in January 1990 would have distorted the 1990 results, making them unrepresentative of the longer term.

Overheads and indirect costs included: functional overheads, general corporate overheads, shared facilities and operations, plus the cost of capital on equipment and facilities. The costs used for the year 2000 status-quo costs of Chapter 18 are steady-state in the sense that allowance has been made for improvements in the cost experience of passenger rail.

System-total data for 1991, as shown in Table 3-1 of Volume 1, were estimated from recently available 1991 VIA Rail data, plus escalated 1987 data for BC Rail, and the Algoma Central, Ontario Northland and Quebec North Shore and Labrador Railways. Total Canadian railway passenger revenues and costs, and VIA Rail's share, are:

	$ million (1991)		
	VIA Rail	Other	Total
Passenger revenue	144	10	154
Operations subsidy	353	38	391
Depreciation and cost of capital[49]	62	included	62
Total			607

Special tax/fee costs for train travel consist of the fuel taxes paid that would be in excess of the normal sales taxes. Average fuel consumption was estimated by Royal Commission staff as 0.043 L/pass-km. Combined with the average special tax-rate on locomotive fuel of 9.5¢/L in 1991, the tax amounted to 0.4¢/pass-km.

8.5 FERRY

Cost estimates are based on a research report to the Royal Commission.[50] The report provides cost, revenue and traffic records for the three major ferry corporations: British Columbia Ferry Corporation, Marine Atlantic Inc. and Northumberland Ferries Ltd., which together provide about 95% of Canada's total ferry passenger-kilometres. Estimates of average costs and revenue per passenger-kilometre are developed for these three operations combined and used to represent all domestic intercity ferries. Other intercity services included are the Central Region Ferries in the Great Lakes (Tobermory to South Baymouth) and St. Lawrence (Matane to Godbout; Matane to Baie Comeau; Rivière du Loup to St. Siméon; Trois Pistoles to Les Escoumins), and the Atlantic region service from Souris to the Magdalen Islands. On the other hand, limiting the focus to domestic services means that the service by Marine Atlantic between Yarmouth and Bar Harbor is consequently excluded, as are services such as Victoria to Seattle, Sidney to Anacortes, Victoria to Port Angeles and Yarmouth to Portland.

Costs and revenues are for the fiscal year 1990-91, but are assumed adequate to represent 1991 conditions and 1991 prices. Capital charges were estimated including depreciation and a capital charge on the remaining value of the assets, in a manner similar to that described for air infrastructure. Costs and revenues were estimated per passenger-vehicle-kilometre; that is, vehicle-kilometres by passenger vehicles, as opposed to trucks. These were distinguished by allocating the costs between freight vehicles and passenger vehicles on the basis of space used by the vehicles, measured in "automobile-equivalent" units (an average heavy truck being about three automobile-equivalents). The resulting estimates are:[51]

	Costs	Revenues
	($/passenger-vehicle-kilometre)	
BC Ferries	0.91	0.76
Marine Atlantic	1.98	0.85
Northumberland Ferries	2.28	1.01

8.5.1 Exclusion of Food Services and Other Merchandise Retailing

As for the other modes (in particular airports), costs and revenues attributable to commercial activities other than providing passenger service, and not included in the ticket price, were subtracted from the ferry data. This included cost and revenue related to catering services and other sales of goods. The accounts provided for BC Ferries and Marine Atlantic offer the relevant information (for the former, "cost of food and goods sold" and "catering and other income"; for the latter, "vessel services revenues"). The calculation, in fact, deducts revenue rather than costs, on the assumption that the revenue recovers not only the costs of the materials concerned, but also an appropriate proportion of crew and vessel costs. (This is a tenuous assumption, which probably overstates the costs concerned and so produces a slight underestimation of the remaining transportation costs.)

The arithmetic of removing catering and other sales was:

- For BC Ferries, to estimate them as a proportion of the "ships" costs, and to deduct this proportion from the "vessels" costs per passenger-vehicle-kilometre;
- For Marine Atlantic, to estimate them as a proportion of the "vessels" expenses, and to deduct this proportion from the "vessels" costs per passenger-vehicle-kilometre; and
- For Northumberland Ferries, no information on such costs was available and no deduction was made.[52]

8.5.2 Exclusion of Excess Vessel Costs Arising Through Local Construction

Capital cost estimates, and thus total vessel costs, were modified to remove the excess amount incurred through purchasing local construction, as opposed to the lowest-cost (off-shore) alternative. This modification of the estimates of costs is in accordance with the Royal Commission's intention that costs incurred by government in pursuit of non-transportation goals be charged to general revenues — implying that those vessel costs arising from an intention to support Canadian shipbuilders, beyond a level provided by standard import tariffs, should not be included in the costs that users are asked to pay.

The amounts of vessel costs concerned can be estimated only very approximately. From a brief tabulation of some prices paid recently for large ferries in Canada and overseas, it appears that the premium for Canadian construction might be of the order of 50% to 100% of the off-shore price.[53] Some corroboration is provided by comparisons of costs for other types of vessels; for example, a price for construction in Canada of a seaway-size bulk freighter is double that of one built in Korea.[54] To the off-shore prices must be added 25% duty, but the differential remains substantial.

For illustrative purposes, it is assumed that the premium for local construction amounts to 33% of the capital cost of the vessel. This proportion is therefore deducted from the vessel capital costs included in the accounts for Marine Atlantic and BC Ferries. The vessel costs are not separately identified for Northumberland Ferries, so no such deduction is made; but the effect of this omission on the system average costs is negligible.

The resulting costs per passenger-vehicle-kilometre, amended for both food services (cost and revenue) and local vessel construction premiums, are:

	Costs	Revenues
	($/passenger-vehicle-kilometre)	
BC Ferries	0.73	0.62
Marine Atlantic	1.74	0.71
Northumberland Ferries	2.28	1.01

8.5.3 Estimation of Costs per Passenger-Kilometre

The earlier cost and revenue estimates attempted to exclude all elements relating to freight transportation. In estimating the costs per ferry passenger-kilometre for comparison with the other modes, it is necessary to distinguish the passengers on ferries who travel in passenger vehicles from the occupants of freight vehicles, who are also described as passengers in the ferry statistics. Assuming 1.1 occupants per commercial vehicle, there were 637,000 passengers in commercial vehicles, or 2.8% of the total of some 22.8 million passengers in 1990-91, for the three companies. Because the commercial vehicle passengers are so small a proportion of total passengers, the subsequent estimate of total passenger-kilometres is clearly not very sensitive to the guessed number of occupants per commercial vehicle.

For BC Ferries and Marine Atlantic, this procedure for estimating "non-commercial passenger-kilometres" was applied to each of the services, allowing overall estimates of 640 million passenger-kilometres for BC Ferries and 135 million passenger-kilometres for Marine Atlantic. For Northumberland Ferries, the amended estimate is 12.07 million passenger-kilometres. Expressed alternatively as numbers of passengers per passenger-vehicle carried by the three companies, the results are as shown in the second column of Table 3(2)-11. The cost and revenue estimates in the previous tables can be divided by these estimates of passengers per vehicle to give costs and revenues per "non-commercial passenger-kilometre" in the final two columns of Table 3(2)-11.

Table 3(2)-11
AVERAGE FERRY UNIT COSTS AND REVENUES

	Passengers per passenger-vehicle	Costs ($ pass-km)	Revenues ($ pass-km)
BC Ferries	2.59	0.282	0.239
Marine Atlantic	2.43	0.718	0.292
Northumberland Ferries	2.48	0.921	0.408
Average		0.366	0.250

The system-average vehicle/carrier cost estimate for ferries is therefore 36.6¢/pass-km, and the "user-borne" portion is 25¢/pass-km.

In the illustrative tables of Volume 1, Chapters 3 and 18, amounts borne by vehicle users/carriers and passengers for accident costs and special transportation taxes/fees are shown separately. In the case of ferries, all of these costs are included in the estimated averages of 36.6¢/pass-km and 25¢/pass-km; thus, they must be deducted to show the remaining vehicle/carrier costs.

8.5.4 Estimation of Special Tax/Fee for Ferry

As the first step in the calculation of special taxes, the amount of fuel used in the ferry services must be estimated per passenger-kilometre. Marine Atlantic provided data for the company's fuel purchases and expenditures over a three-year period.[55] Direct estimates of fuel used by BC Ferries and Northumberland Ferries were not available; estimates based on their expenditures on fuel[56] in 1990, together with an assumed average price of 26.5¢/L plus provincial tax, were used. These estimates suggest a combined total fuel consumption of about 195 million litres for the three ferry companies.

These estimates of consumption were then allocated between freight and passenger vehicles for each company in the same manner as were costs; that is, according to proportions of auto-equivalent units transported. Then the estimates of total (non-commercial) passenger-kilometres for the three companies were used to calculate litres of fuel consumed per passenger-kilometre. The resulting estimate is 0.191 L/pass-km.

The average special tax payable per litre for these ferry services was then calculated. This involved a calculation analogous to that for the special tax component of prices of gasoline used in cars, as discussed earlier. Federal excise and provincial fuel taxes paid, by province, in 1991, on marine fuels are shown in Table 3(2)-12. The amount of provincial tax that would have been payable had the normal sales tax rate been applied to the price of marine fuel was then calculated — also shown in Table 3(2)-12. Finally those amounts were deducted from the total of the federal excise and provincial taxes paid to obtain the net amounts of special transportation tax paid.

Table 3(2)-12
Special Tax Calculation: Ferry
(Taxes in 1991¢/L of marine fuel)

	Nfld.	P.E.I.	N.S.	N.B.	B.C.
Federal excise	4.0	4.0	4.0	4.0	4.0
Provincial tax	0.0	0.0	1.2	0.0	3.34
Tax at PST rate	3.9	3.3	3.3	3.6	1.5
Net special tax	0.1	0.7	1.9	0.4	5.8

To estimate the amounts of fuel used in the east-coast services bought in each province, it is simply assumed that half the fuel used in each of the ferry services is purchased at each end of the trip. The weighted average tax rate paid on the Marine Atlantic services would then be 0.96¢/L, on Northumberland Ferries' services 0.55¢/L, and on the BC Ferries' services, as shown in Table 3(2)-12, 5.8¢/L.

Then, by multiplying these taxes by the estimated consumption per passenger-kilometre, the average special fuel tax payment for all the ferry services is estimated as 0.87¢/pass-km. This is included in the system-wide costs in Table 3.1, appearing as 0.9¢/pass-km when rounded.

The amount of this tax must be deducted from the vehicle/carrier costs together with ferry accident costs, estimated at 0.075¢/pass-km. Resulting user-borne vehicle/carrier costs are reduced from the 25¢/pass-km estimated earlier, to 24.1¢/pass-km, while total vehicle/carrier costs are reduced from 36.6¢/pass-km to 35.7¢/pass-km.

9. Costs for Sample Routes

9.1 CAR

For simplicity, in these illustrations most of the costs of car use are assumed to be constant per kilometre, regardless of route. In reality, vehicle fuel consumption would differ among the routes, being determined by such factors as travel speed and the extent of congestion. Vehicle maintenance and depreciation per kilometre would also vary by those factors, and be influenced by the quality of the highway pavement. Accident risks and, therefore, expected accident costs, are also known to vary by route and traffic conditions. Nevertheless, it is assumed here that such variations are not important to the major purpose of these estimates, which is to show the orders of difference in costs by mode, and subsequently (in Chapter 18) to show the future cost changes expected. Each of these classes of costs is therefore assumed to be the same per vehicle-kilometre on all of the sample routes as the system-wide averages estimated earlier. Also for simplicity, and in the absence of much information, average vehicle occupancies are assumed constant for all sample routes, so these categories of costs remain the same per passenger-kilometre as the system-wide averages.

The exceptions are the highway infrastructure costs and the environmental costs, which are assumed to vary by route, as described in subsections 9.1.1 and 9.1.2.

9.1.1 Costs of Infrastructure

The estimates of highway construction and maintenance costs prepared by Nix et al. and shown in Table 3(2)-3, earlier, differ substantially by class of highway. Adding the cost of capital to those estimates, and inflating to 1991 prices, produces the costs per vehicle-kilometre, which appear in the second column of Table 3(2)-13(i). The proportions in which each class of highway are represented differ among the sample routes, so the average infrastructure cost should also differ by route. The proportions have been estimated only roughly by Royal Commission staff. The estimates made for the four sample routes in Volume 1, Chapter 3 and also for the additional routes in Chapter 18, are as shown in part (i) of Table 3(2)-13.

Part (ii) of Table 3(2)-13 then shows the resulting estimates of costs averaged over the highway types for each of the routes, expressed as costs per vehicle-kilometre and per passenger-kilometre. It can be seen that they differ substantially, being lowest for the all-expressway route between Toronto and Montreal and greatest for the predominantly low-density rural highway route between Winnipeg and Gillam.

The estimates of car infrastructure costs for the sample routes are produced by adding the system-average cost of infrastructure control per passenger-kilometre from subsection 5.1.4., of 0.22¢/pass-km, to the costs per passenger-kilometre in Table 3(2)-13. In addition, for the route from Toronto to Montreal an estimate of the highway land cost of 0.3¢/pass-km, or $1.60 per passenger-trip, is included. Land costs are ignored on the other routes, as they are expected to be much less important within the trip totals.

Table 3(2)-13

HIGHWAY CONSTRUCTION AND MAINTENANCE COSTS FOR SAMPLE ROUTES, INCLUDING COST OF CAPITAL, IN 1991 PRICES

(i) Costs per vehicle-km, and route distance by class of highway									
	Costs (¢/veh-km)		Assumed distance on sample routes by highway type						
			Toronto–Montreal	Saskatoon–Halifax	Val d'Or–Montreal	Vancouver–Toronto	Winnipeg–Gillam	Halifax–St. John's	
Highway class	Car	Bus	(km)	(km)	(km)	(km)	(km)	via Port aux Basques (km)	via Argentia (km)
Expressway	1.091	1.955	539	1,300	114	1,360	0	110	110
Paved highway:									
– top 10%	1.626	3.048	0	1,592.5	0	1,566	200	578.5	179.5
– middle 30%	3.933	7.754	0	1,592.5	336	1,566	875	578.5	179.5
– bottom 60%	10.486	20.980	0	0	0	0	0	0	0
Total route distance	—	—	**539**	**4,485**	**450**	**4,492**	**1,075**	**1,267**	**469**

Sources: Costs by highway type from estimates by Nix et al., including capital charges estimated by Royal Commission staff, and inflated to 1991 prices. Route distances by highway type estimated by Royal Commission staff.

Table 3(2)-13 (cont'd)

HIGHWAY CONSTRUCTION AND MAINTENANCE COSTS FOR SAMPLE ROUTES, INCLUDING COST OF CAPITAL, IN 1991 PRICES

(ii) Average costs by car and bus for sample routes							
	Toronto–Montreal	Saskatoon–Halifax	Val d'Or–Montreal	Vancouver–Toronto	Winnipeg–Gillam	Halifax–St. John's	
Highway class						via Port aux Basques	via Argentia
Car costs:							
Average cost/veh-km (¢)	1.091	2.290	3.213	2.268	3.504	2.633	2.383
Average cost/pass-km (¢)	0.627	1.316	1.846	1.304	2.014	1.513	1.370
Bus costs:							
Average cost/veh-km (¢)	1.955	4.402	6.285	4.358	6.878	5.102	4.593
Average occupancy (pass/veh)	36.19	27.00	21.15	27.00	21.15	20.00	20.00
Average cost/pass-km (¢)	0.054	0.163	0.297	0.161	0.325	0.255	0.230

Source: Bus occupancy by route estimated by Royal Commission staff.

9.1.2 Environmental Costs

As well as differing because of trip lengths, costs of environmental damage are expected to differ among the illustrative routes because of the different distances travelled within the ozone non-attainment areas (ONAs). In fact, because fuel consumption, and implicitly other engine operating conditions, are assumed constant among the routes, emissions are also constant per vehicle-kilometre. The cost for CO_2 (at 3.27¢/kg, as described in the Notes to Chapter 7 in this volume) is therefore also constant per vehicle-kilometre for all routes, at about 0.73¢, or 0.41¢/pass-km.

The cost of emissions of NO_x and VOCs, however, is assumed to be $5/kg only within the ONAs, and only during summer. Otherwise the cost is zero. The portion of each of the sample routes assumed to lie within the ONAs is shown in Table 3(2)-14, for the other modes as well as for car travel. Emissions per vehicle-kilometre are assumed constant during each trip; therefore, the proportion of trip-kilometres within the ONAs represents the proportion of trip emissions within those areas. The fraction of emissions that occur in summer is assumed to be constant at 40%. That portion of the total NO_x and VOCs emissions on each route in ONAs in summer is multiplied by $5/kg to obtain the cost for each route.

A more comprehensive explanation of the derivation of the costs on two of the sample routes, Toronto to Montreal and Saskatoon to Halifax, forms part of the Notes to Chapter 7 in this volume.

9.2 BUS

9.2.1 Costs of Infrastructure

The costs for highway construction and maintenance per bus-kilometre estimated by Nix et al., in Table 3(2)-3, also differ substantially by class of highway, and therefore vary among the sample routes as the types of highways represented differ. Distances by class of highway are assumed to be as described for cars, shown in Table 3(2)-13(i).

Table 3(2)-14

Trip Distances by Mode, and Distances in Ozone Non-Attainment Areas for Sample Routes

	Toronto–Montreal		Saskatoon–Halifax		Val d'Or–Montreal		Vancouver–Toronto		Winnipeg–Churchill		Halifax–St. John's			
											via Port aux Basques		via Argentia	
	km	km in ozone non-attainment areas	km	km in ozone non-attainment zones	km	km in ozone non-attainment zones	km	km in ozone non-attainment zones	km	km in ozone non-attainment zones	km	km in ozone non-attainment zones	km	km in ozone non-attainment zones
Car	539	539	4,485	650	450	114	4,492	250	—	—	1,267	0	469	0
Bus	539	539	4,485	650	450	114	4,492	250	—	—	1,267	0	469	0
Train	540	540	4,468	400	700	200	4,467	250	1,375	0	—	—	—	—
Airplane[a]	496	100	3,500	100	425	50	3,365	100	1,000	0	875	0	875	0
Ferry	—	—	—	—	—	—	—	—	—	—	178	0	519	0

Source: Royal Commission staff estimates.

a. Airplane kilometres in "ozone–sensitive areas" assumed to be 50 km per trip-end within such areas.

The second column shows the costs per vehicle-kilometre for buses by class of highway.

Part (ii) of the same table shows the weighted average cost per bus-kilometre over each route. As for cars, the lowest cost per vehicle-kilometre is incurred over the expressway route between Toronto and Montreal, and the highest over the low-density rural highway route between Winnipeg and Gillam.

The table then shows, in the next-to-last row, the Royal Commission staff estimates of average bus occupancies over routes of these types, and the last row shows the average cost per passenger-kilometre by route, obtained by dividing the cost per vehicle-kilometre by the occupancy on each route.

9.2.2 Environmental Costs

Emissions of CO_2, NO_x and VOCs from buses are assumed to be constant per litre of fuel used, as described in the Notes to Chapter 7 in this volume. They therefore vary per vehicle-kilometre by route only to the extent that fuel use per vehicle-kilometre varies, and also vary per passenger-kilometre to the extent that bus occupancies differ.

Fuel use per bus-kilometre is estimated by Royal Commission staff to be constant at 40 L/100 bus-km on most of the sample routes. Occupancies are assumed to vary by route as was shown in Table 3(2)-13(ii). The resulting fuel use per passenger trip for buses is shown in Table 3(2)-15, which also includes fuel use in the other modes. Emissions by route are obtained by converting the fuel use into CO_2, NO_x and VOCs emissions by the factors implicit in Table 7(2)-1 and 7(2)-2, which appear later in this volume.

Then costs of the emissions by route are calculated as described above for cars. Total trip emissions of CO_2 are multiplied by the assumed cost of 3.27¢/kg. Emissions of NOx and VOCs are first multiplied by the portion of trip-kilometres in the ONAs, also shown in Table 3(2)-15, and by 40% to represent summer; then remaining emissions are multiplied by $5/kg.

Table 3(2)-15

FUEL USE PER PASSENGER-TRIP BY MODE ON SAMPLE ROUTES

	Toronto–Montreal		Saskatoon–Halifax		Val d'Or–Montreal		Vancouver–Toronto		Winnipeg–Churchill		Halifax–St. John's			
											via Port aux Basques		via Argentia	
	L/pass	% in ozone non-attainment areas	L/pass	% in ozone non-attainment zones	L/pass	% in ozone non-attainment zones	L/pass	% in ozone non-attainment zones	L/pass	% in ozone non-attainment zones	L/pass	% in ozone non-attainment zones	L/pass	% in ozone non-attainment zones
Car	27.0	100	224.3	14	22.5	25	224.6	6	—	—	63.4	0	23.5	0
Bus	5.9	100	67.0	14	8.6	25	67.0	6	—	—	23.0	0	8.0	0
Train	15.0	100	283.3	9	102.9	29	270.0	6	260.0	0	—	—	—	—
Airplane[a]	40.8	69	219.2	16	46.3	60	120.0	23	80.8	0	67.2	0	53.8	0
Ferry	—	—	—	—	—	—	—	—	—	—	34.4	0	100.3	0

Source: **Royal Commission staff estimates.**

a. **Airplane fuel use in takeoff/landing assumed to be 35 litres per passenger.**

9.3 TRAIN

9.3.1 Costs of Infrastructure

The infrastructure costs, as for the carrier costs, are taken from data provided by VIA Rail and Transport Canada. Infrastructure costs are presumed to be payments to the freight railways for the service in question.

9.3.2 Environmental Costs

Emissions are assumed to be constant per unit of diesel fuel energy, as shown in Table 7(2)-1 in this volume. Estimated diesel-fuel use per passenger-trip for each sample route is shown in Table 3(2)-15. The two are combined to give emissions of CO_2, NO_x and VOCs per passenger-trip. Total CO_2 emissions are multiplied by a cost of 3.27¢/g. Costs of NO_x and VOCs are calculated by applying the unit cost of $5/kg to the portion of emissions released in the ONAs (from the trip-kilometres in ONAs in Table 3(2)-15) in summer (40%).

9.4 AIRPLANE

9.4.1 Costs of Infrastructure

The allocation of air infrastructure costs to individual sample routes is illustrated in subsection 5.3.3 of this Chapter.

9.4.2 Environmental Costs

Emissions are again assumed to be constant per unit of fuel energy among the sample routes, at rates shown in Table 7(2)-1 of this volume. Estimates of fuel use per passenger-trip are provided in Table 3(2)-15. The two are combined to give emissions of CO_2, NO_x and VOCs per passenger-trip.

Total CO_2 emissions are multiplied by a cost of 3.27¢/g. Amounts of NO_x and VOCs occurring in the ONAs are calculated somewhat differently for aircraft than for the other modes. Instead of using the proportion of route-kilometres that lies within the ONAs, it is assumed that the aircraft fuel used on the ground, climbing and descending at airports within the ONAs contributes to low-level ozone, while fuel used at cruising altitude does not. The relevant amount of fuel (for aircraft of a Level 1 carrier) is estimated by Royal Commission staff to be about 35 litres per passenger-stage. The proportion this represents of fuel used per passenger-trip by route is shown in Table 3(2)-15. This proportion of trip emissions, multiplied by 40% to represent summer, is multiplied by \$5/kg to obtain the NO_x/VOCs cost per passenger-trip.

9.5 FERRY

No route-specific ferry costs are shown in Chapter 3, but 1991 costs for ferry routes are included in Chapter 18. The examples in Chapter 18 are of the two ferry routes between Nova Scotia and Newfoundland. Costs per passenger-kilometre for infrastructure and accidents are assumed to be the same as the system average.

9.5.1 Vehicle/Carrier Costs

Costs for the two routes are obtained from the research report that provided the system-average costs.[57] The same procedures described earlier for the system-average costs were used to remove costs of food services and excess vessel costs arising from local construction, and to estimate fuel costs and taxes in order to distinguish the special tax/fee for the routes.

9.5.2 Environmental Costs

Emissions are again assumed to be constant per unit of fuel energy, as shown in Table 7(2)-1. Fuel use on the two illustrative ferry routes is assumed to be the same per ferry-kilometre, and per passenger-kilometre, and therefore differs per passenger-trip only by route length, as shown in Table 3(2)-15. No costs for NO_x and VOCs are assessed on either of these routes, as their emissions are assumed to occur entirely outside the ONAs.

Endnotes

1. Cross subsidy, in this context, implies that the hypothetical service in question makes more than the average contribution to fixed cost. Most economists would not use this (implied) definition of cross subsidy.

2. Estimates developed from Statistics Canada, *Passenger Bus and Urban Transit Statistics,* Catalogue No. 53-215, 1989; bus fuel consumption data; bus company accounts; and assumed load factors.

3. Treasury Board of Canada, *Benefit-Cost Analysis Guide* (Ottawa: Supply and Services Canada, 1976).

4. There are two methods of accounting for capital costs: investment expenditures can be included in total costs in the year in which they are made, or they can be amortized over time in such a way that the stream of annual "depreciation charges" and of annual "interest charges" (or return on capital) has the same discounted present value as the initial investment expenditure. The latter approach gives a smoother stream of annual costs and provides a better estimate of the cost of using the facility in a particular year. The Royal Commission's cost analysis work uses this amortized cost approach; a real rate of return of 10 percent, applied to one-half the replacement value of the facility, is used to estimate the "interest charge."

5. F. P. Nix, M. Boucher and B. Hutchinson, "Road Costs," in Volume 4 of this report.

6. Ashish Lall, "Transportation Infrastructure Costs in Canada," in Volume 4 of this report.

7. Z. Haritos, *Rational Road Pricing Policies in Canada* (Ottawa: Canadian Transport Commission, 1975), and Strategic Policy Directorate, Transport Canada, *Transport Costs and Revenues in Canada* (Ottawa: Transport Canada, July 1982).

8. The term "expressway" is used to denote a limited access highway.

9. An alternative means of estimating the capital value of the highway stock would be creating average lifetime profiles of costs of construction and repair per kilometre for highways of various qualities, and combining them with estimates of the age profiles of various parts of the network. The necessary unit costs — particularly of costs of new construction of highways of various qualities — and age profiles are not available. Some possible indication of the relevant amounts can be obtained using costs of reconstruction from the report by Nix et al., "Road Costs," to represent costs of new construction (which understates construction costs by the amounts needed for preparation, grading, drainage, etc.). By adding resurfacing and reconstruction costs as also indicated by that report, lifetime profiles of costs by type of highway can be created. Then, assuming highways are of average age (that is, that construction was spread evenly over the last 45 years or so), the following current capital values can be estimated:

		$ million (at 1989 prices)
Expressways		1,860
Paved rural highways	top 10%	1,630
	middle 30%	4,160
	bottom 60%	7,920
Total		15,600

A capital charge at 10% on that total would amount to $1.56 billion per annum. When allocated by vehicle type by passenger car equivalent units, this charge per passenger kilometre for an average car/light truck would amount to approximately 0.5¢/pass-km.

This method would produce the same cost as does the guesswork in the text — that is, close to 1¢/pass-km — if the true unit costs of new construction (per kilometre) were about double those drawn from Nix et al. for reconstruction. It seems quite probable that new construction costs are that much higher.

10. J. J. Lawson, "Available resources for efficient accident prevention," in *IIIe Congrès Mondial de la Prévention routière internationale* (PRI) (Luxembourg: PRI, 1989), pp. 34–47.

11. Pilorusso Research & Consulting Inc., "The Cost of Inter-City Travel by Private Motor Vehicle," a report prepared for the Royal Commission on National Passenger Transportation, RR-05, August 1991.

12. Deliberately ignoring the tolls on international bridges, recognizing that the costs of those bridges do not appear in provincial/federal roads budgets, and are therefore not included in our costs.

13. British Columbia Ministry of Transportation and Highways, *Annual Reports*, 1988–89 and 1989–90.

14. Personal communication, British Columbia Ministry of Transportation and Highways.

15. Maximum gross weight quoted for "B-train double," with exceptions being in Ontario and Yukon, where the limit is 63.5 tonnes. See Council of Ministers of Transportation and Highway Safety, Interjurisdictional Committee on Vehicle Weights and Dimensions, *Summary of Weight and Dimension Regulations for Interprovincial Operations, Resulting from the Memorandum of Understanding on Interprovincial Weights and Dimensions*, September 1989 (available from Canadian Council of Motor Transport Administrators, Ottawa).

16. Nix et al., "Road Costs."

17. Ibid., from Table E.6, average obtained from weighting by vehicle-kilometres by class of highway, and inflating from 1989 to 1991 prices at 4.5% per year.

18. The equivalent standard axle load of a candidate vehicle or axle is defined as the number of passes of a "standard axle load," of 18,000 lb. (8 163 kilograms) on a single axle supported by four tires, required to create the same amount of damage as one pass of the candidate axle load. In customary form ESALs have been calculated from the "fourth-power law" of pavement damage. See Nix et al., "Road Costs," subsection 2.3.3.

19. See subsection 5.1.2. for the derivation of capital costs for cars. Allocating 40% to 60% of the total highway capital stock of $59 billion to highways, and 25% (by PCE-kilometres) to heavy trucks, applying an annual capital charge of 10%, and averaging over 16 billion vehicle-kilometres gives 3.7¢ to 5.5¢/veh-km.

20. F.P. Nix, *Road-User Costs*, Report TP 9766 (Ottawa: Transport Canada, April 1989).

21. As noted in the report by Nix et al., "Road Costs," use of the cost formula with "Waterloo Load Equivalency Factors" instead of ESALs would raise the estimated cost per vehicle-kilometre by some 40% to 50%.

22. It should be noted that the estimates of what are referred to as "marginal pavement costs" in the report by Nix et al. are not directly comparable, either in units of measurement or in concept, with the conventional definition of marginal cost of pavement wear. The latter refers to the cost of wear associated with passage over the pavement of one truck. The report investigated the way in which capital construction costs plus the present discounted value of resurfacing costs over the life of the highway vary with traffic volume, including volume of heavy truck traffic, assuming road and pavement structure are optimal given the traffic volumes. Thus, the report's "marginal pavement cost" represents the estimated increase in discounted life-cycle investment expenditures (a capital stock concept not an annual cost) as the average annual traffic volume increases. Further, the report does not directly address the issue of estimating truck wear on existing highways that may not be optimally matched to traffic volume.

23. Sypher : Mueller International Inc., *Air Infrastructure Costing*, a report prepared for the Royal Commission on National Passenger Transportation, RR-04, August 1991.

24. For the eight largest sites (Dorval and Mirabel are considered as one) or major federal airports (MFAs), which were part of the now discontinued Airports Revolving Fund, financial statements are produced on an annual basis, which conforms to generally accepted accounting principles. The statements are contained in a publicly available document produced each year by Transport Canada entitled "TP 1300 Airports Revolving Fund, Financial Statements for the year ended 19_ _".

    For the next 14 largest sites, which were once part of the Airport Revolving Fund and are now known as federally dependant airports (FDAs), annual financial statements are produced by the site financial officers and submitted to the Financial Advisor of the Airports Group at headquarters. Although these statements are not published or audited like the MFA sites, copies can be obtained through headquarters personnel and represent a reasonably accurate source of site costs and infrastructure.

    For the remaining sites, which are also classified as FDAs, financial statements are not prepared on an annual basis and are only available on a timely basis when Transport Canada undertakes special studies to update the Department's historical financial data base. A complete update of this data base was last undertaken for the fiscal year 1987-88.

25. Costs have been allocated to three user groups — commercial, instrument flight rules (IFR) general aviation (ga), and visual flight rules (VFR) ga. Commercial includes unit toll, charter, and other commercial operations. Unit toll is defined as the transport of people or goods on a toll or price per person or unit. Charter is the transport of a person or good for a price to hire the aircraft per kilometre or hour. Other commercial operations include flights performed by commercial aircraft other than the unit toll or charter services. IFR ga includes itinerant movements of operators using radio navigation instruments to assist the pilot. VFR ga includes itinerant and all local movements of operators not using radio navigation instruments. In general terms, IFR ga tends to use larger, more sophisticated aircraft, while VFR ga tends to use smaller aircraft.

26. See D. Gillen and T. H. Oum, "Transportation Infrastructure Policy: Pricing, Investment and Cost Recovery," in Volume 3 of this report.

27. No readily accessible source of data was available for the replacement cost of Transport Canada's fixed assets; however, historical book value and accumulated depreciation were available on a site-specific basis.

    To develop a reasonable proxy for capital charges based on replacement value for each site the accumulated depreciation was divided by the average annual depreciation expense to estimate the average life of the asset base. From this, an average original year of expenditure for the base was calculated. This original year was then used to determine the cost-escalation factor based on the Statistics Canada's Implicit Price Index for Total Construction, which was applied to the original book value to restate it in terms of 1990–91 dollars. If the asset base increased by more than 20% in any one year, the amount of the expenditure was removed from the cost base and inflated by the factor that corresponded to the year of the expenditure.

28. Transport Canada, *1989–90 Estimates: Part III, Expenditure Plan* (Ottawa: Supply and Services Canada, 1989).

29. On a movement allocation basis, this would be: 4 movements at $42.54 + 3 500 kilometres at $0.15 = $695. Divided among a typical 85 passengers, this amounts to $8 per passenger.

30. Charles Schwier and Richard Lake, "VIA Rail Services: Economic Analysis," in Volume 4 of this report.

31. Statistics Canada, *Rail in Canada, 1989,* Catalogue No. 52-216, 1991.

32. Transport Canada, *Proposed New Cost Recovery Policy: Phase II Discussion Paper,* Report TP 10041 (Ottawa: April 1990), Table 14, updated with values for fiscal year 1990–91 by personal communication from Economic Evaluation and Cost Recovery Directorate, Transport Canada.

33. Most of the estimates of the willingness-to-pay for risk reductions are expressed as values per death avoided, when the risk reductions involve reductions in both deaths and injuries. It is not then appropriate to add to the material losses from injuries a further value for willingness-to-pay to avoid emotional losses through injury. The value of the material losses is therefore used for injured victims, $10,000 per victim.

34. Only in a minority of accident cases is there a court determination of compensation. Other cases settled out of court might include compensation for emotional losses, and in a larger number there is some nominal payment based on the insurance contract. Compensation in all such cases is unlikely to be as great as the cost inferred from the willingness of users to pay for risk reductions.

35. Pilorusso Research & Consulting Inc., *The Cost of Inter-City Travel.*

36. Statistics Canada, *Passenger Bus and Urban Transit Statistics, 1989,* Catalogue No. 53-215, 1992.

37. Tax rates in 1992 for intercity buses are, for example, $522 for a bus with a gross weight as high as 20 000 kilograms in Ontario, and $522 in Saskatchewan for any bus with more than 25 seats.

38. Richard Lake, L. Ross Jacobs and S. T. Byerley, "An Analysis of the Canadian Intercity Scheduled Bus Industry," in Volume 4 of this report.

39. The Canadian bus industry records its data in imperial units.

40. Airline Cost Information Sources

    Aviation Planning Associates, *Analysis of Elements of Direct Operating Costs of Canadian Air Carrier Jet Aircraft* (Canadian Transport Commission, Research Branch, 1983).

    Aviation Planning Associates, *Direct Operating Costs Comparison of DHC-7 and DHC-8 with Competitive Aircraft* (Canadian Transport Commission, Research Branch, 1982).

M.A. Bajwa, *Direct Operating Cost Comparison of DHC-7 & Competitive Aircraft* (Canadian Transport Commission, Research Branch, 1974).

M.A. Bajwa and G. Shurson, *A Study of Mainline and Regional Air Carriers' Terminal Handling Costs* (Canadian Transport Commission, Research Branch, 1981).

M.A. Bajwa and G. Wilson, *An Analysis of Canadian Air Carriers' Operating Costs* (Canadian Transport Commission, Systems Analysis Branch, 1974).

CTC Research, *Inflation and the Canadian Airline Industry* (Canadian Transport Commission, Research Branch, 1984).

R. Fosbrooke, *A Study of the Incidence of Cross-Subsidy in the Canadian Airline Industry* (Canadian Transport Commission, Research Branch, 1980).

J. Gibberd, *Airline Costing: An Introduction* (Canadian Transport Commission, Research Branch, 1985).

J.A. Greig, *The Low-Priced Air Fare Review: The First Five Years* (Canadian Transport Commission, Research Branch, 1983).

J. Greig, and R. Fosbrooke, *Nature of Operating Costs, in Study of Competition in the Canadian Airline Industry: Cost Structure* (Canadian Transport Commission, Research Branch, 1979).

D.B. Laprade, *The Basic Economics of Air Carrier Operations* (Canadian Transport Commission, Research Branch, 1981).

J.C. Moloney, *Air Canada's Domestic Economy Fare Formula and Its Relationship to Average Domestic Scheduled Costs* (Canadian Transport Commission, Research Branch, 1986).

R. Roy, *Economies of Scale in the Airline Industry* (Canadian Transport Commission, Research Branch, 1980).

Roger Roy and Diane Cofsky, *A Productivity Study of Canadian Air Carriers* (Canadian Transport Commission, Research Branch, 1984).

R. Roy, and R. Fosbrooke, *Joint and Common Costs for Major Carriers, in Study of Competition in the Canadian Airline Industry: Cost Structure* (Canadian Transport Commission, Research Branch, 1979).

41. For the purpose of this analysis, an airplane (or seat or passenger) stage is defined as a take off and a landing. A flight may involve additional takeoffs and landings (intermediate stops) but with a single flight coupon and not normally a change of airplane. A trip may include multiple flights but is not broken for purposes other than onward connections.

42. Statistics Canada Catalogue No, 51-005, 51-204 and 51-206 for 1988, 1989 and 1990; Air Canada and PWA Corporation Annual Reports for 1988, 1989, 1990 and 1991 (PWA only).

43. This is a more restrictive definition than that used to estimate the cost of an average domestic trip later in this section. Any change of airline, even to an affiliated carrier, or from domestic to international flights, is counted as an additional passenger trip in the Statistics Canada data, which was partially used to develop this model.

44. As these data were quite uncertain, given the variety of sources, a variant of the model to test the sensitivity of the unit cost estimates to these parameters — particularly the number of flights in the average trip — was run. An assumption of 1.35 flights per trip — more than doubling the assumed proportion of multi-flight trips — resulted in increases in estimated vehicle/carrier cost for the sample routes that ranged from 2.5% for Saskatoon–Halifax to 6.5% for Toronto-Montreal. In the context of the Royal Commission's analyses, this is not significant.

45. The pass-km and stage-km elements of the cost would be more accurately computed using the actual load factors for the stages involved, if these were known. For the present purpose — portrayal of typical cost — the system average Level 1 figure is more appropriate.

46. Inflated from data presented in S. A. Morrison, "Deregulation and Competition in the Canadian Airline Industry," in Volume 4 of this report.

47. As was shown in Table 3(2)-8, combined federal and provincial aviation turbo fuel taxes net of provincial sales tax vary from 0.6¢/L in Newfoundland and 1.3¢/L in Nova Scotia to 9.1¢/L in Saskatchewan. A system-average special tax/fee rate of 5.8¢/L was calculated as a weighted average of consumption of aviation turbo throughout the country. Inasmuch as the system average is calculated for all aviation consumption, it may not be entirely accurate for domestic, as opposed to international, services. A greater source of uncertainty applies to the route-specific estimates. These are based on the assumption that the quantity of fuel consumed during each stage travelled is taxed in the jurisdiction where that stage commences. In the case of Halifax–St John's, the assumed special tax/fee shown is therefore very low, and the tax for a seat-stage taking off from Saskatoon has been assumed to be high. Of course, aircraft do not always take on fuel before every takeoff, or in the exact quantity to be consumed during the succeeding stage. Subject to overriding safety considerations, airlines manage their fuel acquisition to minimize their costs of operation, of which fuel cost — including taxes — is an important element.

48. Charles Schwier and Richard Lake, "VIA Rail Services: Economic Analysis," in Volume 4 of this report. (See Section 3, Rail Passenger Cost Model and Appendices A, B and C.)

49. Capital charges include depreciation and a 10% cost of capital, and assume that all assets are 50% depreciated.

50. Geoplan Consultants Inc., *Canadian Ferry Costs and Industry Analysis*, a report prepared for the Royal Commission on National Passenger Transportation, RR-09, December 1991.

51. Ibid., costs from Tables 5.1 and 5.2, and revenues from Tables 6.1 and 6.2.

52. The total costs concerned would be too small to have other than a negligible effect on estimated average costs.

53. Geoplan, *Canadian Ferry Costs*, Table 8.1.

54. The Research and Traffic Group, *The Great Lakes and St. Lawrence Seaway System: Commercial Attractiveness and Priorities for Policy Development*, report prepared for the Marine Office, Ontario Ministry of Transportation, 1990.

55. Geoplan Consultants Inc., Marine Atlantic Background Information 1988–1990, a working paper prepared for the Royal Commission on National Passenger Transportation, 1991.

56. Geoplan, *Canadian Ferry Costs*, Tables 4.3 and 3.2, respectively.

57. Ibid.

Annex 1: Opportunity Cost of Highway Land

An attempt is made here to estimate the amount of land occupied by the highway network, and its opportunity cost, in terms of value in reasonable alternative use.

ROUTE-KILOMETRES BY PROVINCE

The lengths of highways are obtained from the annual statistical publication of the Transportation Association of Canada.[1] The estimated route-lengths by province are shown in Table 3(2)-A1, and total 8 220 km of expressway and 129 016 km of paved rural highway.

AREA OF LAND DEDICATED TO HIGHWAYS

The width of land used for expressways varies substantially depending on the nature of the terrain and surrounding land use, as well as the number of lanes, widths of medians, shoulders, and so on. It is assumed for simplicity that the average width of the right-of-way for conventional four-lane rural expressways is 100 m. This is believed generous — leading again to a possible slight over-estimate of land use. For two-lane rural highways, the standard width of right-of-way is 100 feet (30.5 m).

A simple calculation then allows an estimate of the total area of land taken by expressways as 82 000 hectares, and of that occupied by rural highways as 393 000 hectares, for a total of 475 000 hectares. Provincial estimates are also shown in Table 3(2)-A1.

1. In recent years, for example, Transportation Association of Canada, *Highways in Canada: 1991 Report*, (Ottawa: TAC, 1991), these figures have been presented only in "equivalent two-lane kilometres," but estimates of the route-kilometres are possible by reference to the publication for 1985, Roads and Transportation Association of Canada, *Roadway Infrastructure Study* (Ottawa: RTAC, 1987). For "paved rural roads" it is reasonable to assume that two-lane kilometres are identical to route-kilometre, as the 1985 publication showed the former to be less than 2% greater than the latter (and this assumption will therefore produce a very slight over-estimate of land costs). For expressways, the adjustment is more important, as the difference between two-lane kilometre and route-kilometre is shown by the 1985 publication to be large, and to differ substantially by province. The particular assumption made here is that the average freeway is four lanes, with the exceptions of Quebec and Nova Scotia, for which the 1985 publication showed that the expressways had fewer lanes than the national average. It has been assumed for both provinces that the 1985 highways still exist, and that all expressway-kilometres added since that date have been of four-lane standard.

Table 3(2)-A1

Area and Value of Land Used for Provincial Expressways and Highways, 1990

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	Nfld.	All provinces
Expressways:											
– route-km	427	1,232	24	0	1,882	3,200	110	1,300	0	45	8,220
– rural hectares	4,227	12,197	238	0	18,632	31,680	1,089	12,870	0	446	81,378
– urban hectares	43	123	2	0	188	320	11	130	0	5	822
Other highways:											
– route-km	20,554	12,907	10,299	6,878	16,419	36,245	4,400	11,804	3,408	6,102	129,016
– rural hectares	62,022	38,947	31,077	20,755	49,545	109,370	13,277	35,619	10,284	18,413	389,308
– urban hectares	626	393	314	210	500	1,105	134	360	104	186	3,932
All highways:											
– rural hectares	66,249	51,144	31,315	20,755	68,176	141,050	14,366	48,489	10,284	18,858	470,686
– urban hectares	669	517	316	210	689	1,425	145	490	104	190	4,754
– total hectares	66,919	51,661	31,631	20,964	68,865	142,475	14,511	48,979	10,388	19,049	475,441
Rural value/hectare ($)	1,198	788	516	642	2,644	1,053	808	872	1,453	1,527	1,223
Urban land value/ hectare ($)	370,645	370,645	370,645	370,645	370,645	370,645	370,645	370,645	370,645	370,645	370,645
(i) Value of total hectares as farmland ($M)	80	41	16	13	182	150	12	43	15	29	581
(ii) Value of rural hectares as farmland, and urban hectares for housing ($M)	327	232	133	91	435	677	65	224	53	99	2,338

Sources: Route-km from Transportation Association of Canada.
Farmland values from Statistics Canada.
Urban residential land values derived by Royal Commission staff from house prices provided by Canada Mortgage and Housing Corporation.

OPPORTUNITY COST OF THE LAND

In attempting to identify this opportunity cost, it is tempting to look at the market prices commanded by equivalent land close by. But this is subject to a conceptual criticism: surrounding land use can be substantially altered by the existence of the highway. In general, the accessibility provided by the highway generates more surrounding activity than otherwise, and raises the market value of the surrounding land.

For the rural land used for highways in Canada, this concern is probably not of practical importance. One can probably simply look to the use of the land prior to the highway being built, or consider what the use would revert to if the highway were scrapped, and come to a similar conclusion about the realistic opportunity costs. If there were only local access (through the grid road system), the land would probably be usable only for some form of agriculture or forestry, or might not be suitable for either and remain unused. No information is available to estimate which portions of Canadian highways would revert to each of these purposes, nor are details available of actual land prices by location, from which it might be possible to estimate values of land used for specific highways. The average prices of farmland by province, however, are available, and are shown in Table 3(2)-A1.[2] Such averages are province-wide, and might represent land on average that is even more remote from settlements than the land used for highways. On the other hand, these prices are for the portions of land that are usable for farming, when much of the land on which highways are constructed would likely otherwise be too poor for farming, and worth even less. These prices for farmland can be used as an indication of the alternative value of land used for highways, in the expectation that they probably overestimate the true opportunity costs.

The complexity is greater for urban land occupied by highways. Accessibility increases the value of the adjacent land. Therefore the

2. Personal communication from Agriculture Division, Statistics Canada, February 1992.

opportunity cost of the highway land should not be represented by the market value of adjacent land, but more reasonably by that of equivalent land that does not have the accessibility advantage from the highway. It could be difficult, if not impossible, to identify such "equivalent land," without some other accessibility advantage. Again, the logical test might be the value that the land could command if the highway were entirely abandoned. It seems reasonable to assume that the land would otherwise be served simply by local access streets, and be usable for residential or commercial purposes comparable with land similarly served in the community concerned.

For illustrative purposes, it is assumed that the alternative use would be for residential purposes, with value equal to the average price of land for new house construction for the entire cities concerned (therefore reflecting the total accessibility advantages gained from the communities' transport connections, but with no premium from direct proximity to any particular connection).

Estimates of average new detached/semi-detached house prices in 1991 were obtained from Canada Mortgage and Housing Corporation (CMHC).[3] The appropriate national average of residential land prices is elusive, as CMHC does not provide estimates of new house prices for all of the communities on the national network. Instead, one can only guess at the relevant price from the averages for those larger communities that are provided. These show that the average new house price in 1991 among the 25 largest metropolitan areas was $197,000, of which approximately 30% is the land component, or about $59,000. Among the 52 largest communities, the value was $149,000, and the land component[4] at 30% amounted to approximately $50,000. These communities feature prominently in the primary highway network, but so do a much larger number of smaller communities.

3. In personal communications between Royal Commission staff and staff from Statistics Division of CMHC, Feb. 27,1992.

4. Information provided by Statistics Canada and CMHC by city suggests that the land proportion of the total house price is surprisingly constant at nearly 30%, when total prices ranged between $109,000 and $305,000 among the cities covered. As the information is compiled from reports made by builders, it is possible that they are using a simple rule-of-thumb of 30% in their responses.

Furthermore, those land values are for serviced land and for detached houses. The average value for urban land occupied by highways is probably therefore substantially lower. For illustration, an average value is assumed of $30,000 for a lot of 4,000 square feet (370 m^2). With five lots per acre (or, more than 12 per hectare), allowing for services, this suggests values of unserviced land of about $150,000 per acre, or $371,000 per hectare, in 1990 prices.

The area of urban land involved is not large as a proportion of total land used for highways, but, as will become obvious in the examples that follow, the precise amount and its value is crucial to the estimate of the total value of the land used. No record is available of the length of the urban portions of the highway system; that is, those portions that, in the costing scheme, are assumed to displace residential land rather than farmland. It seems certain that the proportion cannot be as much as 5% (1 km in 20, or 7 000 km of the entire 140 000 km of primary highways being in urban areas), and more likely is closer to 1% (1 km in 100, or 1 400 km in total). A proportion of 1% of the highway system will represent urban portions.

RESULTS OF ALTERNATIVE ESTIMATES

Alternative Value as Farmland

Table 3(2)-A1 shows the value that the road network would have if the only alternative use of the entire system was as farmland. Using the average farmland prices provided by Statistics Canada, the 82 200 hectares of expressways would be worth $111 million, and the 393 000 hectares of 2-lane highway would be worth $470 million, giving a total for the whole system of $581 million.

Alternative Rural Value as Farmland, Urban Value for Housing

Table 3(2)-A1 also shows estimates for the opportunity costs of the land if 99% of it is rural, usable for farming, and the other 1% is in urban areas, usable for residential development. The essential assumptions from above are:

• Expressway right-of-way width	100 metres
• Paved 2-lane highway right-of-way width	100 feet
• Proportion of all highways in urban areas	1%
• Average price of urban residential land per unserviced hectare	$370,000

The urban portions of the highway network have an estimated value of $1.8 billion. The total value of the urban and rural systems is now estimated at $2.4 billion. The importance of the assumptions about the area and value of the urban portions can be appreciated, as the rural part of the network, while 99% of the total length of the system, has an alternative value at farmland prices of $570 million, only 24% of the total value.

It is judged that this latter estimate, including urban land valued by its potential alternative development, is more appropriate than valuing the entire land as farmland. The estimate is therefore converted to a cost per passenger-kilometre, as follows.

Estimated Opportunity Cost of Land per Passenger-Kilometre

In order to compute these land costs per unit of traffic, the capital value of the land is converted into an annual sum, using a real rate of 10% per year as the opportunity cost rate.

Land costs are then allocated between private passenger and other vehicles according to the number of "passenger-car-equivalent-kilometres" they contribute annually. As noted earlier, this procedure allocates some 70% of costs to cars/light trucks in passenger use.

Also as noted earlier, annual traffic on the highway network by cars and light trucks in passenger use is estimated as 120 billion vehicle-kilometres, and 210 billion passenger-kilometres.

The results of the computations are as follows:

Total capital cost of land	$2,400 million
Annualized cost at 10%	$240 million per year
Annualized cost attributable to cars	$170 million per year
Cost per passenger-kilometre	$0.0008

In conclusion, using the base-case assumptions, the total land value is estimated as approximately $2.4 billion, which, when annualized at real interest rate of 10% in perpetuity produces a value of approximately 0.08¢/pass-km. Given the uncertainty in this estimate, it is incorporated in the highway infrastructure cost estimates, rounded to 0.1¢/pass-km.

Annex 2: Opportunity Cost of Airport Land

The dimensions of the nine major federal airports, together with the latest appraisals (by purpose) of the land available at each of the sites, were made available by Transport Canada,[1] and are shown in Table 3(2)-A2. The appraised values are for actual parcels of land on the airport property available for the specified uses. Objective appraisers (usually Public Works Canada) rate the property based on its characteristics and comparisons with land used for similar purposes in the immediate area.

Table 3(2)-A2
Appraised Value of Land at Major Federal Airports, 1991, by Purpose

	Size	Value appraised per square metre, by type of use					
	(hectares)	Light industrial with air-side access ($)	Light industrial ($)	Commercial ($)	Heavy industrial with air-side access ($)	Heavy industrial ($)	Agricultural ($ per hectare)
Halifax	951	30	—	36	—	17	(870)[a]
Mirabel	6,920	28-35	23–28	32–82	12–24	10–20	1,400
Dorval	1,668	75	45	100	—	25	—
Pearson	1,715	—	68–79	124	—	50	—
Ottawa	2,086	—	78–90	100–120	—	40	—
Winnipeg	1,504	35	—	40	—	30	—
Edmonton	2,800	21	—	—	—	20	2,700
Calgary	1,839	43	—	50	—	38	—
Vancouver	2,800[b]	—	86–109	—	—	—	—

a. **Appraised value not provided by Transport Canada, so instead the figure is the average value for farmland in Nova Scotia estimated by Statistics Canada, Agriculture Division.**
b. **1 000 hectares assumed available for alternative development, to preserve wetland.**

It can be seen that land for "commercial" purposes has the highest value: this would be land with excellent access — probably on an arterial road — with potential for development of shops, hotels, and so on. It is therefore a very limited proportion of the land on any

1. Personal communication between Royal Commission staff and staff of Transport Canada Airports Group, March 1992.

airport site, and its appraised value is probably dependent on the traffic attracted by the airport. As such, it is inappropriate as a measure of the opportunity cost of the airport land, that is, value in alternative use if the airport were not there.

The light and heavy industrial land designated as "with air-side access" is close enough, and on direct roadways to the air-side land, so that it could be used for services for the airlines and aircraft. ("Light industrial" use would include hangars, flight kitchens, fuelling, de-icing; "heavy industrial" use would be rare, including, for example, oil tank farms.) Such land therefore has a premium value over industrial land without air-side access, which can presumably be used only for the same purposes as equivalent land outside of the airport. The appraised value of this land without air-side access therefore gives an indication of the value of the land in industrial use if the airport were not there.

The appraised values of land for agricultural use are clearly much lower than values for the other purposes. Much airport land is apparently usable for farming, and large parts of some airports are currently leased for it — particularly Edmonton, but with sizeable portions also of Calgary and Winnipeg airports.

The appraised values do not include residential use as a current option, but it should be considered in seeking the opportunity cost of the land. Abandonment of the airports (or shifting them to more remote locations) could make available large tracts of land close enough to the centres of some cities that they would be attractive for residential purposes. Even though some of the sites are surrounded by light industrial or heavy-industrial activities, they are sufficiently large that they could be developed as residential enclaves.

In fact, they could become very large residential developments. Table 3(2)-A3 shows the number of houses that could be built on some of the airports, if there were only about 12 houses to the hectare (five to the acre) — which assumes only about half the available land would be house-lots, with the rest used for services, institutions, and so on.

About 20,000 houses could be built on the land area of each of Dorval, Pearson or Calgary airports, about 25,000 on Ottawa's site, or about 35,000 on that in Vancouver. Table 3(2)-A3 also shows the value of this land at the average price estimated for the relevant cities (estimated as described earlier for the value of highway land, assuming serviced land accounts for 30% of new house prices, obtained from Canada Mortgage and Housing Corporation).

Table 3(2)-A3
Value of Airports if Developed for Residential Use, 1991

	Number of houses at 12 per hectare (approx)	Value of residential land ($ per hectare)[a]
Dorval	20,000	300,000
Pearson	20,000	900,000
Ottawa	25,000	400,000
Calgary	22,000	500,000
Vancouver	32,000[b]	700,000

a. **Based on estimated values per serviced lot provided for cities from Canada Mortgage and Housing Corporation; reduced by $10,000 per lot as a rough allowance for servicing.**
b. **Only 1 000 hectares assumed available for development.**

If entirely used for residential development, the areas of Pearson and Calgary airports would apparently be worth more than for light industrial use, at about $1.5 billion and $0.9 billion respectively. The sites at Ottawa ($0.8 billion), Vancouver ($0.7 billion) and, in particular Dorval ($0.5 billion) would, by these simplistic calculations, apparently be worth less in residential than in light industrial use.

It should be noted also that these developments would be so large that they would certainly affect the price of housing, and residential land, even in the three largest cities. They might be impractically large, depressing prices so much that the development would only be viable if spread over many years. In cities of the size of Ottawa or Calgary it would certainly not be viable to add so much housing in the short term (25,000 houses would probably add 15% to 25% to the total number existing in Ottawa). Therefore it is probably unreasonable to assume residential development as the opportunity use of the entire area of any of the major federal airports.

For illustrative purposes, Table 3(2)-A4 shows the hypothetical value of the area of each of the airports in possible alternative use. The estimates are very rough, given the uncertainties in the estimated average values per unit of land by purpose, and particularly the reasoning on alternative uses. The reasoning is as follows:

- The sites at Halifax, Mirabel and Edmonton are sufficiently distant from other centres of activity that the possibility of attracting industrial or commercial activity to fill their sites is remote, and farming seems the more reasonable option (and even that might be optimistic for Halifax, or for the entire site of Mirabel).
- For the other airports, it seems likely that some portion of the land could find alternative light industrial use. For Ottawa, Winnipeg and Calgary, the airport areas would add so much land to that available for light industrial use within those cities that it would be very unlikely that the whole area would be developed. There is substantial land available of similar quality, at similar distances from the city centres in each of those communities. It is assumed that 25% of the areas of these airports could be sold at the current price for light industrial land (or, more precisely, that at each of the sites a value equivalent to the current price multiplied by 25% of the surface area could be realized if an attempt to sell the entire area was made).
- For Dorval and Vancouver it is assumed that land so accessible to the city is in sufficient demand that most or all of their usable surface could be turned to light industrial use. The amount of land concerned would still be a significant addition to total light industrial land available even in those regions, so it can be expected that making these tracts available would lower the market price, to some extent. To allow for the interaction of the amount available and its price, it is assumed that the maximum value obtainable from these sites is 50% of their surface area[2] multiplied by the current price — representing, for example, being able to find buyers for 50% of the area at current prices, or lowering the price by 50% in selling the entire space immediately.

2. It is also assumed that only 1 000 hectares of the Vancouver site would be available for development, the remainder being conserved.

- For Pearson, it is assumed that the alternative use is residential, and that a value equivalent to 50% of the current lot price could be realized if the entire surface area was sold.

Table 3(2)-A4
OPPORTUNITY COSTS OF LAND AT MAJOR AIRPORTS, 1991

Airport	Estimated land values ($ millions)
Halifax	1
Mirabel	10
Dorval	400
Pearson	750
Ottawa	440
Winnipeg	130
Edmonton	8
Calgary	200
Vancouver	500
Total (rounded)	**2,500**

Value of Land at Other Airports

Transport Canada has also provided the surface areas of another 87 airports (without any information on their appraised values). The land used for many minor airports has little opportunity cost, in that equivalent unused land is available close to many of the cities and towns concerned. On the other hand, similar land, close to the larger centres, could be very valuable in alternative use. To represent the possibilities, without any site-specific information, it has been assumed for the 20 next-most-important airports, comprising "Class III" in the study for the Royal Commission of airport costing,[3] that the average value of the land at these sites is half the average for the seven Class II major federal airports (that is, the nine airports in Table 3(2)-A4 except Pearson and Vancouver, which form Class I). From the above analysis, the average value per hectare for those seven was $67,000. The average assumed for the next 20 is therefore $33,500 per hectare. Their total area is 12 319 hectares, so the total is $411 million. Added to the median value of the nine major airports, the total then becomes $2.9 billion.

3. Sypher : Mueller International Inc., *Air Infrastructure Costing*, a report prepared for the Royal Commission on National Passenger Transportation, RR-04, August 1991.

For all remaining airports, the value of the land is assumed to be negligible (especially given the margin of error in the above estimate).

Annualized Value of the Land

The total capital value estimated above is about $2.9 billion. Using a real rate of 10% per year as the opportunity cost rate for capital assets, this land cost is estimated at $290 million per year.

Land Value per Passenger-Trip, and Passenger-Kilometre

Averaged over a total of 62,813,444 enplaned/deplaned (E/D) passengers at all airports in 1988, the total land value would then amount to some $4.60 per passenger. For the illustrative costs in 1991, this is rounded up to $5 per E/D passenger, or $10 per stage. Averaged over the representative air trip of 1 478 km with 1.6 stages, it amounts to 1.08¢/pass-km, included in the system-wide average costs as 1¢/pass-km.