THE IMPACTS OF PUBLIC TRANSIT SUBSIDIES IN WINNIPEG

A Thesis

Submitted to the Faculty of Graduate Studies

in Partial Fulfillment of the Requirements for the Degree of

Master of City Planning

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BY

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF CITY PLANNING

To

my Mother and my Wife
whose contribution to
my education can not
be measured.

ABSTRACT

This thesis assesses the impacts of transit subsidies in the City of Winnipeg from 1962 to 1976 with special reference to the potential benefits put forth by transit subsidy advocates and to the transportation policies and guidelines adopted by City Council.

The nature and magnitude of transit subsidies, and the impact assessments on transit ridership, automobile travel, peak hour congestion, downtown development, automobile ownership and energy consumption between 1962 and 1976 are carried out by using the 1962, 1971 and 1976 origin and destination studies, transit system and operation statistics as well as data from Statistics Canada.

Although the magnitude of transit subsidy has increased quite drastically between 1962 and 1976 as a result of a rapid growth in transit costs coupled with a slow growth in system revenues, its impacts on increasing transit ridership, restraining automobile travel, reducing peak hour congestion, reducing air and noise pollution, lowering the level of gasoline consumption and car ownership, as well as revitalizing the downtown area have been insignificant.

The extension and addition of suburban transit service, the inflation of wages and the cost of goods, higher labor compensations, and the policy of maintaining low transit fares have all contributed to the growth of the transit deficit (and subsidy) and to the decline in the effectiveness and efficiency of transit operations.

The failures of existing transit and transit subsidy policies are evident. In an attempt to address their shortcomings, three sets of alternate policies relating to transit cost, revenue, efficiency, and effectiveness of transit operations are formulated, and an alternate source of subsidy is suggested.

ACKNOWLEDGEMENTS

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My special thanks should go to the staff at the Streets and Transportation Division of the City of Winnipeg for the provision of data for this research and also my summer work experience with the Division proved to be invaluable towards my study.

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My greatest debt is to my wife and my mother who have not only borne all the costs of my education but also have shown unequivocal patience and understanding during my study. To these two great women, I dedicate this work.

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CHAPTER I

THE PROBLEM

1.1 The Problem

This thesis assesses the impacts of transit subsidies in the City of Winnipeg from 1962 to 1976, with special reference to the potential impacts described below and to the transportation policies and guidelines adopted by City Council.

Subsidization of urban public transit has become a standard practice in Canada since the early sixties.[1] The public transit system in Winnipeg, being no exception, has received substantial subsidies in the form of operating and capital grants from the municipal and the provincial governments. At the same time, the magnitude of transit operating deficits covered by these two governments has increased drastically over the fifteen year study period - from 6% of total operating costs in 1962 to an astounding 60% in 1976.

In addressing this problem, the subsidization of urban public transit has been advocated by many transportation economists and planners[2] as a means of alleviating peak hour congestion, reducing automobile travel, increasing transit ridership, minimizing externalities of the private automobile,and

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1. Frankena (18), p.215.

2. For examples: Baum (7), Jackson (33), Sherman (67,68), Renshaw (56), and Train (74).

as a mechanism in redistributing income. An analysis of the magnitude and extent of transit subsidies in Winnipeg between 1962 and 1976 is very useful in testing these assertions.

1.2 Justification and Significance

The transportation system is the most critical component of every urban centre, and transportation developments often exert profound impacts on the shapes and forms of our urban landscapes. Important technological innovations in transportation, such as the railroad, electric streetcars, rapid transit, and the private automobile, each in their historical sequence, became instrumental to the growth and development of North American cities. Of these, the private automobile is by far the most important instrument in shaping the North American city.

1.2.1 The Private Automobile

The growth and development patterns of North American cities encourage extensive use of private automobiles, especially for work trips during peak hours.[1] Associated with the private automobile is peak hour congestion, which has become synonymous with the Urban Transportation Problem. The externalities created by the private automobile such as congestion cost, air and noise pollution, and social disruption

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1. 46% of the total automobile work trips were made during the morning peak hour in Winnipeg. Source: 1976 origin and destination study - City of Winnipeg.

are enormous - but difficult to measure. These externalities have become the price of urban living.

Fundamental to the process of conventional transportation planning is the accommodation of both peak hour demand for automobile travel, as well as the rapid growth that most cities experienced during the last two decades. The apparent superiority of the private mode over the public mode[1] (in terms of convenience, flexibility, comfort, privacy and shorter travel time) has been the major factor contributing to the decision to accommodate the peak hour demand of private automobiles. This will be detailed later.

Construction of urban freeways and expansion of existing transport networks are typical solutions to ease traffic congestions and to satisfy future increases in travel demand. [2] While travel time savings can be attributed to these urban freeways and expanded facilities, they also give rise to many undesirable repercussions. The land takings required for highway construction and expansion may break up established neighbourhoods and may lead to serious social disorganization and deteriation of neighbourhood. [3] The aesthetic

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1. See Baum (7), p.9.

2. The Winnipeg Area Transportation Study (WATS) is a typical example of conventional transportation planning which was the fad at that time. The Winnipeg South-West Corridor Study also refects to a large extent the principles of this mode of transportation planning.

3. The proposed McGregor and Sherbrook Overpass in Winnipeg has prompted deep concerns from social workers and planners working in that area. They are projecting further deterioration of neighbourhood in the surrounding area of the overpass which has already been beseiged with severe social problems.

quality of the urban landscape may be severely impaired by an extensive network of freeways. Improved transport networks between the central city and the suburbs often lead to a much higher rate of suburbanization and urban sprawl. This can reduce the urban tax base, which may cause the central city to decline. The construction and expansion of transport facilities often require substantial public funds which may increase the financial burdens of the city government, thereby making the solutions of many other public and social problems more difficult.[1] As well, reduction in automobile travel time and congestion level as a result of an increase in highway capacity may encourage more automobile travel, which will in turn increase the level of congestion, air and noise pollution. Unfortunately, these are the same externalities[2] which urban freeways attempt to combat.[3]

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1. Automobile related subsidies ranged from 10% (1976 City of Winnipeg Budget) to a soaring 30% (City of Sanfrancisco, Douglas B. Lee Jr.(41)) These levels of subsidies are significant in light of the success of Proposition 13 in California which prompted many city governments to cut their public expenditures in order to curb increases in taxes. Elimination of automobile subsidies will undoubtedly increase the financial viability of city governments.

2. These externalities include congestion cost, air and noise pollution, and social disruption.

3. The new St. Vital-Fort Garry Bridge is a case in point. This new bridge was designed to ease traffic congestions on Jubilee Avenue and to provide a new linkage between St. Vital and Fort Garry. It only diverts traffic from Jubilee Avenue and the Perimeter Highway marginally. It also increases the level of traffic congestion on Pembina Highway especially near the intersection of the bridge and Pembina. The new bridge also affects residential and commercial land values in the vicinity of the bridge site. The newly completed shopping centre has undoubtedly increased the level of congestion near the intersection.

1.2.2 Conventional Transportation Planning

These urban transportation problems may be attributed to a number of maladies present in the current transportation planning process which suffers from a heavy reliance on the rational decision-making mode of planning. This mode of planning, according to Britton Harris is "a well-established paradigm of the planning process",[1] which involves the setting of goals and objectives, the formulation of alternatives, the forecasting of impacts and evaluation of alternatives with respect to the goals and objectives as well as to their possible impacts and selecting the best alternative for implemention.[2]

The conventional transportation planning process follows basically the same procedures of the rational decision-making model. It is customary for transportation planners to formulate their goals and objectives in terms of physical development of an area or an urban centre at a point in the future which will reflect these goals and objectives. This plan is usually based on methods employed by traffic engineers in dimensioning the capacity requirements of urban transport network, gearing to servicing trend-type, and land use prognostication, which are built on analyses of demographic,economic,

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1. In the foreword to Robinson's book (58), p.9.

2. For a history and critiques of the rational decision-making mode of planning, see Friedmann & Hudson (20) pp.3-10.

travel, land use, and physical characteristics. Various alternatives are then formulated and subsequently evaluated with respect to the goals and objectives, as well as their impacts. The"best" plan is then selected from among these alternatives.[1] A typical transportation planning model is depicted diagrammatically in Figure 1.

Critics of the rational decision-making mode of transportation planning [2] argue that this methodology fails to deal with changing problems and issues of our urban centres. The urban transportation problem is becoming more and more critical in light of an array of conflicting issues such as financial crises, worsening congestions, and energy shortages, which confront most urban communities nowadays. The limitation of this mode of planning is apparent in its goals and objectives formulation stage. They are formulated with total objectivity; therefore the method used should simply dictate the goals and objectives formulated. Furthermore, as the models used are based on static or equilibrium relationships among socio-economic variables, spatial patterns, and travel demands, the resulting projections will often reflect identtical relationships.

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1. Examples of the conventional transportation planning process can be found in Hutchinson (31), RTAC Committee on Urban Transportation Planning (60), and Lane, Powell & Smith (40).

2. Some of these critics are : Hirten (30), Dewees (16), Vickery (76), Friedmann and Hudson (20).

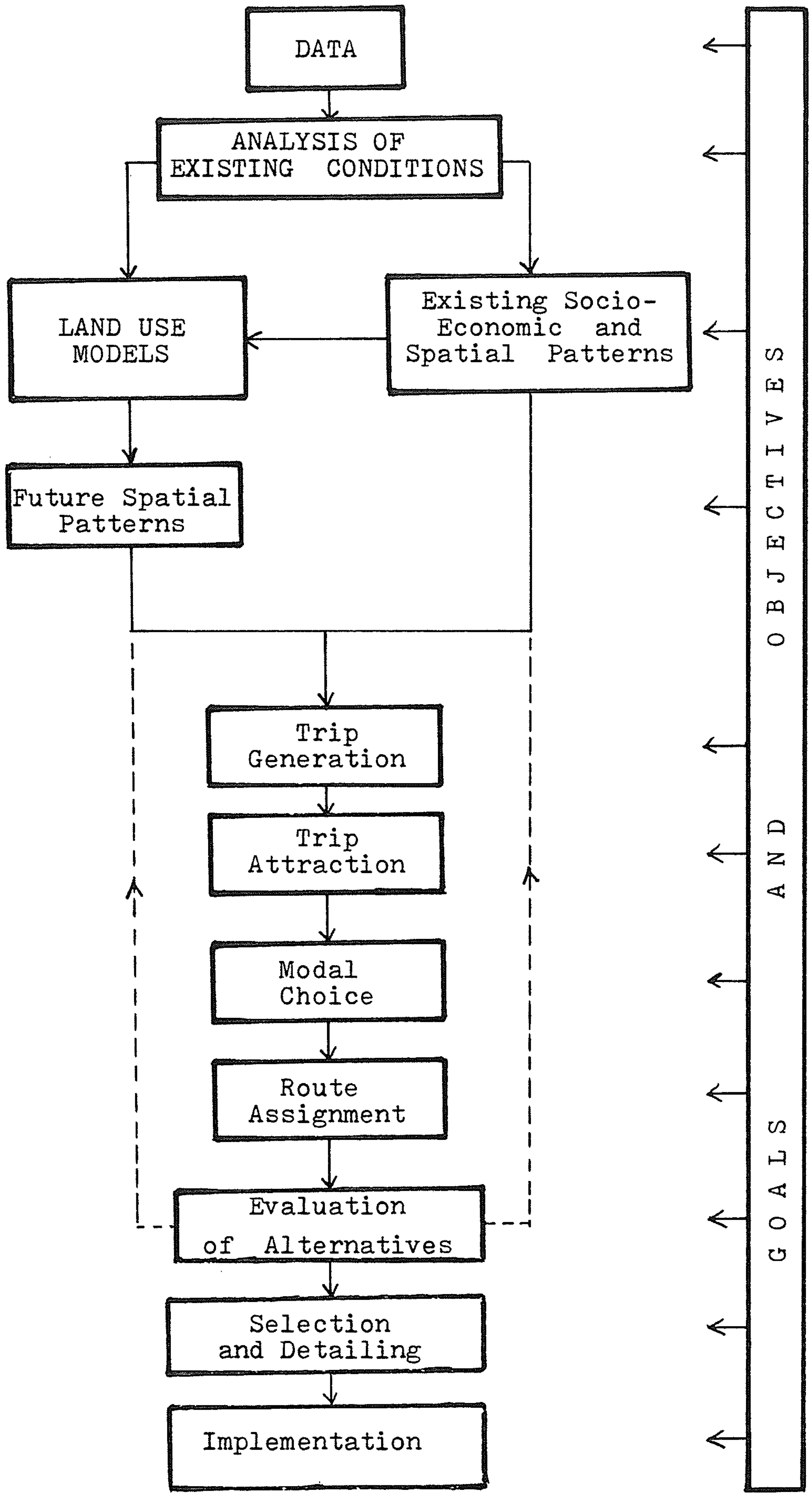

Figure 1: Conventional Transportation Planning Model
Source: Adapted from Urban Transportation Planning Guide (60)

In as much as the projected socio-economic and physical developments will create increases in travel demand at a future date, the plan or planned actions produced will then be geared to match the demand level. Plans or planned actions formulated often possess these goals and objectives:

1. moving automobiles, not passengers;
2. meeting peak hour travel demand and relieving congestion by expanding present infrastructure and constructing new ones; and
3. encouraging the uncontestable public acceptance of and dependance upon the private automobile by offering various forms of direct and indirect subsidies, but only supporting public transit marginally.[1]

The inherent limitations of this mode of transportation planning thus produce goals and objectives that are not responsive to the changing needs of urban communities. It also neglects the social, economic and environmental impacts on neighbourhoods affected by new transportation facilities.[2]

1.2.3 Alternative Approaches

New approaches in urban transportation planning have been called for by Hirten.[3] Effective transportation planning should not be an exercise of matching demand level with supply capacity.

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1. For example, automobile related subsidies amounted to about 10% of the 1976 City of Winnipeg Budget while transit subsidies only amounted to 2.6%.

2. Again, the proposed Sherbrook and McGregor Overpass is an example of ignoring externalities borne by core area residents in order to improve the mobility of automobile users elsewhere.

3. Hirten (30).

It should involve a process of goal and objective formulation which is sensitive to an array of conflicting issues facing our urban communities. It should encompass social, environmental, financial and transportation goals and objectives with respect to a particular policy problem. It should also involve an analytical framework based on economic, behavioural, locational and decision theories; engineering analysis and an evaluation framework to assess social, environmental, economical and political impacts.

These new approaches are outlined as follows:

1. Public involvement and praticipation in the planning process;
2. reduction or total elimination of private automobile subsidies in order to discourage public dependance on the private automobile;
3. new emphasis on public transportation; and
4. encouragement of multipurpose transportation system.

The second and third approach are of special significance to this thesis and will be discussed in detail in the following sections.

1.3 Transit Subsidies as a Second-Best Solution

The clear convenience, security and low private costs offered by cars has meant that cities in Canada have been slow to take aggressive steps to control the flood of automobiles in urban areas. They have also been slow to recognize and/or to eliminate the various forms of private automobile subsidies.[1]

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1. A comprehensive list of automobile subsidies can be found in Lee (41).

Indeed, few planners recognize these implicit subsidies. The conventional wisdom of constructing and expanding transport infrastructures to combat traffic congestions not only has been proven to be ineffective but also has undersirable repercussions. Traffic congestion, air and noise pollution will prevail as long as the private auto-users are paying less than the full cost of operating the automobile. Reduction in automobile travel will not become a reality unless indirect and direct subsidies to the private automobile are reduced or eliminated. Furthermore, the private automobile user should internalize these subsidies as well as the externalities incurred by him. This will be detailed shortly.

Many economists and planners[1] advocate the use of a congestion toll (tax) to reduce peak hour automobile travel. The theoretical basis of congestion toll using marginal cost pricing principles is very attractive, and suggests that traffic congestion will be lessened if the automobile users internalize the externalities they imposed on themselves and to others. Thus, the total welfare of the society can be maximized. However, political and practical considerations challenge the application of the congestion toll theory.

A departure from the ideal congestion pricing scheme for the private automobile is inevitable and subsidization of

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1. Some of them are: Agnew (5), Beesley & Roth (9), Boardman & Lave (12), Inman (32), Mohring (49), Vickery (77,78), and Walters (79,80).

urban public transit is considered to be a second-best solution to minimize all these externalities by another group of economists and planners.[1] They argue that by lowering the average cost of public transit, (the decreasing cost mode) some of the private automobile users (the increasing cost mode) would be diverted to public transit. The externalities created by the private automobiles such as congestion, air and noise pollution, thus can be minimized.[2] Furthermore, socially and economically deprived groups will have better access to job centres, shopping and recreation facilities.

Subsidization of urban public transit has been the dominant transportation policy in Winnipeg as well as in the rest of Canada during the last two decades. The present study is an attempt to assess the impacts of transit subsidies in Winnipeg between 1962 and 1976.

1.4 Organization of This Thesis

In the preceeding three sections of this chapter, the problem of this thesis has been defined, justifications and significance of this problem have been put forth, and the use of transit subsidies as a second-best solution has briefly been discussed.

Two economic models are presented in Chapter 2. The first deals with congestion. The theories of congestion are

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1. They include Abe (2), Baum (7), Jackson (33), Renshaw (56), Sherman (67, 68) and Train (74).
2. A detail treatment of this model will be presented in Chapter 2 along with the congestion toll model and second-best model.

elaborated in the context of urban transportation and optimal tolls associated with the congestion models are explored. Finally, the conceptual and practical limitations of the congestion models are discussed. The second model deals with transit subsidy. Pareto optimality and second-best theory based on Welfare Economics are described so as to provide a basis for the development of a transit subsidy model. The possible ramifications of transit subsidies are discussed.

The primary focus of Chapter 3 is to assess the impacts of transit subsidies in Winnipeg between 1962 and 1976 with respect to transportation policies and guidelines adopted by the City Council of Winnipeg and to the potential benefits described in Chapter 2. The nature and magnitude of transit subsidies are examined in detail. The impacts of transit subsidies on transit ridership, automobile travels, peak hour congestion, downtown development, and the environment are the major concerns of this chapter.

Alternate transit and transit subsidy policies, along with their possible impacts are discussed in Chapter 5. Three sets of alternatives are formulated: (1) alteration of transit fare structure, (2) rationalization of transit operations, and (3) road pricing scheme to subsidize transit. Finally, the impacts of these policies are summarized in the form of a goals-achievement matrix.

CHAPTER II

REVIEW OF LITERATURE

2.1 Introduction

Two economic models of urban transportation are presented in this chapter. The theories of congestion are reviewed and optimal tolls are examined. The conceptual and practical limitations of congestion tolls are discussed. Pareto optimality and second-best theory based on Welfare Economics are defined and explored, in order to provide a framework for the development of a second-best transit subsidy model which departs from the optimal solutions of the congestion models. This transit subsidy model provides a conceptual framework to examine the effects of transit subsidy policies. Furthermore, it also provides an analytical tool in alternate transit policy formulations in Chapter 5.

2.2 The Theory of Congestion

The earliest formulation of congestion theory is to be found in the first edition of Pigou's Wealth and Welfare.[1] His classic example of the two competing roads has stimulated various research efforts in the formalization of the theory of congestion using marginal cost pricing principles to maximize resource allocation in transportation.[2]

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1. Pigou (53)

2. The following economists have contributed greatly in the development of the theory: Walters (78, 80), Johnson (34), Vickery (77), Mohring (49) and Agnew (4,5).

2.2.1 Pigou's Formulation

In Pigou's example of the two competing roads, in which the first (1) is a poor-grade road with no capacity restraint i.e., a broad road capable of accomodating any level of traffic), and the other (2) is a paved road with limited capacity. These two roads connect City A and City B and are considered to be perfect substitutes for one another.

This formulation illustrates that travellers prefer to use the paved road until its capacity has been exceeded; at this point, the cost of delay due to traffic congestion causes some of them to switch to the gravel road. Pigou suggested that by imposing a toll on the paved road, traffic congestion will also be reduced because the additional cost will make some of the travellers willing to use the gravel road.

The average and marginal cost curves[1] of these two competing roads are depicted diagrammatically in Figure 2.[2] AC_1 represents the average cost curve and MC_1 represents the marginal cost curve of the paved road. The marginal cost curve rises above the average cost curve because externalities such as congestion, noise, and air pollution due to the increase in traffic level are aggregated to this curve. AC_2 represents

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1. Average cost includes travel time cost as well as vehicle variable operating costs. Marginal cost includes average cost plus cost of delay due to an additional driver loaded onto the traffic stream. A detail treatment of the marginal cost concept and its relationship to average cost can be found in 2.2.2.

2. See Renshaw (56).

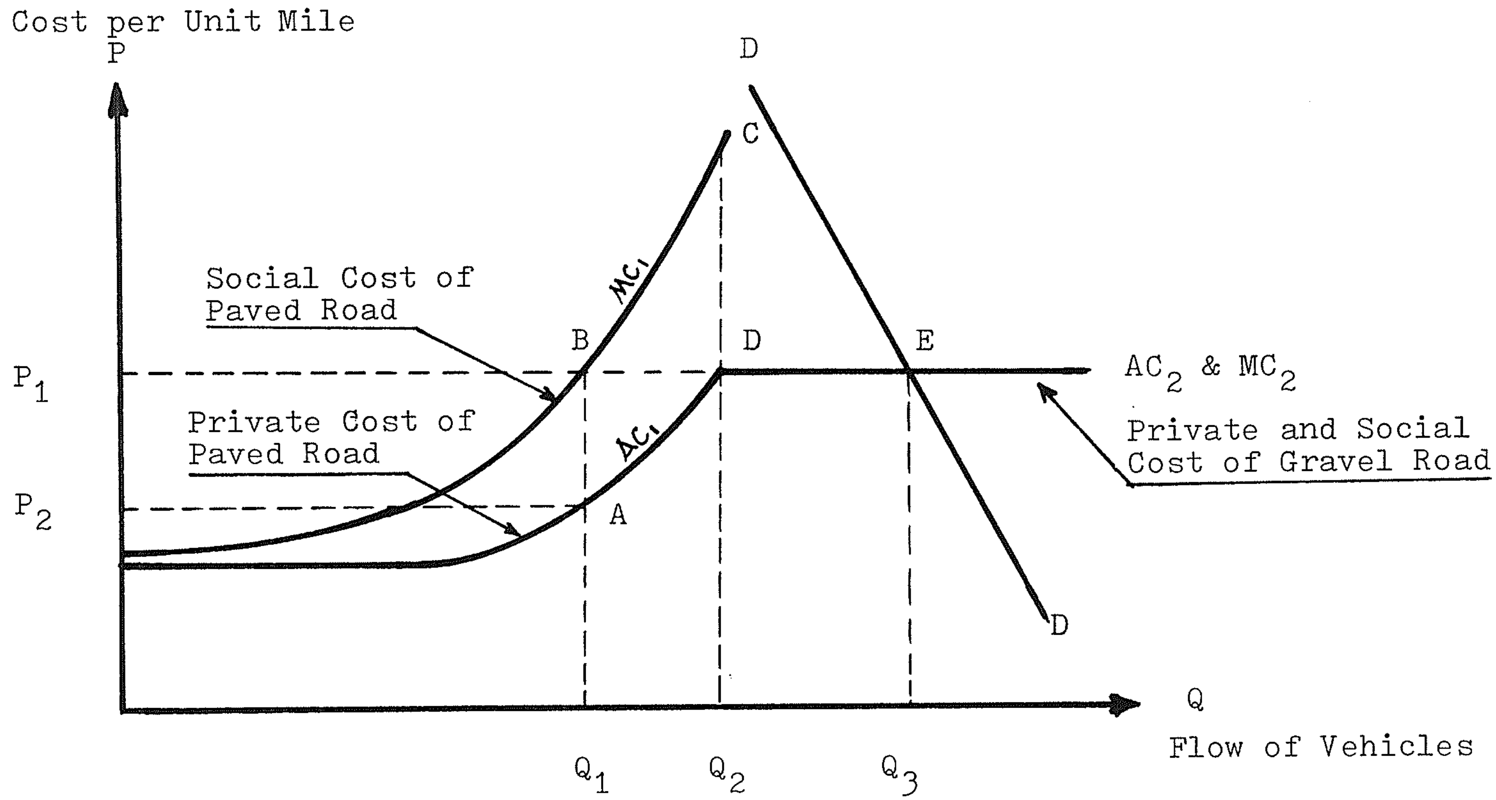

Figure 2: Pigou's Two Competing Roads: consumers prefer to use the paved road, until the cost of congestion makes them willing to use the gravel road.

the average cost curve of the poor-grade road; a constant average cost is assumed due to its unlimited capacity. MC_2 is equal to AC_2 for traffic congestion and therefore delay is absent. The demand schedule is represented by the line D-D, which shows the willingness to consume road travel as a function of the cost borne by the traveller.

If there is no toll on the utilization of the better road, then Q_2 vehicles will travel on the paved road while $(Q_3 - Q_2)$ will use the gravel road. At this point Q_2, the average costs of the two competing roads are equal and a state of equilibrium is maintained, so long as the two roads are perfect substitutes at the same price. However, the marginal costs are different at the point Q_2. Automobile users travelling on the paved road are incurring a social cost equal to the area P_2CD.

If a toll equal to $(P_1 - P_2)$, is charged for the usage of the paved road, then traffic on the better facility will fall to a less congested level at Q_1 and the number of vehicles using the inferior facility will increases by $(Q_2 - Q_1)$. At this point Q_1, the average costs for both roads remain the same. The externalities P_2CD present in the no-toll case is eliminated by the toll without making any user worse off. The society gains additional revenues from the congestion toll. The efficiency of resource allocation between the two competing roads can be maximized by the application of marginal cost pricing. The essence of the idea is to force the user to pay the full costs of consuming the facility.

2.2.2 Static Theory of Congestion

The classic work by Walters on congestion[1] represents a benchmark in the formalization of Pigou's theory. A majority of the research on congestion and congestion tolls have been developed using his static theory of congestion.

In the development of his theory, Walters defines three separate situations; hence three models are formulated. They are: (1) non-bottleneck model, (2) bottleneck model, and (3) network model. The model presented below is a short run static model for the non-bottleneck case.[2] It is selected because of its simplicity and applicability to the transit subsidy situation presented later this chapter.

Assumed are the following:

1. the traffic is homogeneous, (i.e. vehicles and drivers are identical.)
2. any given volume of traffic has the same operating costs and speed, (e.g., no differences in fuel economy between cars)
3. fixed highway capacity, and
4. the social and environmental effects of congestion are negligible.

The homogeneity assumptions are unrealistic, as it is readily

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1. See Walters (79).

2. Comprehensive treatments of these three models can be found in his first article in congestion theory. See Walters (79). His work on congestion toll (road user charges) appears in a World Bank Publication. See Walters (80).

admitted by Walters, but they seek to simplify the construction of this model. They might have been dropped, but they make the model more complicated at little gain in understanding the issue in question.

On a very lightly travelled highway, drivers will be able to attain their desired speed of travel. As the number of drivers increases, the speed at which they wish to travel decreases, largely due to an increase in traffic density. This relationship is portrayed in Figure 3.[1] The reduction in speed also represents an increase in travel time/cost as well as in vehicle variable operating costs.[2] These costs increase moderately at lower traffic density and sharply at higher levels of traffic. This relationship is represented by the average cost curve (AC) in Figure 4.

This relationship suggests that for every additional automobile loaded onto the traffic stream, the driver not only incurs costs upon himself but also imposes costs on every other driver travelling in the same traffic stream. The increase in average costs is smaller than the increase in marginal cost because the additional cost caused by an additional driver is being spread to every other user.

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1. The relationship between speed and flow in Figure 3 is empirical. It is based on data collected by Lerch (42) for over 10,000 south bound vehicles on I495 near 170S.

2. Although road maintenance costs also tend to rise with traffic density, this analysis is limited to the direct costs bourne by the users only.

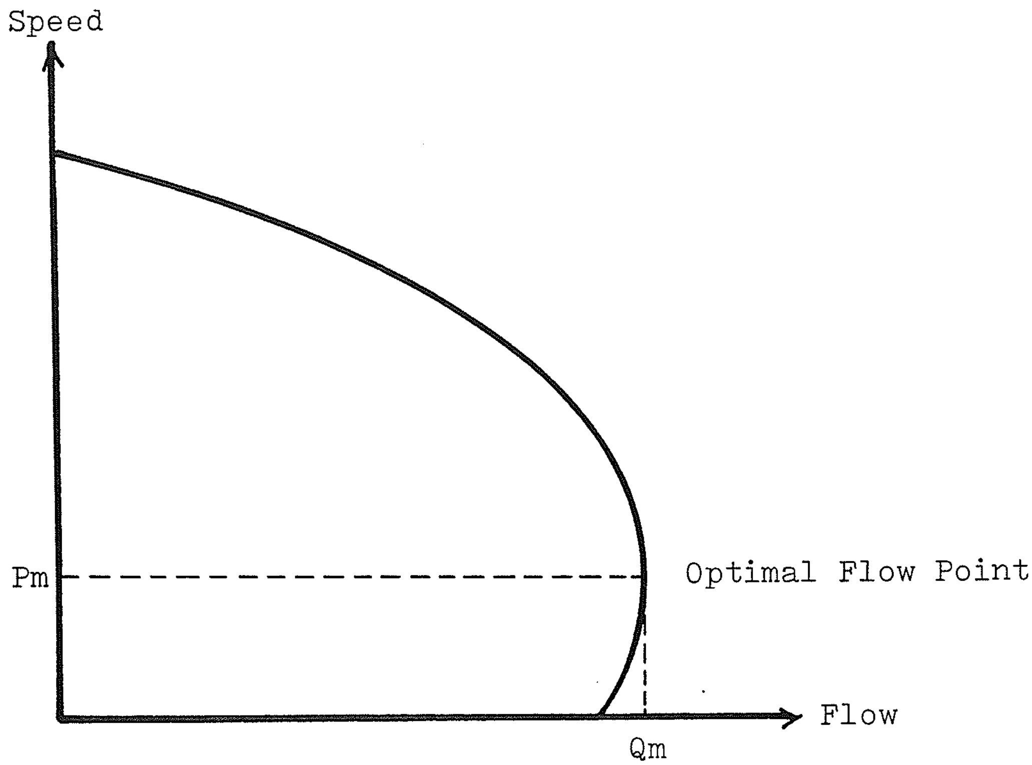

Figure 3: The relationship between Speed and Flow

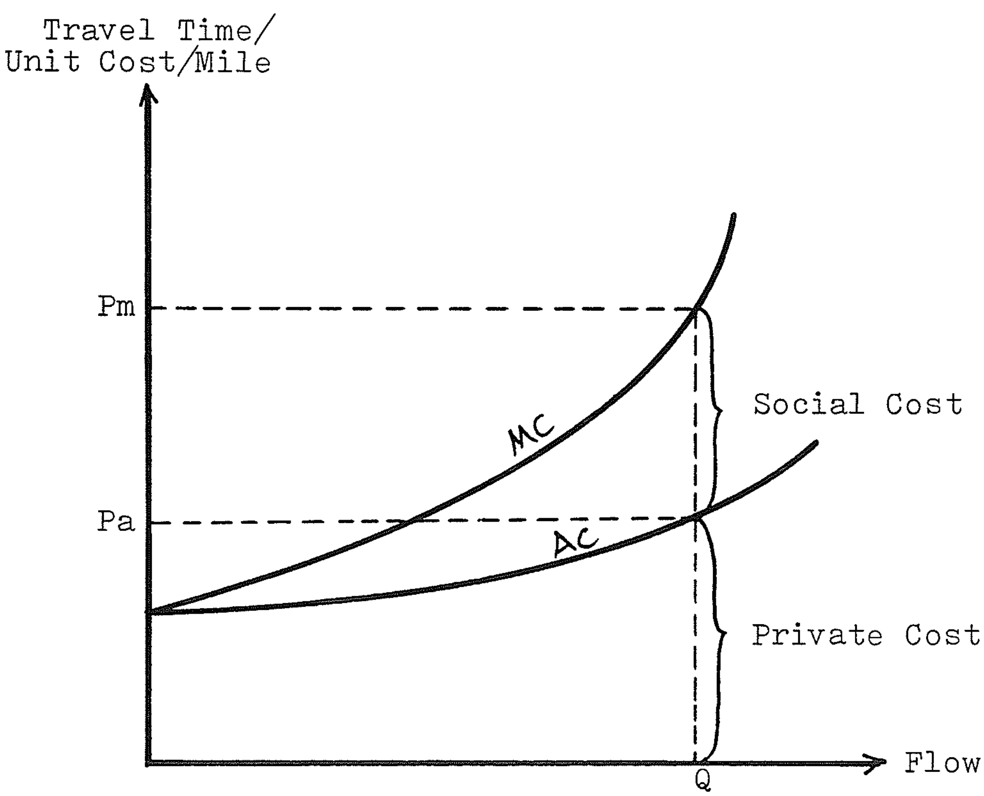

Figure 4: The Relationship Between Travel Time (Cost) and Flow

The increase in marginal cost is greater because the increase for the group as a whole is attributed to this user only. The marginal cost curve rises slowly above the average cost curve initially, and then drastically at higher traffic densities. (Figure 4) This drastic increase in marginal cost is largely due to an increase in congestion level as a result of lower speeds at higher traffic density; in other words, the cost of time plays a key role in the calculation of marginal cost.

The reduction in speed caused by an additional vehicle is experienced by every other driver in the same traffic stream because they are all travelling at more or less the same speed. The users are therefore paying the average cost (the private cost) for their trips. The external effects,such as delays due to traffic congestion caused by an additional vehicle, are not fully captured by the road pricing scheme without a congestion toll or tax.[1] Hence, we denote marginal cost as the social cost, to distinguish it from the private cost borne by the users. In order to recapture this social cost, the theory of congestion suggests the imposition of an optimal congestion toll which is equal to the difference between the marginal social cost and average private cost. This toll, as in Pigou's illustration, would maximize benefits to all drivers as well as to the society, or, be pareto optimal.

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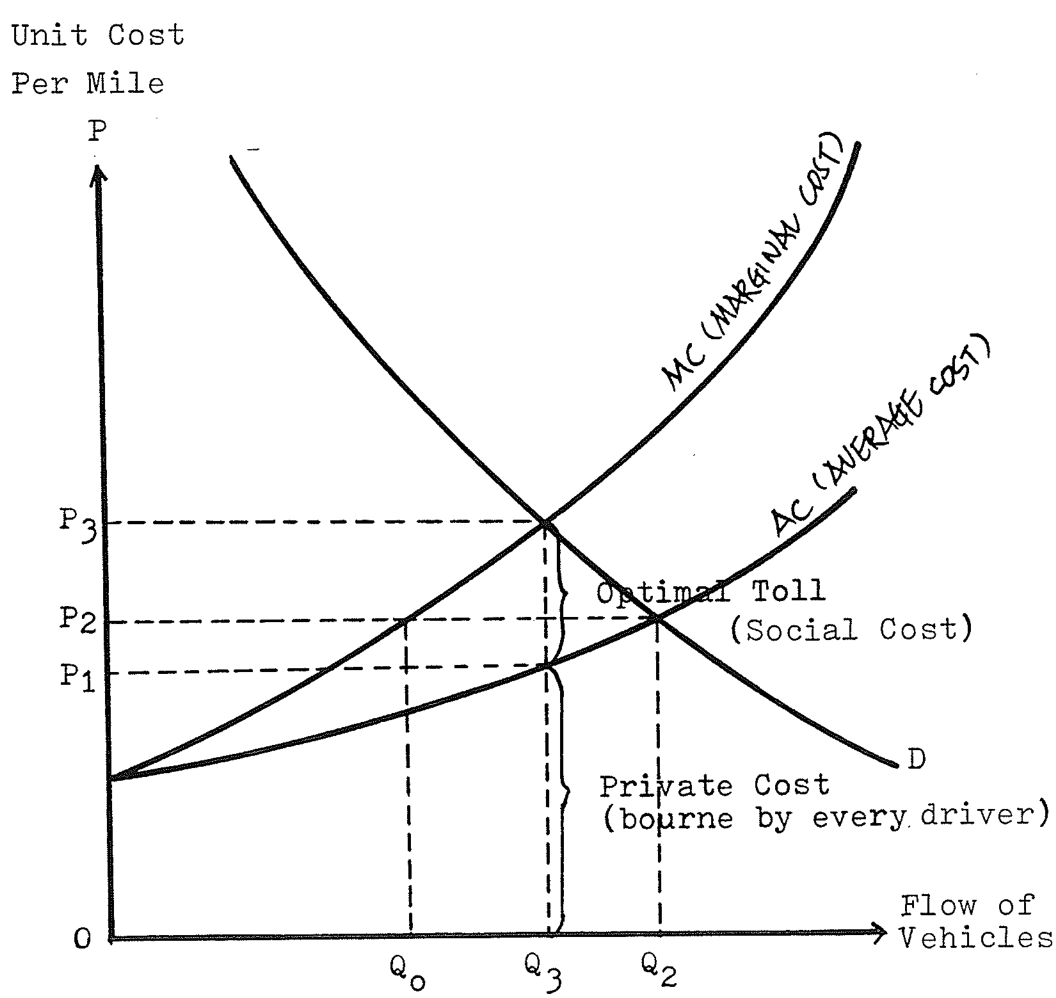
1. Note that road pricing refers to the operating costs, fixed costs, taxes, and other charges incurred by the individual user.

The solution of an optimal toll is portrayed in Figure 5. The unit curve AC measures the average private cost borne by each individual driver, and MC measures the marginal social cost. D-D is the demand schedule for automobile travel. An average cost pricing scheme is in effect under non-bottleneck conditions; the equilibrium quantity would be Q_2 and the equilibrium price would be P_2. If marginal cost pricing is to be used, the number of users would fall to Q_o, where price equals the marginal cost. For any flow greater than Q_o, the marginal cost is greater than the average cost. Therefore the marginal cost is greater than the average cost. Therefore the marginal cost incurred by the $(Q_2 - Q_o)$ users is not borne by themselves if everybody is paying the average private cost for their trips; in effect, some form of subsidy is occurring. The above analysis forms the basis of congestion toll theory.

Using marginal cost pricing, the equilibrium price would be P_3 and the equilibrium quantity would be Q_3. However, the Q_3 users experience only the cost of P_1 but not P_3, because they are travelling at the same average speed in the traffic stream. Since they all have the same valuation of travel time and the same variable vehicle operating costs (by assumption), they are therefore encountering the same cost. The cost $(P_3 - P_1)$ is then of no physical meaning to them because it is not being internalized. In order to reflect the true cost of using the highway, a toll equal to $(P_3 - P_1)$ should be levied on every driver.

Figure 5

Optimal Congestion Toll



2.2.3 Dynamic Theory of Congestion

Most of the research efforts on congestion and congestion toll have been largely built on Walter's classic formulation. Many of these studies[1] seek to refine the static congestion model, establishing a better fit for the speed and flow relationship, and researching the value of travel time savings. However, most of these studies deal with the non-bottleneck case only.

Agnew develops a dynamic theory of congestion, and optimal control theory is used to calculate the"correct" marginal cost and the associated toll for any traffic level [2] (bottleneck and non-bottleneck). He maintains that congestion is by nature a dynamic phenonmenon, and hence the static theory of congestion is inadequate. He argues that the marginal cost of the static model is incorrect because it fails to reflect subsequent changes in the level of congestion. He develops a correct definition of marginal cost from the costate variable of the dynamic model which would avoid the irregular results of the static model under the bottleneck case.[3] However, the determination of an "optimal toll" depends

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1. These studies include: Boardman and Lave (12), Inman (32), Goodwin (24,25), Hensher (29), Johnson (34), Porter (54), Keeler and Small (36), Littlechild (44), Mohring (49), Nelson (50), Richardson (57), Roth (59,60), Smeed (69), Rothenberg (61), Sherman (67,68) & Vickery (77).

2. Agnew (4,5).

3. Discussion of these irregular results of the static model can be found in Walters (79), p.680 and in Agnew (5) pp.391-392).

critically on the speed and flow relationship and the value of travel time,[1] and therefore the dynamic theory does not change the substantive results of the static theory to any significant extent.

2.2.4 Applications

The theoretical models and arguments relating to congestion tolls presented in the preceding three sections strongly indicate that a congestion toll is an effective means of relieving peak hour congestions in urban areas, in terms of economic efficiency. Economically, a congestion toll is also very appealing since no one is worse off because of the toll. As well, externalities such as congestion,and air and noise pollution are minimized to a large extent. Furthermore, the present state of electronic technology would undoubtedly be capable of implementing such a congestion toll very efficiently and economically by employing automated scanning devices installed on road sides to measure traffic level, compute the appropriate toll and automatically register the charges onto recording devices installed on automobiles.[2]

However, the application of congestion tolls on a large transportation network to control peak hour congestion has

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1. See Boardman and Lave (12), Inman (32) and Hensher (29).
2. In fact, experiments on these devices have been carried in city of SanFrancisco. Vickery (78).

not yet been reported anywhere in the world. The use of tolls on bridges, tunnels and highways are numerous, but these are for revenue purposes, and not to correct inefficiencies;[1] cases of the imposition of an actual congestion toll are difficult to find.[2]

One of the problems associated with a congestion toll is in the determination of an optimal toll value; the measurement of an optimal toll is much more difficult than its theoretical formulation would suggest. The marginal cost and average cost are relatively easy to identify once the speed and flow relationship as well as the value of travel time are given. Thus, the value of an optimal toll is critically dependent on the speed and flow function and the value of time savings. However, there have been great variations in the measurements of these functions, which consequently give rise to a wide range to "optimal" congestion tolls. Knowledge of the demand curve is also instrumental in determining an optimal toll, but at this time, no satisfactory procedure or statistical method exists to estimate this demand function. Walters cannot derive a toll mathematically from empirical studies. He can only speculate on the shape of the demand

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1. It is important to distinguish the role of tolls in: (a) revenue for capital construction and operation (b) to correct the inefficiency of a faulty road pricing scheme, and (c) to redistribute income. The congestion toll discussed in this chapter assumes the role in catagory(b).

2. In Singapore, limited success in its Downtown Area Licensing Project has been reported by Watson and Holland (81).

curve and estimate the amount of gasoline tax that should be charged in order to impose a congestion toll indirectly.[1] Agnew, while recognizing the importance of the demand function can be estimated by a similar methodology devloped by Williamson in peak load pricing.[2]

Apart from the technical complexity of determining an optimal congestion toll, the array of direct and indirect policy options in the implementation of a congestion toll and their impacts also created a selection problem. After evaluating all available policy options (Figure 6), Beesley concludes that further research on these policy options is needed.[3]

In actuality, however, the practical application of a congestion toll scheme is beyond any theoretical or technical considerations. The acceptance of such scheme by the public and the politicians is very much dependent on the recognition that congestion costs are externalities which have to be internalized to maximize total welfare of the society, rather than merely being costs unrelated to the physical resources consumed. Until such a time that the concept of social cost is accepted, the implementation of a congestion toll will not become a reality. A society which places individual freedom

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1. Walters (79), pp.692-697).
2. Williamson (83).
3. Beesley (11), pp.226-246.

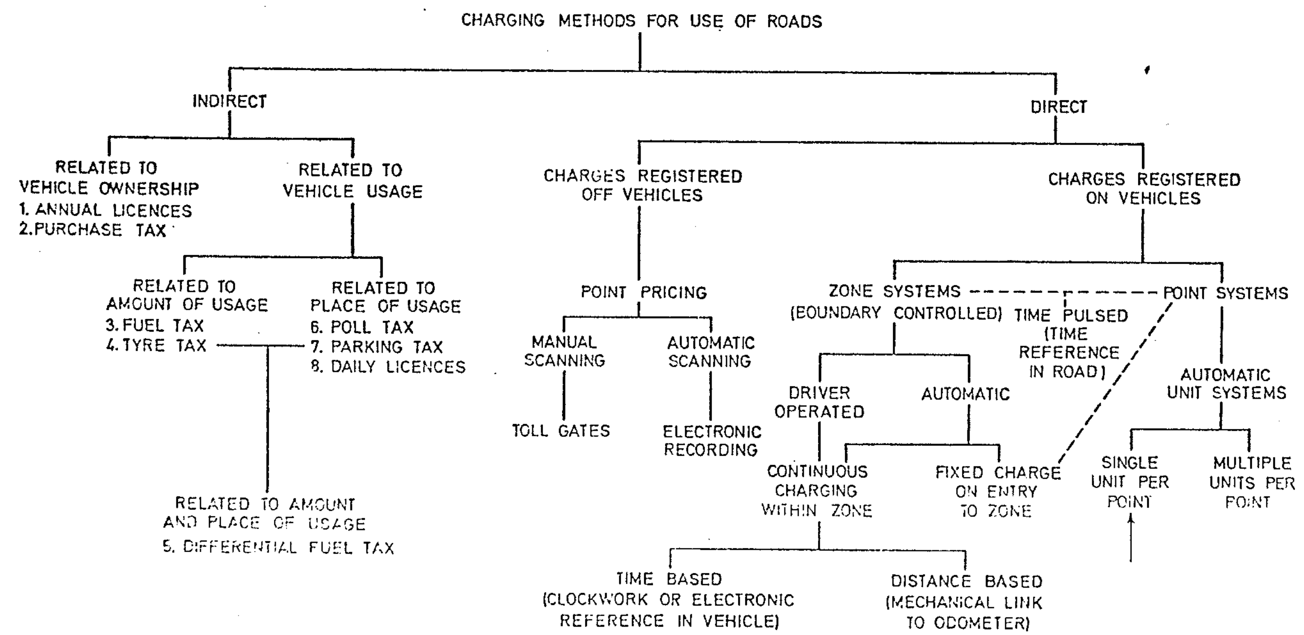

Figure 6: Charging Methods for use of Roads

Source: Beesley (11) p.245.

above any other concerns will tend to reject any such regulation of the private automobile in order to solve its urban transportation problems.

2.3 Subsidization of Urban Public Transit As A Second-Best Solution

Subsidization of urban public transit as a second-best solution to the imposition of a congestion toll using marginal cost pricing has been investigated by Sherman, Abe, Train Renshaw, Baum, and others.[1] The conceptual and practical difficulties of congestion tolls discussed previously are the basic arguments for subsidizing public transit as a second-best solution. The theoretical and economic basis of transit subsidily as a second-best solution are examined in this section.

2.3.1 Pareto Optimality and Second-Best Solution

It has been mentioned in 2.2.1 and 2.2.2 that the imposition of a congestion toll using marginal cost pricing would not make anybody better off or worse off. At that optimal equilibrium point, resource allocation between the private automobile and public transit is considered to be "Pareto optimal",[2]

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1. Sherman (67, 68), Abe (2), Train (74), Renshaw (56), Baum (7), and Mohring (49).
2. A Pareto optimal point is one in which a policy can make no one better off without reducing the welfare of at least one other person. Actually there are an infinity of such points (distribution of income), which tends to weaken this rule as a policy guideline.

since it would be impossible to increase the utility of one mode without decreasing the utility of the other, given a fixed demand level. However, the present road pricing system does not require the private automobile users to pay the marginal cost; instead they are paying the average private cost of their trips. As a result, the condition necessary to achieve Pareto optimality is violated.

A departure from the ideal congestion pricing scheme for the private automobile is inevitable, and subsidization of urban public transit is considered to be the "second-best" solution to minimize externalities created by the private automobile. The essence of the second-best solution is that if one major activity (i.e., the private automobile) is underpriced, then we move closer to an optimal solution by underpricing a complementary activity (i.e., public transit) rather than trying to recover costs by introducing a taxing scheme (i.e., a congestion toll).

They theory of second-best suggests that:

> "if one or more of the necessary conditions for Pareto optimality cannot be satisfied, in general it is neither necessary or desirable to satisfy the remaining conditions." 1

Since the faulty pricing of the private automobile cannot be corrected using the best solution because of political reasons, then a change in the private cost of public transit may be considered to be the second-best solution.

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1. Heads (27), p.14.

Misallocation will occur if one mode is being underpriced, because the private cost of one mode will affect the usage of the substitue mode. In this case, peak hour traffic congestion is caused by an excessive demand for automobile trips. The major contributing factor is that the private automobile is underpriced relative to its competing mode - public transit. The second-best solution is to lower the private cost of public transit in the same direction of the private automobile in order to lessen this misallocation. The Pareto optimal allocation again cannot be achieved by offering subsidies to transit, but the misallocation problem, as well as the social costs of private automobiles, may be minimized.[1]

2.3.2 Transit Subsidy Model

A model of transit subsidy as a second-best solution is developed using Pigou's two competing roads and is presented diagrammatically in Figure 7. Implicit to this model are the following assumptions:

1. automobile trips are homogeneous, (vehicles and drivers are identical)
2. transit trips are homogeneous, (same origin and destination)
3. all travellers using the same mode have the same valuation of travel time,

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1. A detail discussion of this assertion is presented in 2.3.2.

4. fixed highway capacity, and
5. automobiles and transit are perfect substitutes for each other

The average costs and marginal costs curves for private automobile trips are represented by AC_a and MC_a respectively, in Figure 7. Average costs include travel time cost and variable vehicle operating costs. Marginal costs include travel time cost and variable vehicle operating costs, plus externalities such as air and noise pollution. These costs rise slowly initially, and sharply as the traffic flow approaches capacity. This reflects the higher time and operating costs incurred when travelling at reduced speed at higher traffic density. The marginal costs are greater than the average costs because the increases in time and vehicle operating costs of an additional automobile trip are begin aggregated to that user.[1]

The average costs and marginal costs curves for public transit trips are represented by AC_t and MC_t respectively in Figure 7. Average private costs include walking time, waiting time, and travel time, as well as transit fare.[2]

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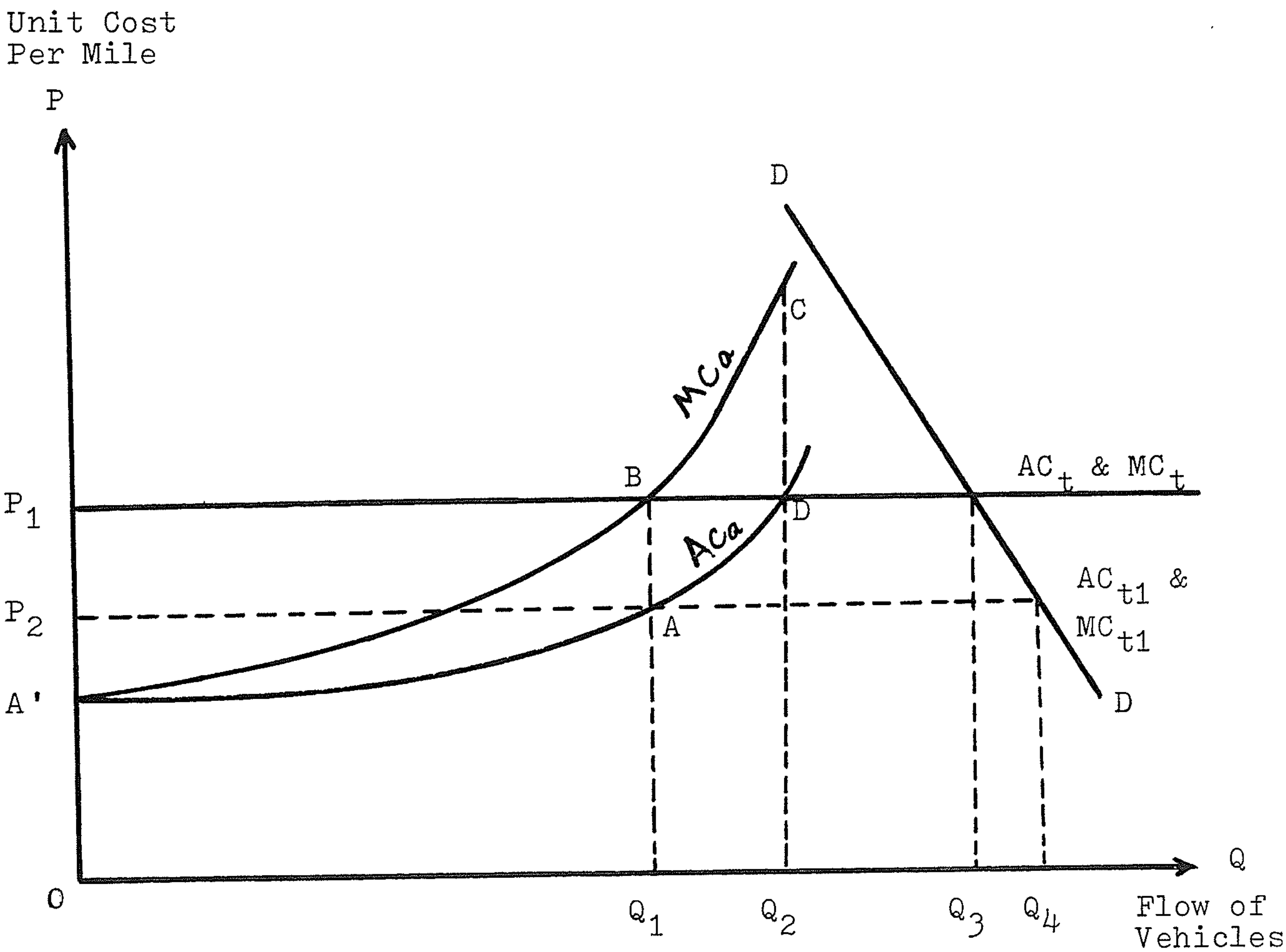
1. For a discussion of average and marginal cost, see 2.2.2.
2. Average private costs refer to the costs borne by transit riders only. Although the average costs of providing transit services are not constant and are higher than the transit fare especially at the initial level, the transit riders are not actually paying the average costs, instead they are paying a constant fare which largely reflects the average costs of providing transit services. Transit operation is a case of increasing returns to scale. For detail discussion, see section 2.3.3.

Figure 7 : Transit Subsidy as a Second-Best Solution to Relieve Traffic Congestion



Legend:

MC_a = Marginal Costs of the Private Automobile

AC_a = Average Costs of the Private Automobile

MC_t = Marginal Costs of Public Transit

AC_t = Average Costs of Public Transit

MC_{t1} = Marginal Costs of Public Transit after Subsidy

AC_{t1} = Average Costs of Public Transit after Subsidy

D-D = Demand Scheldule for road travel

Marginal costs are the same as average private costs except that transit fare is replaced by the costs of providing transit services. Externalitities created by public transit trips are considered to be negligible relative to automobile trips due to the much higher load factor of the transit buses. The average private costs curve is constant at all demand levels, as the transit fare is assumed to be the same for all travellers. Initially, the marginal costs are very much higher than the average private costs, which reflects the scale economies of transit operation. In order to simplify this exposition, the marginal costs of providing transit service are assumed to be equal to the transit fare.[1] In such a case, the marginal costs curve and the average private costs curve are the same and at a constant level, except at the initial stage. Finally, the demand for trips is represented by the demand schedule D-D.

If average costs are charged for private auto trips, then Q_2 auto trips and (Q_3-Q_2) transit trips will be demanded. At the point Q_2, the average costs of auto and transit are equal, but the marginal costs are not. The private auto users

----

1. In actuality, the marginal costs curve declines slightly rather at constant level with the average private costs curve. However, the assumption of constant marginal costs will not invalidate the analysis. In fact, the lower the marginal costs the stronger the case for transit subsidies under the increasing returns to scale argument. As well, the marginal costs of transit operation are only a tiny portion of the total transportation costs represented by the marginal costs curve, therefore it is realistic to assume it is constant.

are in fact imposing marginal costs equal to the area $OA'CQ_2$ while paying $OA'DQ_2$. The theory of congestion toll suggests that the imposition of a toll equal to (P_1-P_2) on auto users will reduce auto trips to a less congested level at Q_1, and transit trips will increase by an amount equal to (Q_2-Q_1). The average costs for both auto and transit trips remain the same at the new equilibrium point B. The externalities A'CD created in the absence of a toll thus can be eliminated without making anyone worse off. Gains to society will be in the form of congestion toll revenues (ABP_1P_2) and social costs (ABCD). Total transportation costs and welfare hence can be maximized between auto and transit by using congestion pricing.

Again, however, political and practical difficulties are the major stumbling blocks in the application of a congestion pricing scheme. Auto users only experience the average costs of their trips, hence marginal costs have no physical meaning to them. Any attempt to implement such a pricing scheme would be unpopular politically, and therefore practical applications are limited, especially in Canada and the United States.

Many economists[1] argue that by offering subsidies to public transit for system improvements designed to minimize walking time, waiting time, and travel time of using public transit will be considered to be a second-best solution as compared to the ideal congestion pricing scheme. A model of

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1. For examples: Baum (7), Jackson (33), Renshaw (56), Sherman (67, 68), and Train (74).

transit subsidy as a second-best solution to relieve traffic congestion is presented in Figure 7 . If a subsidy is being offered to public transit, the average costs and marginal costs of public transit would be lowered to P_2 from P_1. AC_{t1} and MC_{t1} would be the resulting average costs and marginal costs curves.

Now, the new equilibrium point is at A where the average costs of private automobile and public transit are equal. Automobile trips will be reduced to Q_1 from Q_2 while transit trips will enjoy an increase equal to $(Q_2-Q_1)$from automobile diversions as well as an increase in travel demand equal to (Q_4-Q_3). The impacts of transit subsidies are:

1. automobile trips are reduced to a less congested level at Q_1 and externalities are minimized from A'CD to A'AB and
2. transit riders will benefit from better transit services and a reduction in transportation costs.

Subsidization of public transit is considered to be a second-best solution, since at Q_1 private and social costs still diverge.[1]

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1. Note that second-best solutions require the divergence of social marginal costs as a necessary condition to achieve an optimal position.

2.3.3 Increasing Returns to Scale

In the previous section, transit subsidies are justified on the grounds that the social costs of private automobiles are not fully captured by the existing pricing mechanism. Another economic argument for transit subsidy is of a general nature, and relates to the scale economies of the industry. An expansion of the transit industry will result a reduction in cost per unit of output because of specialization of tasks, division of labor, or the use of large specialized machinery and equipment (a rapid transit facility, for example). Since the prices of factors are assumed constant, the fall in costs per unit must result because output increases faster than input as the scale of the transit industry expands. Such an industry is often said to be encountering increasing returns to scale.

The theoretical argument for subsidy under increasing returns to scale was advanced by Pigou. He stated that there is :

> "a presumption in favour of State bounties to industries in which conditions of decreasing supply price simpliciter are operating, and of State taxes upon industries in which conditions of increasing supply price from the community are operating."[1]

It has been shown by Mohring that transit industries are operating under increasing returns to scale.[2] In Figure 8,

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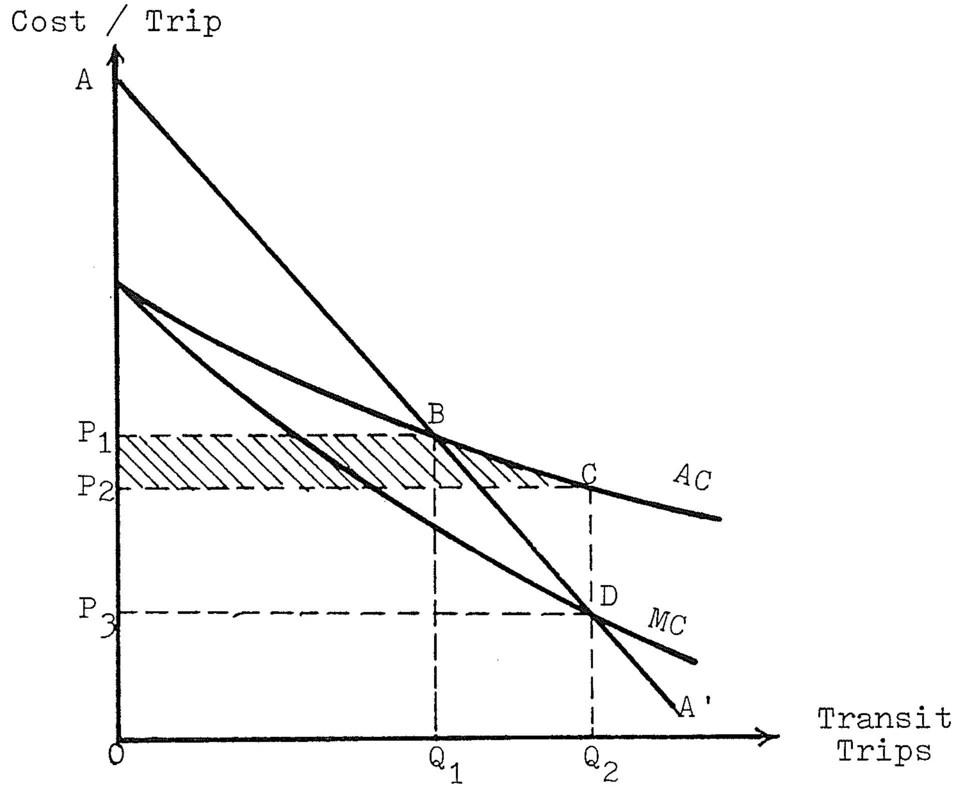
1. Pigou (53), p.224.

2. Mohring (49), pp.145-157.

Figure 8: Transit Operation Under Increasing Returns to Scale



MC and AC represent the marginal and average costs of providing transit services at various level of demand. A-A'represents the demand curve for transit trips. If the total transit operating cost is to be recovered, then P_1 should be charged and the number of transit trips demanded would be Q_1. The consumer surplus would be ABP_1. If marginal cost pricing is to be used, then price would fall from P_1 to P_3 and transit trips would increase from Q_1 to Q_2. The consumer surplus would be ADP_3. But the cost of providing transit services at Q_2 would be P_2, and a subsidy equal to P_2CDP_3 would be required to cover the deficit. This subsidy is justified on the ground that total benefit exceeds total cost by the shaded area P_1BCP_2 if transit trips are priced at marginal cost rather than average cost.

Moreover, this pricing rule is not valid if it is being used in isolation. As it has been demonstrated by Seneca[1], the marginal cost pricing of transport modes does not necessary yield optimal allocation of traffic. The marginal cost of the competing mode as well as the demand curve must be taken into consideration and examined simultaneously in order to minimize total transportation costs and to maximize benefits. Therefore, the transit subsidy model developed in the last section is more preferable in the analysis of transit subsidies.

2.3.4 Effects of Transit Subsidies

A primary objective of transit subsidies is to relieve urban traffic congestion, especially during the peak-hour. Improved transit services such as construction of rapid transit facilities, improvement in the collection and distribution system, more frequent scheduling, and exclusive transitways designed to minimize travel time, waiting time, walking time, and the inflexibility of using the transit mode will divert automobile users to public transit.[2] An increase in

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1. Seneca (64), pp.950-952.
2. Empirical evidences can be found in Kraft (39), Dewee (16), and Baum (7).

transit ridership and a corresponding decrease in automobile travel will then reduce traffic congestion. The automobile is also a major contributor of air and noise pollution in large urban centres. With fewer automobiles on the road, the level of air and noise pollution will decrease accordingly. The diversion of car users to public transit will lead to a reduction in total energy consumption, as some travellers are switching from an energy inefficient mode - the private automobile, to an energy efficient mode - public transit. Furthermore, the reduction in automobile travel will lessen financial burdens for the construction and improvement of transportation infrastructures.

Good transit services are usually available from the core areas to downtown, but services to the dispersed job centres and industrial parks are often indirect, infrequent, and extremely time-consuming. Improvement in the level of transit services will provide these residents with better accessibility to jobs. Improved transit services will also benefit groups with limited mobility such as senior citizens, students, handicap people and captive transit riders.

In many Canadian and American cities, retail sales, employment, and population within the downtown area have either declined or remained stagnant while enormous growth has occured in areas outside downtown, especially in the suburban areas. The lack of parking facilities and the congested traffic characteristic to the downtown area are often cited as major factors contributing to its decline or stagnation.

Further improvements in transit services to the downtown area will reduce traffic congestion and parking requirements, thereby inducing more shopping trips and creating employment opportunities in downtown. Improvements in the public transit system will rejuvenate the downtown area and re-direct some of the land use developments to the central city from the suburban areas.

The private automobile is a formidable attraction to most travellers because of its convenience, comfort, and flexibility. Subsidies in the form of fare reduction or free transit have been demonstrated to be ineffective in increasing transit patronage.[1] Therefore, subsidies should be used to improve service characteristics of the public transit system,as described earlier in this section.[2]

2.4 Summary

Pigou's classic example of the two competing roads provides a simple illustration of the application of marginal cost pricing to maximize the allocation efficiency of two hypothetical transport facilities. Forty-one years later, the theory of congestion (as advanced by Walters) marks the formalization of this theory. Walters argues that a motorist entering a traffic stream incurs not only a congestion cost

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1. See Kraft (39), Dewee (16) and Baum (7).
2. A recent released transit survey conducted by the Winnipeg Development Plan Review Group indicates that Winnipeggers were dissatisfied with present transit services. They want more direct transit services to minimize the need for transfers.

upon himself but also upon every other driver in the same traffic stream. He maintains that by imposing a toll equal to the marginal social cost and the average private cost, the level of congestion would be minimized and general welfare would be maximized. Although the theorectical basis of this hypothesis is very attractive, its practical application in an urban transport network has been consistently rejected, mainly for political and social reasons.

The existing road pricing system, however, fails to capture the full cost incurred by private automobiles. Travelling by private automobile is therefore underpriced and since the 'best' solution has been rejected, reduction in the private cost of public transit through subsidization would consider to be a second-best solution. Many transportation planners maintain that transit subsidies used to improve transit system characteristics and designed to minimize travel time, waiting time, walking time, and the inflexibility of the use of the transit mode would divert automobile users to public transit. The resulting impacts would include a reduction in peak hour congestion, air pollution, and noise pollution. Also, improved transit would benefit groups with limited mobility.

CHAPTER III

THE IMPACTS OF PUBLIC TRANSIT SUBSIDIES IN WINNIPEG

3.1 Introduction

The primary focus of this chapter is to assess the various impacts of public transit subsidies in Winnipeg with respect to their possible effects outlined in the last chapter and to transportation policies and guidelines adopted by the city government. The nature and magnitude of transit deficits and subsidies of the Winnipeg transit system are presented and discussed. The 1962, 1971 and 1976 origin-destination studies are employed to ascertain the impacts on transit ridership, automobile travel and urban development in Winnipeg. The degree and extent of peak hour traffic congestion within the study period are examined by utilizing data on traffic volumes, road capacity, travel time, and vehicle speed of the 1976 and 1962 coded road network of Winnipeg. Finally, impacts on the environment, energy consumption, and passenger car registration are considered.

3.2 The Magnitude of Transit Deficits and Subsidies

Subsidization of urban public transit has become a standard practice in Canada since the early sixties.[1] The public transit system in Winnipeg, being no exception, received a substantial amount of subsidies from the Regional Government

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1. Frankena (18), p.215.

(before January 1, 1972) City Government (after January 1, 1972) and the Manitoba Government. Two types of subsidy were offered by these governments; transit operating subsidies were used to cover transit operating deficits resulting from a much slower growth in transit revenues and a very rapid growth in total operating costs. The two governments also shared equally the capital costs of acquiring vehicles and equipment in an effort to 'modernize' public transit in Winnipeg by utilizing motor buses on the entire transit system.

3.2.1 Capital Subsidies

Prior to 1956, street cars, trolley coaches and motor buses were running on the streets of Winnipeg. With the 'modernization' of the public transit system, street cars ceased their existence in 1955 and trolley coaches disappeared from the streets 15 years later in 1970.[1] These vehicles were replaced by motor buses manufactured in Winnipeg by Flyer Industries Ltd. Table 1 presents the vehicle types and sizes of the transit fleet in Winnipeg between 1962 and 1976. Trolley coaches constitued one-third of the fleet in 1962 and but by 1971 they were totally eliminated, having been replaced by diesel buses. In addition, the fleet has expanded by

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1. The disappearance of trolley coaches and street cars in many cities in the U.S. has been claimed by Snell (70) as a scandal in which major bus manufacturers (e.g. GM) were alleged to be responsible for the discontinuance of street car and trolley services in order to increase their bus sales.

about 100 vehicles during the 15 year period. Seventeen gas engine buses with a seating capacity of 15-19 were also introduced for Dial-a-Bus and suburban feeder operatings in the early seventies.

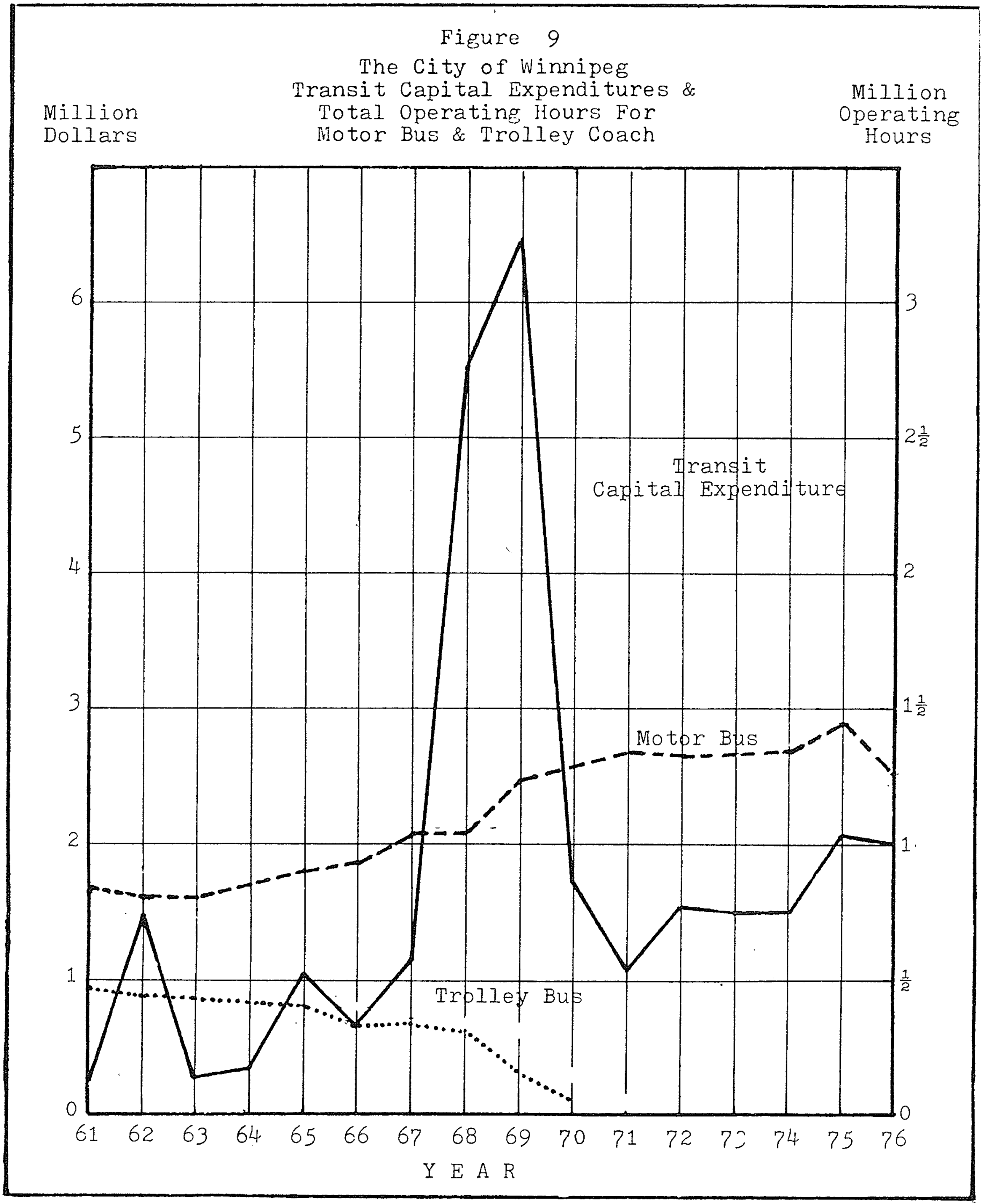
Both the provincial and Municipal government contributed equally in the acquisition of new motor buses for this complete shift in transit technology in Winnipeg. The magnitude of capital expenditures (subsidies) are depicted graphically in Figure 9. As well, total vehicle hours operated by trolley coaches and motor buses were charted on the same diagram using the right vertical scale. Between 1962 and 1968, there was a gradual decline in the trolley coach operating hours while utilization of motor buses was on the increase. Two years later, trolley coach services were phased out entirely. A sharp increase in capital expenditures totalling 12 million dollars in 1968 and 1969 can readily be observed in Figure 9. Transit capital expenditures dipped from its all time high in 1969 to 1.7 millions in 1970 when the conversion of transit technology was completed. Transit capital expenditures increased steadily again after 1971. The total increase between 1971 and 1976 was about 1 million or 100%. This increase indicated an expansion of transit services particularly in the suburban areas with 50 new bus purchases. (Table 1 and Figure 9)

TABLE 1

WINNIPEG TRANSIT SYSTEM
TRANSIT FLEET SIZE
1962 - 1976

TYPE OF VEHICLE	1962	1971	1976
Trolley Coaches 43-47 Seated Passengers	140	---	---
Diesel Buses 51-53 Seated Passengers	190	416	443
43-46 Seated Passengers	79	68	74
30 Seated Passengers	23	---	---
Gas Engine Buses 15-19 Seated Passengers	---	---	17
TOTAL	432	484	534

Source: Streets and Transportation Division,
The City of Winnipeg.



Source: From Tables 22 and 23 in Appendix III

3.2.2 Operating Deficits and Subsidies

The first operating deficit of the Winnipeg transit system occurred in 1960, and one has occurred in every subsequent year to date. In order to understand the magnitude of transit deficits and subsidies, it is necessary to examine transit operating costs and revenues at the same time.

Total operating costs of the Winnipeg transit system increased drastically from 8.3 million dollars in 1962 to 26.9 million dollars in 1976, an increase of some 223% in 15 years. The sharpest increases occurred between 1970 and 1976, and coincidently, the trolley coaches were put out of service at that time. On the other hand, system revenues grew at a much slower rate than operating costs. Transit revenues rose very gradually from 1962 to 1968, then took on to a sharper climb in 1969 resulting from an increase in basic adult fare from 15¢ to 25¢ that year. Transit revenues again remained quite stable after 1968. The OPEC embargo, coupled with an increase in the level of transit services, spurred a demand for public transit in 1974 and 1975. Transit revenues showed promising increases of 16.7% in 1974 and 15.7% in 1975. However, these increases were shortlived and the demand dropped substantially in 1976. This reduction was largely a direct consequence of the 7-week transit strike in 1976 which forced transit riders to seek alternate transport modes. Unfortunately, many former transit patrons did not switch back to public transit after the strike had ended. Indeed, transit ridership in 1977 and 1978 have dropped in comparison to transit patronage in 1975.[1] Total increase in system revenues amounted to 2.9 millions or 38%, compared to 18.6 millions or a 223% increase in operating costs between 1962 and 1976. (The above analysis is based on the statistics presented in Table 2)

When system revenues do not keep pace with costs, operating deficits are implied. By 1968, transit deficits had increased from half a million in 1962 to over 4 millions. (Table 2) The 67% increase in adult basic fare in 1968 only reduced the deficits marginally, by a quarter of a million. Transit deficits doubled the following year after trolley coach services were completly removed in 1970. After a slightly lower deficit in 1971, transit deficits took off and doubled in five years - from 7.2 millions in 1972 to 16.3 millions in 1976. The overall increase in operating deficits amounted to 15.7 millions or 2991% in 15 years ! (Table 2)

Although the first transit deficit occurred in 1960, no subsidy was required until 1962 when the Rate Stablization Reserve Fund was dwindling and finally depleted in 1963. The responsibility of raising taxes to cover transit deficits has been largely with the municipal government. The provincial government began contributing a small subsidy in 1966, but no cost-sharing formula with the city was used. The magnitude of municipal and provincial subsidies are presented in Table 2.

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1. The increase in new and used car sales during the strike period indicated that some of the transit riders decided to make the switch to private automobiles. Some of them enjoyed their alternate modes and decided not to use transit again when the strike was ended.

Table 2: Transit Revenue, Cost, Deficit, and Subsidy - Winnipeg, 1960 - 1976

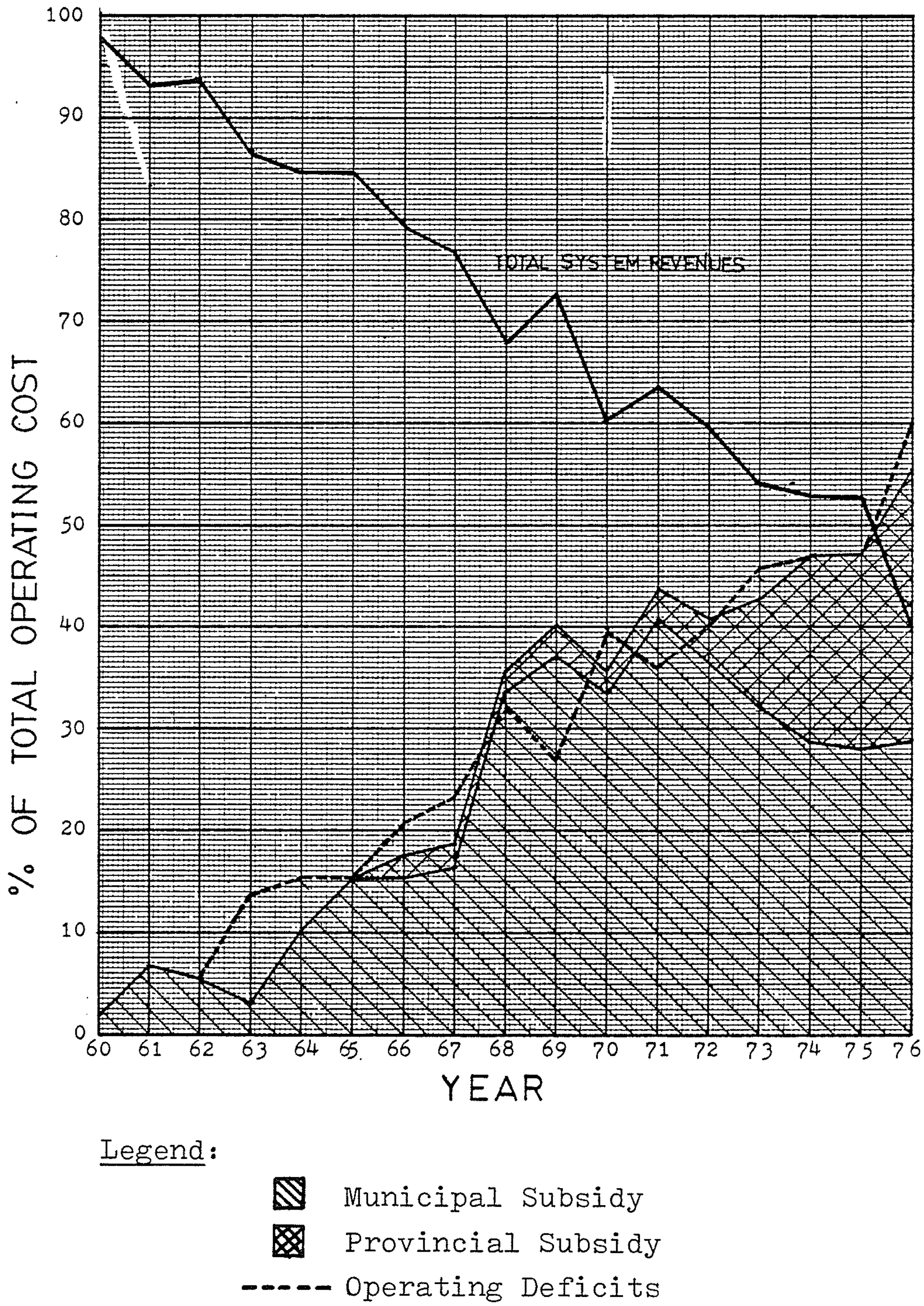
Year	Operating Cost	System Revenue	Deficit	Provincial Subsidy	Municipal Subsidy	Total Subsidy
1960	9,773,950	9,585,506	188,444	-	188,444*	188,444
1961	8,304,246	7,749,069	555,177	-	555,177*	555,177
1962	8,336,162	7,809,939	526,223	-	526,223+	526,223
1963	9,137,131	7,895,803	1,241,328	-	276,222**	276,222
1964	9,457,587	8,001,204	1,456,383	-	965,106	965,106
1965	9,640,780	8,148,201	1,492,579	-	1,456,383	1,456,383
1966	10,594,291	8,401,033	2,193,258	239,425	1,617,851	1,857,276
1967	11,329,877	8,692,856	2,637,021	248,072	1,852,600	2,100,672
1968	12,779,107	8,661,829	4,117,278	256,063	4,300,000	4,556,063
1969	14,235,949	10,367,365	3,868,584	424,932	5,276,000	5,700,932
1970	17,709,265	10,654,786	7,054,479	509,105	5,927,000	6,436,105
1971	16,840,585	10,739,367	6,101,218	523,600	6,856,420	7,380.020
1972	18,052,068	10,777,805	7,274,263	769,133	6,580,532	7,349,665
1973	19,774,347	10,677,195	9,097,152	2,090,321	6,364,777	8,455,098
1974	22,551,378	11,926,909	10,624,469	4,181,551	6,442,918	10,624,469
1975	26,165,384	13,815,542	12,349,842	5,025,213	7,324,629	12,349,842
1976	26,941,622	10,674,182	16,267,440	7,106,181	7,813,388	14,919,569

Source: Metro Winnipeg Financial Reports, 1962 - 1976
* Subsidy from Rate Stabilization Fund
\+ Subsidy included 310,283 from the Rate Stabilization Fund
** Subsidy included 45,954 from the Rate Stabilization Fund

Total operating subsides have multiplied from half a million in 1962 to 15 millions in 1976. This represented a 3000% hike in 15 years! Total transit subsidies increased steadily from 1962 to 1973, with the sharpest rise occurring between 1973 and 1976 - 6.5 million dollars, or 76% in just four years.

The most interesting observation can be found by comparing provincial and municipal subsidies. In order to make these comparisons easier to comprehend, total, provincial and municipal subsidies are expressed as percentages of total operating costs. As well, system revenues and deficits are converted to percentages and illustrated graphically in Figure 10. System revenues declined (1962-1976) while deficits rose steadily and passed the 50% mark in 1975. Transit subsidies were used to cover these deficits partially or fully. Before 1972, municipal subsidies rose more or less at the same rate as transit deficits and the amount of provincial subsidies was relatively small (between 2 to 3% of total operating costs). The magnitude of municipal subsidies subsided substantially (in relation to total costs) and provincial subsidies increased drastically between 1972 and 1976. By 1976, the City and the province shared the deficit almost equally. The drastic increases in provincial funding signified a change in provincial transit policy. The Manitoba government explicitly requested the City of Winnipeg to freeze transit fare, which would otherwise have had to be raised to meet the rising costs of operation. In return, a substantial provincial grant was offered to Winnipeg Transit to reimburse the

Figure 10
THE CITY OF WINNIPEG
Transit System Revenues, Operating Deficits
Provincial & Municipal Subsidies
As A Percentage of Total Operating Costs



Source: Drawn from Table 21 in Appendix III loss in operating revenues.

The magnitude of transit subsidies can also be observed by analysing the average full-cost fare and the average fare for each year between 1962 and 1976, presented in Table 3. The full-cost fare was the fare which would have had to be charged to each bus passenger if the total cost of operation were to be recovered. The average fare was the fare paid out-of-pocket by each bus passenger. The gaps between the average full-cost fare and the average fare widened over the study period. In 1962, each passenger was paying 94% of the full-cost fare and by 1976, each of them was paying 39%. The differences between the full-cost fare and the average fare were in fact being subsidized. The 1976 average transit fare would have had to be raised to 48.6¢ from 19.2¢ if transit subsidies were eliminated.

3.3 The Impacts of Transit Subsidies

The magnitude of transit subsidies, both capital and operating, were considered to be substantial during the 15 year study period. The degree of subsidization reached a record high in 1976 - 55.4% of total operating costs or 15 millions. In view of the restraint policies imposed by the two levels of government which were prompted by the success of Proposition 13 in California, it is necessary to assess the impacts of these subsidies with respect to the potential effects outlined earlier in section 2.3.4 and to transportation policies and guidelines adopted by City Council.

Table 3

Average Full Cost Fare, Average Fare & Deficits
Winnipeg Transit : 1962 - 1976

YEAR	Av. Full Cost Fare	Average Fare	Deficits
1962	0.1476	0.1383	0.0093
1963	0.1608	0.1390	0.0218
1964	0.1664	0.1408	0.0256
1965	0.1653	0.1397	0.0256
1966	0.1758	0.1394	0.0364
1967	0.1835	0.1408	0.0427
1968	0.2075	0.1406	0.0669
1969	0.2419	0.1762	0.0657
1970	0.3018	0.1816	0.1202
1971	0.2900	0.1849	0.1051
1972	0.3095	0.1848	0.1247
1973	0.3409	0.1840	0.1568
1974	0.3637	0.1924	0.1714
1975	0.3925	0.2073	0.1853
1976	0.4856	0.1924	0.2932

Sources: Computed from Tables 2 and 9

Notes: Average Full Cost Fare is calculated by dividing total operating costs by revenue passengers.

Average fare is calculated by dividing system revenues by revenue passengers.

3.3.1 Impacts on Transit Ridership and Automobile Travel

One of the major objectives of transit subsidies is to encourage public transit usage and to reduce automobile travel especially during the peak hours.[1] The purpose of this section is to examine the impacts on automobile usage and transit patronage through three separate time series analyses. Transit and automobile work trip data are extracted from the 1962, 1971 and 1976 origin-destination (O-D) studies for these analyses. As well, traffic counts and transit statistics are also utilized.

3.3.1.1 A.M. Peak Hour

It is customary for transportation studies to place a heavy emphasis on the analysis of A.M. peak hour demand because it is the busiest hour of the day. Of all total daily work trips, 44.2% (1976) to 48.7% (1962) were made during the A.M. peak hour. The problem of peak loading worsened when three-quarters of these trips were made by private automobiles. (1976 O-D study) The externalities associated with the private automobile such as congestion, social disruption, and air and noise pollution are enormous but difficult to measure.[2]

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1. See Appendix I, Transportation PolicyI,Guidelines 3 & 5, and Transportation Policy II, Guideline 1.

2. For a discussion of these externalities, see section 1.2.1.

The A.M. peak hour ratio which measures the proportion of peak hour work trips to total daily work trips, lowered slightly from 0.487 in 1962 to 0.469 in 1971 and to 0.442 in 1976. The period between 1971 and 1976 showed a greater 'peak load spreading' effect. The drop in this ratio represented a modest change in the standard working hours of 8:30 a.m. to 4:30 p.m. by some public and private agencies. The adoptation of staggered work hours would undoubtedly reduce the peak flow of traffic to some extent.

However, the decline in the A.M. peak hour work trip ratio was more than offset by a 36% increase in peak hour work trips. Table 4 traces the changes in A.M. peak hour work trips (by mode) between the years 1962 and 1976. It is noteworthy that automobile work trips grew at a much faster rate than any mode. They rose by 56% compared to a mere 6% hike in transit work trips over the 15 year period. Furthermore, both automobile passenger and walk/cycle trips increased at a higer rate than transit trips. The private automobile alone captured 87% of the growth in travel demand during the A.M. peak hour compared to a 5% share for public transit. These figures suggest that public transit was the least competitive mode and considered to be the least attractive (desirable) mode of travel to work. The private automobile, on the other hand, was the most competitive mode and considered to be the most desirable mode of travel to work.

The shrinking modal split also confirms the above conclusion. The modal split has eroded from 28.1% in 1962 to

Table 4: Mode of Travel - Winnipeg, 1962, 1971 & 1976

Mode of Travel	1962	1971	1976
Vehicle Driver	37,242 51.2%	50,332 53.6%	56,725 57.2%
Bus Passenger	20,445 28.1%	21,167 22.6%	21,723 21.9%
Vehicle Passenger	8,402 11.5%	12,985 13.7%	11,614 11.7%
Walk, Cycle	6,657 9.2%	9,461 10.1%	9,138 9.2%

Source: Streets and Transportation Division, The City of Winnipeg.

Table 5: Rides Per Capita - Winnipeg, 1962 - 1976

Year	Rides/Capita	Year	Rides/Capita
1962	120	1970	111
1963	119	1971	108
1964	116	1972	107
1965	117	1973	105
1966	120	1974	111
1967	121	1975	119
1968	119	1976	98
1969	113	1976	113*

Source: Streets and Transportation Division, The City of Winnipeg.

* Rides per capita adusted for the 7-week transit strike in 1976.

22.6% in 1971. The change between 1971 and 1976 was moderate. The proportion of work trips using public transit has declined 6.8% in 15 years, while private automobile usage has increased by 6%. (Table 4)

3.3.1.2 Hourly Transit Passenger and Automobile Distribution

The impacts on transit ridership and automobile travel can also be ascertained by the hourly distribution of transit passengers and automobiles depicted graphically in Figure 11 and 12 respectively. These statistics were obtained by actual passenger and traffic counts and are slightly different from the origin-destination studies used in the last section, in that all trips made during the day are included, regardless of purpose.

Public transit generally exhibited very modest increases for all working hours. The increase in A.M. peak hour trips was greater than the P.M. peak hour trips. It is also interesting to note that the greatest gain in ridership was not during the peak hours but during a period between 2:00 p.m. and 4:00 p.m. This might be attributed to a growth in shopping and university student transit trips. (Figure 11)

The hourly distribution of private automobiles crossing the screen line[1] showed drastic increases in all working

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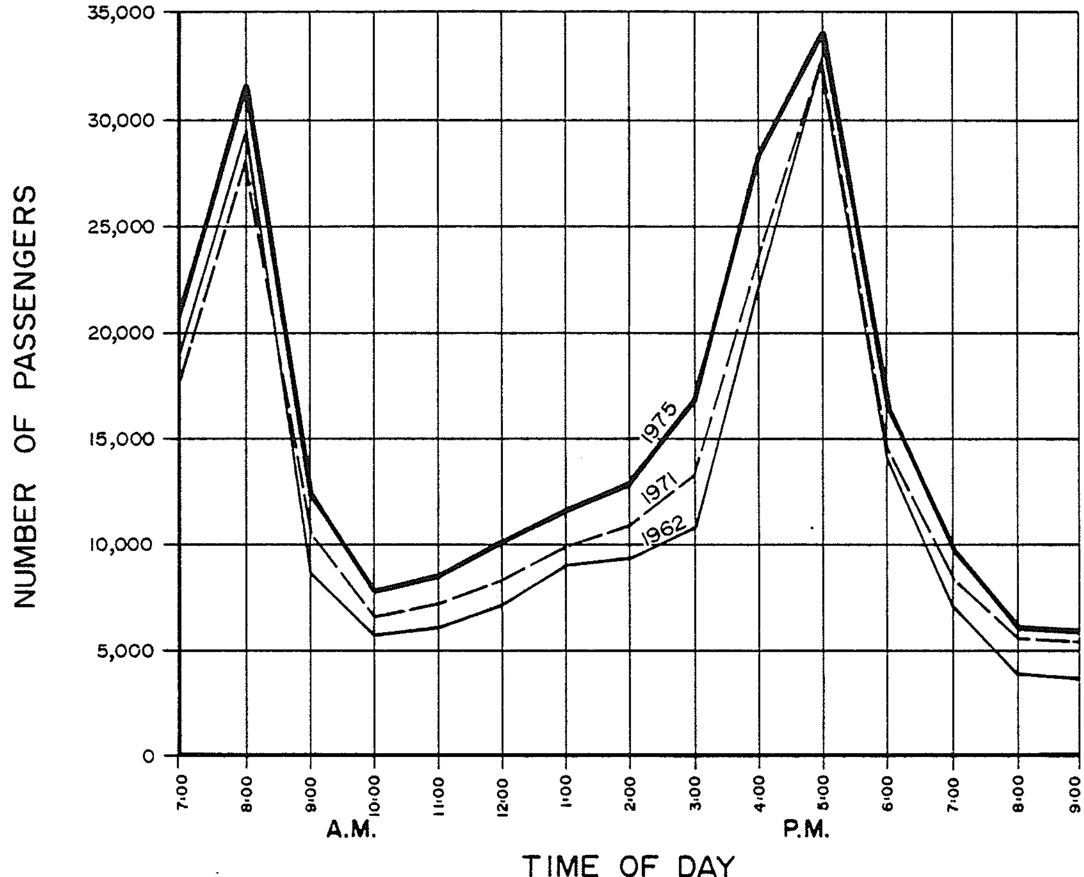
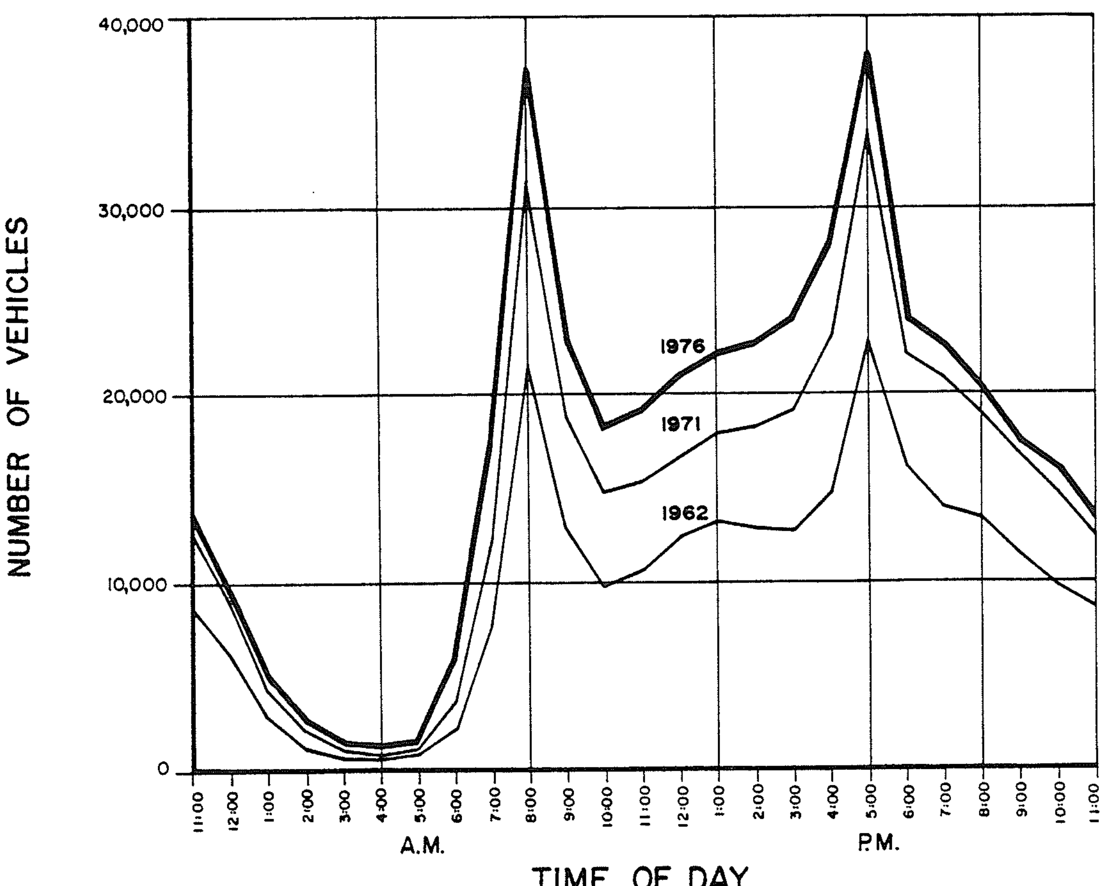
1. The screen line is defined as the Red and Assiniboine River within the city limit of Winnipeg. The hourly distribution of automobiles crossing the bridges and crossings during a 24-hour period.

Figure 11: Hourly Transit Passenger Distribution Av. Weekday



Source: Travel and Demographic Trends (84)

Figure 12: Vehicle Screen Line Crossings - 1962 to 1976



Source: Travel and Demographic Trends (84) hours and especially during peak hours. The estimated increases in peak hour vehicular traffic was approximately 80% between 1962 and 1976. The periods between 9 a.m. and 4 p.m. also exhibited remarkable growth. (Figure 12)

These trends indicate that private automobiles were more popular than public transit for work trips during peak hours and also for other trips during off-peak hours. Public transit was less attractive to all types of trip makers.

3.3.1.3 Rides per Capita

Rides per Capita for transit are computed by dividing total transit passengers by total population. These statistics are presented in Table 5 and show that rides per capita declined between 1962 and 1976. Between 1962 and 1973, people were making 14 fewer transit trips on an average. Although there had been a resurgent interest in transit in 1974 and 1975, the 7-week transit strike caused the figure dipped to a record low of 98 rides per capita in 1976. If we take away the effects of the transit strike, the adjusted figure stood at the same level as in 1973 at 106 rides per capita. Transit ridership has shrunk in relation to population. People are making fewer transit trips than before.

Although there are no available statistics for automobile rides per capita, we can assess this impact indirectly. Travel demand for work trips has grown 36% while population has risen at a slower rate of 20% during the study period. The private automobile trips shared a substantial proportion of the growth in travel demand. (73% of the total increase in A.M. peak hour work trips were made by automobile drivers - Table 4) We can therefore infer that automobile rides per capita have risen considerably. It is reasonable to assume that on an average, people made more automobile trips in 1976 than in 1962.

This analysis also confirms conclusions reached previously. Public transit was less competitive and less attractive than the private automobile. Despite substantial increases in public grants to transit, these do not appear to have had a significant effect on restraining automobile travel and a very marginal impact on transit ridership.

3.3.2 Peak Hour Traffic Congestion

Another objective of transit subsidies is to alleviate peak hour traffic congestion by inducing higher transit patronage, thus restraining automobile usage.[1] As it has been demonstrated in the previous sections, despite receiving massive subsidies, public transit not only failed to divert automobile travellers to transit but also failed very dismally in capturing a share of the growth in travel demand. The 56% growth in automobile A.M. work trips over the 15 year study period would undoubtedly make the peak hour traffic congestion problem more critical if no extensive construction

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1. See section 2.3.2 and Winnipeg transportation policy I and II in Appendix I.

or expansion of transport facilities had been carried out. In order to ascertain the degree and extent of traffic congestion over time, data on highway capacity and volume during the A.M. peak hour in 1962 and 1976 are utilized.

Volume and capacity ratios have been calculated for each intersections of the 1962 and 1976 coded road networks of Winnipeg. The results are represented diagrammatically in Figure 13 and 14. A volume and capacity ratio is calculated by dividing the volume of observed traffic passing an intersection by the practical capacity of that intersection. The practical capacity of an intersection is defined as the maximum volume of traffic that can be discharged by an intersection in one hour under normal street and climatic conditions with most of the vehicles being able to clear the intersection without waiting more than one signal cycle. A solid circle indicates a volume-capacity ratio greater than one, which indicates that delay and congestion are prevalent during the peak hour and that conditions are considered unsatisfactory at the intersection. A circle represents a volume-capacity ratio between 0.75 to 1.00 which denotes that traffic congestion is considered to be acceptable, but approaching an unsatisfactory level.[1]

In 1962, most of the congested intersections were concentrated near and within the downtown area, especially at bridges and major arteries leading in and out of downtown.

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1. Travel and Demographic Trends (84), p.32.

A few major arteries outside the downtown area also experienced traffic congestions approaching unacceptable level. They were Marion Avenue, Portage Avenue, Notre Dame Avenue, Salter Street, McPhillips Street, Arlington Street, Maryland Street, and Sherbrook Street. The area of traffic congestion was limited to a radius extending approximately 2 miles from Downtown. (Figure 13)

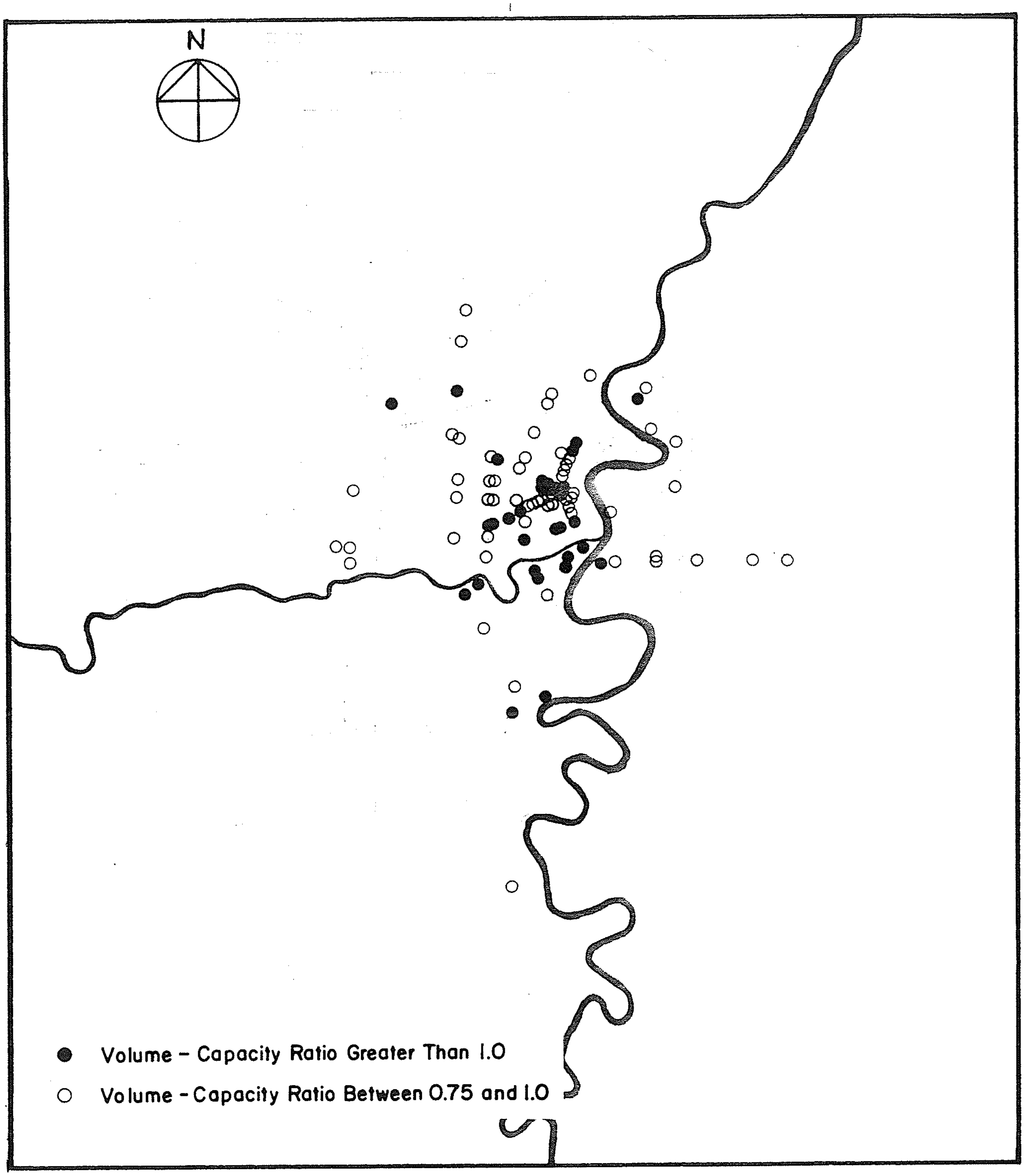
By 1976, peak hour traffic congestion had increased tremendously. The extent of traffic congestion has extended to intersections within a radius approximately 3.5 miles from downtown. (Figure 14) Traffic congestion is no longer restricted to the central area of Winnipeg; its occurrence radiates outwards in all directions. The number of intersections with a volume-capacity ratio greater than one has increased from 30 to 87. Conditions on many arterial streets leading into major employment centres such as Downtown, Health Sciences Centre, St. James Industrial Park, St. Boniface Industrial Park, Inkster Industrial Park, and the University of Manitoba, have reached unacceptable levels. Delays and congestions on many regional streets are either at or approaching unacceptable levels.

The preceding analysis reveals that the degree and extent of peak hour traffic congestion in Winnipeg have incresed drastically. They also confirm the analyses on automobile travel and transit ridership performed in the previous section. The impact of transit subsidies on peak hour traffic congestion was definitely insignificant.

FIGURE 13

THE CITY OF WINNIPEG

Intersection Volume - Capacity Relationship
Peak Hour - 1962

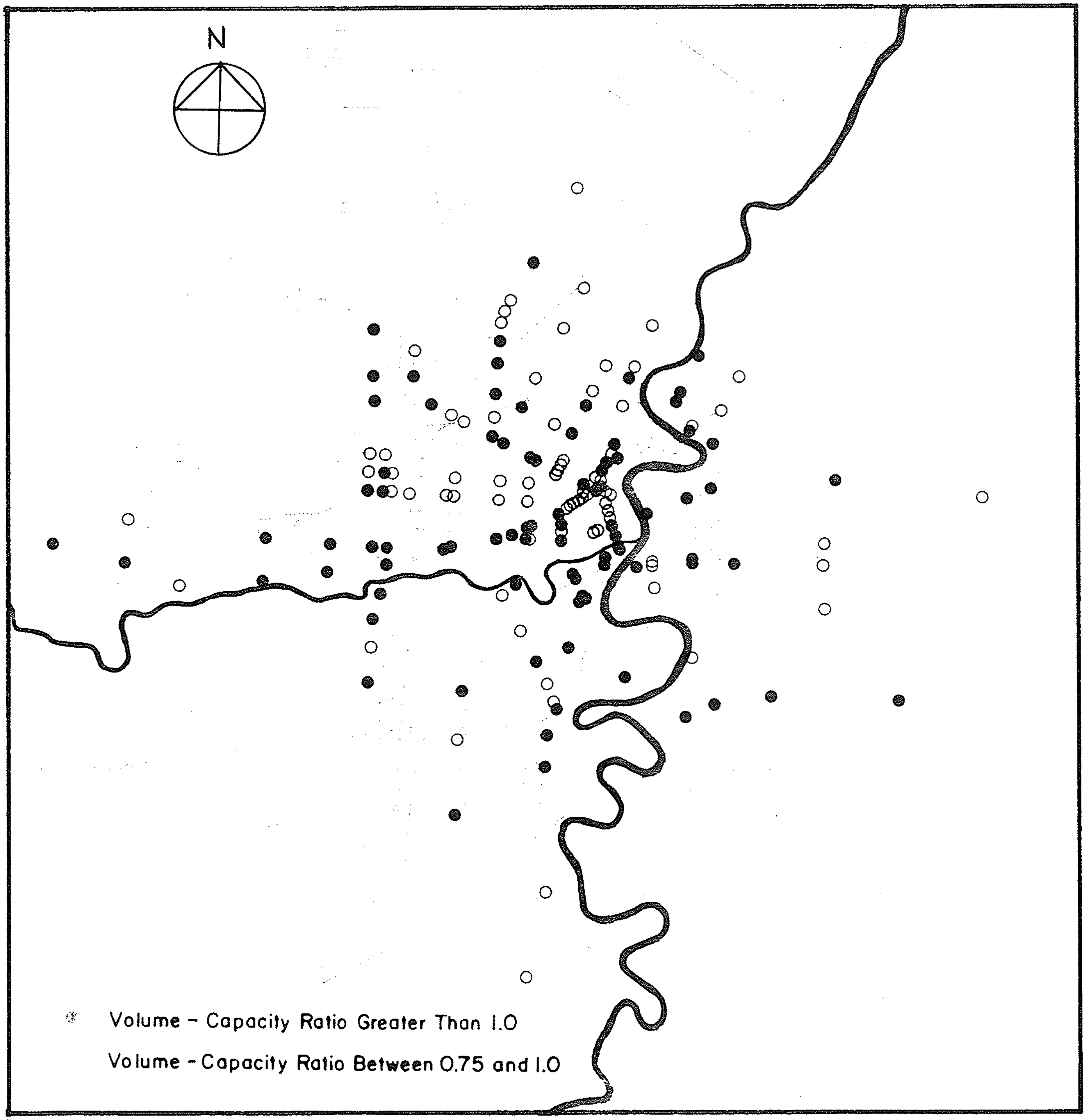


Source: Streets and Transportation Division
The City of Winnipeg

FIGURE 14

THE CITY OF WINNIPEG

Intersection Volume - Capacity Relationship
Peak Hour - 1976



Source: Streets and Transportation Division
The City of Winnipeg

3.3.3 Impacts on Urban Development

Two specific urban developmental impacts are examined in this section. The first assessment is related to impacts on population, dwelling unit, employment and travel patterns in three study areas. The second assessment is concerned with impacts on public transit ridership and on automobile travel to the major employment centres in Winnipeg.

3.3.3.1 Downtown, Inner Area and Outer Area

In many Canadian and North American cities, population, employment, and retail trade in the downtwon area have declined substantially during the last two decades, while enormous growth has occurred outside the downtown. One of the objectives of public transit is to improve the downtown environment and to prevent further deterioration of the central area by providing efficient transit services to these areas.[1]

In order to investigate the development impacts, the City of Winnipeg is divided into three distinct areas:[2] (1) Downtown - defined as an area bounded to the east by the Red River, to the south by the Assiniboine River, to the west by Osborne, Salter and Isabel Street, and to the north by the Canadian Pacific Rail Line, (2) Inner Area - defined as an area less

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1. See Winnipeg Downtown Policy Guideline 3(b) in Appendix I and section 2.3.4.

2. A map showing the location of these 3 areas can be found in Figure 20 in Appendix II.

TABLE 6 : Demographic, Economic, and Travel Characteristics For The Downtown, The Inner Area and The Outer Area of Winnipeg

Characteristics	DOWNTOWN			INNER AREA			OUTER AREA		
	1962	1976	Δ%	1962	1976	Δ%	1962	1976	Δ%
Population	18,977	15,936	-16	376,216	347,824	-8	75,426	203,053	169
Dwelling Units	6,761	8,738	29	101,437	124,131	22	18,118	59,049	225
Patterned Employment*	60,429	54,567	-10	67,545	107,030	58	21,790	60,040	176
A.M. Peak Work Trip Origins									
Total	5,386	3,432	-36	57,230	59,979	5	10,130	35,521	251
Automobile Drivers	1,197	677	-57	29,738	32,436	9	6,307	23,409	271
Bus Passengers	1,330	975	-27	17,579	14,995	-15	1,536	5,737	274
A. M. Peak W.T. Destinations									
Total	31,646	26,540	-16	31,356	45,921	46	9,714	25,653	164
Automobile Drivers	12,261	10,879	-11	19,645	30,160	54	5,336	14,717	176
Bus Passengers	13,644	10,511	-23	5,713	6,904	21	1,088	4,291	294
Downtown Parking Supply	30,795	31,775	3						

Source: Streets and Transportation Division, The City of Winnipeg

*"A patterned opportunity is one that indicates that the person involved with the opportunity utilizes or creates a demand for some portion of the transportation system in his travel to and from work and that his work trip travel habits are regular and predictable. Hence, a person who resides in a residential area and who travels regularly by vehicle or transit or by some other means of travel to and from his place of employment is said to have a patterned employment opportunity. Post-secondary students, because of their concentrated demand on the transportation system, were considered as part of patterned employment force of the metropolitan area."Travel & Demographic Trends(84),p.9.

than 3 miles away from Downtown, and (3) Outer Area - defined as an area greater than 3 miles away from Downtown. A summary of the impacts on population, dwelling unit, employment and travel patterns of these three areas are presented in Table 6.

Between 1962 and 1976, the Downtown area suffered from a reduction in population, and patterned employment, as well as automobile and transit work trips, but the number of dwelling units was on the rise. This gain was largely due to increases in high-density residential developments. However, population and employment opportunities have shrunk by 16% and 10% respectively. (Table 6) Despite the relatively good transit services, the reduction in population and employment also led to a decline in automobile and transit work trips destined to and originated from Downtown. The reduction in transit work trips destined to Downtown was more than double the reduction in automobile work trips. (Table 6) The major contributing factors to this decline were the worsening peak hour congestion problem and limited parking facilities. Half of the Downtown traffic in 1976 was through traffic, which certainly aggravated peak hour traffic congestion in the Downtown.[1] The total number of parking spaces in the Downtown area increased by a modest 3% in 15 years. (Table 6) Although the parking utilization rate (as measured by demand and supply)

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1. IBI Group (88), p.37.

was 80% in 1976,[1] there was still a shortage of parking spaces in the heart of Downtown, as the excess capacity was located on the fringe areas.[2] The decline in employment also indicates a decrease in retail trade in Downtown. With the constructio of new and expansion of existing suburban shopping centres, retail trade and employment opportunities have declined even further in the central area of Winnipeg (Table 6).

Although the Inner Area experienced a decline in population, there was no decline in patterned employment. Over the 15 year period, 40,000 more jobs were added to the area, an increase of 58%. The growth in employment opportunities occurred mainly in industrial parks and shopping centres located in the Inner Area. Lower land values and the availability of ample supply of parking spaces were largely responsible for this growth. Of the total increases in transit and automobile A.M. peak hour work trips destined to the Inner Area, 90% were using the private automobile. (Table 6)

Another significant feature of the Inner Area was a 15% decline in A.M. peak hour transit work trips originating from the area, most likely due to shrinking population and growing affluence. This is significant because 86% of all transit ridership has a very substantial impact on total transit patronage in Winnipeg. The loss in transit trips was accounted for by an increase in automobile trips.

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1. IBI Group (88), p.32.
2. 1978 Downtown Parking Survey, Streets and Transportation Division.

The Outer Area of Winnipeg, which housed many of the new suburbs, has experienced enormous growth in all sectors. (Table 6) Population growth in these new suburbs, created by natural increases, in-migrations, and out-migrations from the Inner Area and Downtown, totalled 127,627 or 169% in 15 years. As a result, there have been increases in transit work trips (274%) and automobile driver trips (271%) originated from the Outer Area. However, the growth in the demand for transit was over-shadowed by the growth in the demand for the private automobile. The private automobile captured 80% of the growth in total work trips during the A.M. peak hour. This rise in transit patronage was mainly due to substantial improvements in the level of transit services in the Outer Area.[1]

The increase in employment in the Outer Area compared favourably to the growth of employment in the Inner Area. (38,250 to 39,485) Again this growth occurred in industrial parks and suburban shopping centres, where land was less expensive and parking was more abundant. Total growth in A.M. peak hour work trips by automobiles and public transit destined to this area were 176% and 294%, respectively. The growth in public transit patronage was very encouraging; however, the modal split was still at a very low level. The next section will demonstrate that the incidence of transit

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1. Supporting arguments for this assertion are presented in section 4.2.1.

usage is directly related to employment density, therefore the gain in employment opportunities in the Inner and Outer Area, which are characterized by low employment density, did not significantly alter the modal splits for transit trips destined to these areas.

3.3.3.2 Major Employment Centres

Another objective of public transit is to provide improved transit services to centres of concentrated employment, especially for those who do not have an access to a private automobile.[1] There are eight major employment centres in Winnipeg.[2] Total employment, modal splits, and employment densities of these centres are presented in Table 7.

Between 1971 and 1976, total patterned employment gained in all major centres with the exception of Downtown and the Health Sciences Centre. The University of Manitoba, and the Inkster and Fort Garry Industrial Parks, all experienced very rapid increases in patterned employment. The percentage of total employment of these eight centres has dropped from 68..4% to 64.5% in 5 years which indicates that some growth in employment has occurred outside these centres, especially in suburban shopping centres.

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1. See Winnipeg Transportation Policy Guideline II.3(b) in Appendix I and section 2.3.4.

2. A map showing the locations of these centres can be found in Figure 20 in Appendix II.

TABLE 7

Total Employment, Modal Splits & Employment Densities of Eight Major Employment Centres in Winnipeg

Major Employment Centres	Total Employment*			% of Total Employment		Modal Split		Employment per Acre
	1971	1976	Δ %	1971	1976	1971	1976	1976
Downtown	61,478	54,567	-11.2%	31.0	24.6	41	39.6	50.0
University of Manitoba	17,678	23,051	30.4%	9.0	10.4	24	29.6	46.1
Health Sciences Centre	7,857	7,314	-6.9%	4.0	3.3	27	28.3	32.5
St. James Industrial Area	26,321	29,670	12.8%	13.4	13.4	15	16.7	11.4
Inkster Industrial Area	5,893	7,979	35.4%	3.0	3.6	12	13.8	4.7
Transcona Industrial Park	3,928	4,211	7.2%	2.0	1.9	5	8.0	5.3
Fort Garry Industrial Area	3,928	7,092	80.5%	2.0	3.2	11	5.3	5.5
St. Boniface Industrial Area	7,857	9,309	18.5%	4.0	4.2	8	3.8	2.7
	134,940	143,193	6.1%	68.4	64.5		26.3	12.4

Sources: The City of Winnipeg, Public Transit Study, Appendix "A", Figures 1 & 2, and Transportation System Measurement Characteristics, prepared by the IBI Group, p.36.

* Total employment for these centres are calculated by multiplying total employment of the City by the % of total employment of the centre.

There have been modest increase in transit ridership to and from these employment centres between 1971-1976 with the exception of Downtown and the Fort Garry and Inkster Industrial Parks. Nevertheless, these increases in transit patronage are not significant when they are compared to the gains in total employment and automobile trips. Furthermore, the modal splits of the Industrial Parks were much lower than the overall average. (Table 7)

In general, a high correlation (R^2=0.91) exists in Winnipeg between employment densities and transit ridership. The Downtwon area has the highest employment density and modal split. The reasons are immediately apparent. The Downtown enjoys the best transit services in the entire city because most of the bus routes (except suburban feeders) radiate from the central area. The concentration of employment in Downtown is more susceptible to the provision of good and efficient transit services from all part of the city. Apart from limited parking facilities, the cost of parking tends to be another deterrant to automobile work trips destined to Downtown. The Health Sciences Centre also enjoys good transit services from many of the transit routes serving Downtown because of its relative location. As a result, the transit ridrship, for the Health Sciences Centre was slightly lower than the modal split for the University of Manitoba, though the latter has a much higher employment density. (Table 7)

The modal split for the University of Manitoba was lower than expected, however, with 76% of all transit trips destined to the University being captive to transit, which was higher than the city average of 61%. (1976 O-D) The high employment density also justifies the provision of good and efficient transit services. Apart from the regular bus services, the staff and students also have access to the Dial-a-Bus and Uni-Bus services. The lower modal split might be attributed to the high incidence of carpooling among the students. The percentage of carpooling at the University of Manitoba (as measured by automobile passengers) was 17.5 as compared to 10.3% of the overall city average. Nevertheless, the transit ridership increased from 24% in 1971 to 29.6% in 1976. This increase was probably due to better transit services, and higher gasoline and parking costs.

It is difficult to provide efficient transit services to industrial parks because of low employment densities, and their relative locations. When transit travel time is twice automobile travel time, the choice of mode becomes very clear unless the traveller does not have access to a private automobile. The percentages of transit captive destined to these industrial parks were usually high. The proportion of transit riders who were captive to transit ranged from 80% to 100%. (1976 O-D Study) Again, the availability of free (inexpensive) parking in these industrial parks was definitly a factor for low transit patronage.

3.3.4 Impacts on the Environment , Gasoline Consumptions, and Passenger Vehicle Registrations

As has been mentioned earlier, transit subsidies could also be effective in reducing the level and extent of air and noise pollution. As well, the level of energy consumption and automobile ownership would also be lowered.

3.3.4.1 Air and Noise Pollution

Although there is no quantitative data on the degree and extent of air and noise pollution, one can make inferences indirectly from data on automobile usage and peak hour congestion in Winnipeg. The private automobile is the major contributor of air and noise pollution in urban areas, and therefore the drastic growth in urban motoring and mounting peak hour congestions would certainly heighten the degree and extent of air and noise pollution considerably in Winnipeg over the 15 year period.

3.3.4.2 Gasoline Consumption and Passenger Vehicle Registration

Data on gasoline consumption is not available for the City of Winnipeg, and therefore a direct assessment of relative levels of gasoline consumption is not possible. An indirect impact assessment can be made on the basis of provincial gasoline consumption statistics. Between 1962 and 1976, net sales of gasoline in Manitoba rose by 89.4%, and the number of registered passenger vehicles also increased by 74.5%. (Table 8) It can be observed that there is a positive relationship between gasoline consumption and the number of vehicles registered. The total number of passenger vehicle registrations rose by 75.4% in Winnipeg during the same period. The growth in automobile usage revealed by earlier analyses would lead to an increase in gasoline consumption. Since Winnipeg accounts for over half of all passenger vehicles registered in Manitoba, and the growth rate for automobile ownership was the same as the provincial average, it is reasonable to assume that the growth in gasoline consumption in Winnipeg should be similar to that of the province. The move toward energy efficient cars should mitigate this increase somewhat, but it should be noted that at the time of writing, Canadians in general have not rushed to buy small cars. In fact they are purchasing larger cars in greater numbers than ever.[1] In part this is due to changes in currency exchange rates, and in part to the subsidy car drivers received in the form of lower gasoline prices.

Passenger vehicle registrations and gasoline consumptions on a per capita or dwelling unit basis have also increased appreciably. These statistics tend to reflect the real growth because increases in population and dwelling units are being held constant. On an average, each person in Winnipeg consumed 57% and each dwelling unit used 24.6% more gasoline in

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1. During the first quarter of 1979, Statistics Canada reported that Canadians were buying more full size cars than ever.

Table 8: Net Sales of Gasoline & Passenger Vehicle Registrations - Manitoba and Winnipeg, 1962 & 1976

	1962	1976	Δ %
Manitoba			
Net Sales of Gasoline (Gallons)	157,472,882	298,136,099	89.4
Passenger Vehicle Registrations	236,737	413,072	74.5
Winnipeg			
Passenger Vehicle Registrations	125,606	220,817	75.8
% of total Pass. Veh. Reg.	53	53	
Passenger Vehicle per capita	0.2669	0.3896	46.0
Passenger Vehicle per D.U.	0.9944	1.1506	15.7
Net Sales of Gas per capita*	177.34	278.77	57.2
Net Sales of Gas per D.U.*	660.72	823.33	24.6

Sources: Statistics Canada Catalogue No.53-219, Road Motor Vehicle: Registrations and Catalogue No.53-218, Road Motor Vehicle: Fuel Sales. Population and dwelling unit statistics are extracted from 1962 and 1976 origin-destination studies.

* Estimated from net sales of gasoline in Manitoba and the percentage of passenger vehicles registered in Winnipeg.

1976 than in 1962. (Table 8) The increase in automobile ownership on a per capita or dwelling unit basis are also reflected.

In spite of the substantial amount of subsidies given to public transit, it appears that they have not had a role in controlling or reducing air pollution, noise pollution, gasoline consumption, or automobile growth. Of course, these correlations are suggestive and not conclusive.

3.4 Summary

The public transit system in Winnipeg has received a substantial amount of subsidy in the form of capital and operating grants from the City and provincial governments. Total operating costs have increased drastically from 8.3 million dollars in 1962 to 26.9 million dollars in 1976 - an increase of 223%. At the same time, the increase in the operating deficit amounted to 13.7 million dollars, or 2991% over 15 years. In 1962 each passenger was paying 94% of the full cost fare, but by 1976 they were paying only 29%. The 1976 average fare would have had to have been raised from 20¢ to 50¢ if transit subsidies were to be eliminated. Despite the growth in transit subsidy, it has not seemed to have had any significant impacts on increasing transit ridership, restraining automobile travel, reducing peak hour congestion, reducing air and noise pollution, lowering the level of energy consumption and automobile ownership, or revitalizing the downtown area. Finally, it is important to point out that the analyses presented in this chapter are only partial and the findings should not be used indiscriminately.

CHAPTER IV

SOURCES OF TRANSIT DEFICITS

4.1 Introduction

The impact assessments presented in the previous chapter indicate that transit subsidies have not been successful in meeting their major objectives. The most significant failures of public transit subsidies were their inability to expand transit ridership or to reduce or restrain automobile usage.

In this chapter, the sources of transit deficits are investigated through an examination of total operating costs, system revenues, and the efficiency and effectiveness of the public transit system in Winnipeg from 1962 to 1976, in order to be able to offer some explanations and insights into the failures of transit subsidies.

4.2 Analysis of Transit Operating Costs

The major factors contributing to the 223% growth in total transit operating costs between 1962 and 1976 were: (1) extension and provision of transit services especially to the suburban areas and (2) inflation and increase in employee wages and benefits.

4.2.1 Provision and extension of transit services

In response to the expansion of Winnipeg, growth in population and employment opportunities, the Winnipeg Transit

System extended its transit services to the suburban areas, expanded its transit fleet, and increased the total operating hours and miles over the 15 year period. (Table 9) Between 1962 and 1976, transit coverage in Winnipeg has increased 27% from 197 route-miles to 250 route-miles. The transit fleet also expanded at the same magnitude as transit coverage. However, the 119 new revenue vehicles did not include an estimated 168 diesel buses[1] required to replace trolley coaches and older motor vehicles. Using the 1976 adjusted figure (because of the transit strike in 1976), the total number of bus-miles operated also increased at the same rate as transit coverage and transit fleet. Between 1962 and 1975, the total number of bus-miles operated has boosted from 12.7 million miles to 15.9 million miles (25%) while the total number of bus-hours operated has grown from 1.22 million hours to 1.45 million hours. The growth rate of bus-hours was slower than that of bus-miles. This apparent increase in efficiency (as measured by operating speed) might be a result of the shift in transit technology and extension of suburban transit services.[2]

The growth in the provision of transit services occurred mainly in the suburban areas of Winnipeg in the form of bus

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1. Discussion of this shift in transit technology can be found in section 3.2.1.

2. A more detail discussion of transit operating efficiency can be found in section 4.3.

TABLE 9

THE CITY OF WINNIPEG

Transit System Characteristics

1961 - 1976

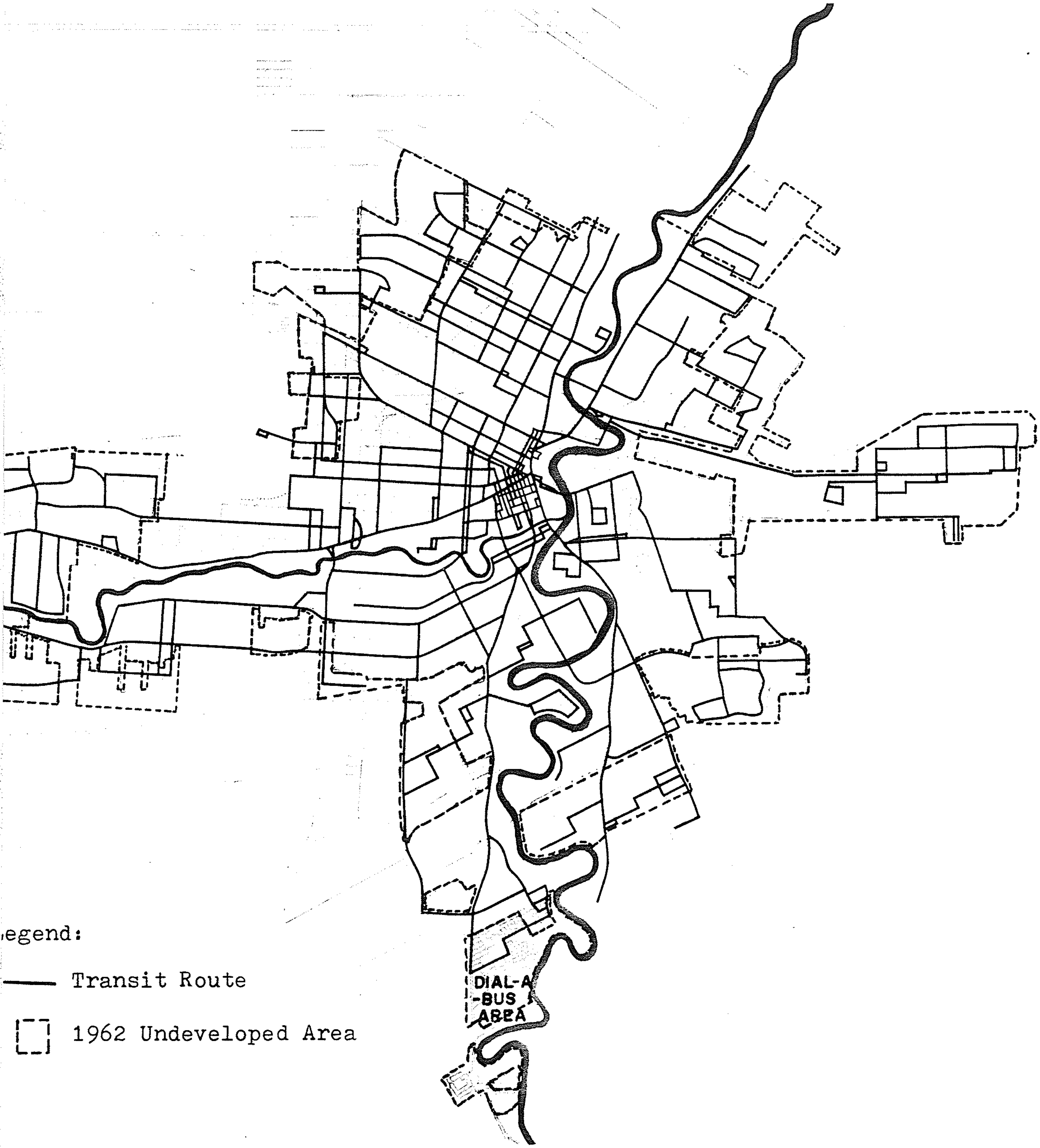
Year	Route Mile	Revenue Vehicle	Revenue Passenger	Bus Mile	Bus Hour
1961	193	422	56,702,734	12,799,535	1,235,466
1962	197	432	56,466,747	12,726,146	1,221,371
1963	211	440	56,822,997	13,344,652	1,270,448
1964	215	440	56,831,408	13,723,944	1,310,575
1965	215	469	58,307,301	14,031,210	1,333,257
1966	220	469	60,278,658	14,396,390	1,366,158
1967	229	469	61,737,301	14,864,040	1,396,600
1968	227	490	61,586,148	14,751,528	1,389,833
1969	232	490	58,854,409	14,554,814	1,349,795
1970	232	485	58,674,987	14,435,852	1,349,795
1971	204	485	58,076,195	14,458,900	1,330,096
1972	248	483	58,318,554	14,495,425	1,322,649
1973	249	484	58,008,666	14,675,494	1,330,401
1974	256	495	62,000,815	14,919,079	1,346,915
1975	257	595	65,657,764	15,929,418	1,453,545
1976*	286	534	55,477,272	13,758,922	1,269,021
1976+			64,079,758	16,140,740	1,465,850

* In 1976, Winnipeg experienced a 7-Week transit strike.

\+ Adjusted Figures for the transit strike.

Sources: Metro Financial Reports 62-72 and City of Winnipeg Financial Reports 73-76.

Figure 15: 1976 A.M. Peak Hour Transit Service



Legend:

—— Transit Route

[ ] 1962 Undeveloped Area

Source: Travel and Demographic Trends (84) route addition or extension. Figure 15 depicts the extent of A.M. peak hour transit services in Winnipeg on an average week-day in 1976. The solid black lines represent transit routes and the shaded areas bounded by dotted lines are undeveloped areas in 1962. As it is evident on this map that transit services have expanded considerably from 1962 to 1976. These service additions and extensions occurred predominantly in the outlying areas of Winnipeg which were undeveloped in 1962.

Table 10 presents a breakdown of all transit route types for 1962, 1971 and 1976. It can be seen that the total number of transit routes remained unaltered between 1962 and 1971. However, fourteen additional transit routes were introduced between 1971 and 1976, comprised of 11 feeder bus routes, 2 express bus routes, and 1 dial-a-bus area, all of which were designed to cater exclusively to suburban travellers. Furthermore, it is also reasonable to assume that existing bus routes were also extended somewhat in order to serve these suburbs.

In order to improve mobility within the downtown area, free Downtown Shuttle Services were provided during the off-peak hours. Two additional routes were introduced in 1976. They were devised to serve the public working, shopping, or residing in the Downtown area. As well, they were designed to relieve some of the intra-downtown congestions created by the private automobile. The addition of these two routes, however, did not significantly increase the total cost of operation.

The preceding analyses indicate that the growth in the provision of transit services, especially in the suburban areas, has been one of the major factors contributing to the growth in transit operating costs. The magnitude of transit service expansions has been estimated to be between 20.5% (as measured by increases in bus-hours operated) to 27% (as measured by increases in bus-miles operated) between 1962 and 1976. Within the study period, the largest service expansion occurred between 1972 and 1976.

Table 10: Winnipeg Transit Routes - 1962, 1971 and 1976

Route Classification	1962	1971	1976
1. Express Routes	2	2	4
2. DownTown Terminating Routes	14	17	17
3. Through Downtown Routes	7	7	7
4. Crosstown Routes	3	4	3
5. Feeder Routes	11	7	18
6. Downtown Shuttle D.A.S.H.	--	--	2
7. Dial-a-Bus Service Areas	--	--	1 Area
Total Routes	37	37	51

Source: Streets and Transportation Division,
The City of Winnipeg

However, it is not evident that suburban transit routes cost more per mile; in fact, they might cost less per mile due to higher operating speeds and fewer boarding and alighting. As it will be demonstrated later in section 4.4.2, trips originated or destined to suburban areas cost more per trip as compared to non-suburban destinations. This is largely due to fewer passengers spreading over a larger area (suburban areas are characterized by lower development densities) and longer trip lengths taken by suburban travellers. Empirical evidences from cities in the United States also give support to the above assertion.[1]

4.2.2 Inflation, Employee Wages and Benefits

Transit service expansion was only one of the major factors contributing to the increase in total transit operating costs. Inflation in wages and goods accounted for 57.5% of the total growth in transit operating costs between 1962 and 1976.[2] The remaining 42.5% was chiefly attributed to transit service expansion and meeting increases in wage demands and employee benefits which were over the Consumer Price Index.

Table 11 presents a breakdown of transit cost component increases for two periods between 1961 and 1976.[3] These

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1. See Ortner & Wachs (52) and Sale & Green (62).
2. See Table 20 in Appendix III.
3. The raw data on which Table 11 is generated can be found in Table 20 in Appendix III.

Table 11
Breakdown of Total Transit Cost Increases
Winnipeg, 1962 - 1976

Cost Components	1962 - 1971		1971 - 1976	
	Unit Cost Increase/ Bus-Hour	% of Total Increases	Unit Cost Increase/ Bus-Hour	% of Total Increases
General Administration	0.0312	0.56	-0.0416	-
Maintenance	0.2566	4.61	0.1858	2.06
Fuel and Power	-0.0929	-	0.2109	2.34
Transportation	1.3397	24.08	0.8722	9.68
Scheldule	0.0255	0.46	0.0122	0.14
Information & Publicity	0.0411	0.74	0.0142	0.16
Claimcosts	0.0215	0.39	-0.0497	-
Employee Benefits	0.3417	6.14	0.2533	2.81
Municipal Taxes	0.0787	1.41	0.0243	0.27
General Gov't Charage	0.0907	1.63	-0.0412	-
Interest Charge	0.5853	10.52	-0.2801	-
Depreciation	0.0691	1.24	-0.1542	-
Miscellaneous	0.0358	0.64	0.0019	0.02
Cost-of-Living Increases	2.6462	47.57	7.4363	82.52
Total	5.5631	100.00	9.0111	100.00

Sources: Computed from Table 20 in Appendix III.

Note: The Consumer Price Index of Winnipeg is used to deflate all cost components. The increases shown here are real growth of these components over inflation on an unit bus-hour basis.

increases were first deflated by the Consumer Price Index for the City of Winnipeg, and expressed on a per bus-hour basis,[1] so as to compensate for the differences in transit operation between periods. This table also enable us to isolate the real causes of transit cost increases among the various components by holding inflation and service expansion constant.

Between 1962 and 1971, inflation accounted for almost half of the total cost increases. Apart from cost-of-living increases employee wages('Transportation' in Table 14)[2] and benefits also contributed very substantially to the cost hike. Together, they accounted for 30% of the total cost increases. Interest charges on debts created by transit deficits incurred during the previous years shared a significant portion (10%) of the rise in transit costs.

The period between 1971 and 1976 also indicates that inflation and employee wages and benefits were major factors in the growth of transit operating costs. More importantly, cost-of-living increases contributed a much larger share of the total growth in transit cost. These increases accounted for 82.5% of the overall grwoth. The rate of inflation during this period averaged 10.6% per year as compared to 2.7%

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1. Bus-hour is chosen for the unit cost computation because many of these cost components (e.g. employee wages and benefits) are related more closely to bus-hour than bus-mile.

2. Transportation includes wages for bus drivers, transportation instructors, supervisors and administrators. The bus driver wages accounted for approximately 90% of this cost component.

per year during the previous period, therefore inflation has taken a much larger share in the cost increases between 1971 and 1976. Employee wages and benefits were the second largest contributors of the cost hike. Together, they accounted for 12.5% of the total cost increases.

If we isolate inflation from the cost increases, employee wages and benefits shared 72% of all transit cost component increases. Fuel consumption which was not a factor in the previous period, accounted for 13.4% of the total. This reflected the drastic increase in fuel cost especially after the OPEC embargo in 1974. Maintenance cost also accounted for a fair portion of the increases. Interest charges decreased during this period, largely due to the increased government subsidies in covering transit operating deficits.

It is important to place the wages and employee benefits in perspective. A worker receives a wage settlement greater than the cost of living, does not mean that he is becoming better off relative to other workers. All workers should share the real growth of the economy (i.e. after inflation), in order to maintain their relative positions in the economic pie. Therefore, the above analysis does not indicate that transit workers in Winnipeg were better off,as data on wages and employee benefits for other transit workers are not readily available at the time of writing. However, it can be concluded that transit industries are labour intensive, therefore an increase in wages and employee benefits would lead to an inflation in transit operating costs.

4.3 Analysis of Transit Revenues

In the previous section, inflation, transit service expansions, and increases in employee wages and benefits have been identified as the major contributing factors to the drastic increases in transit operating costs. Transit system revenues have not been growing as rapidly as transit costs. Two major factors responsible for the slow growth or decline in transit system revenues are examined in this section. They are: (1) maintaining transit fare or slowing down transit fare increases and (2) addition and extension of suburban transit services.

4.3.1 Maintaining Transit Fare or Slowing Down Increases in Transit Fare

Although maintaining transit fare or slowing down increases in transit fare has not been stated as an explicit policy statement by the municipal government, it is evident from the changes in transit fare structures between 1955 and 1976 (table 12) that it has been an implicit policy. The adult Basic Cash and Ticket Fare which generated over 80% of total system revenues, showed at best very modest increases between 1955 and 1969. The adult Cash Fare remained unchanged at 15¢ per ride and Adult Ticket Fare changed from 2 tickets for 25¢ in 1955 to 7 tickets for one dollar in 1957. In July, 1955, Adult Cash and Ticket Fare were raised from 10¢ and 5/50¢ in 1951 to 15¢ and 2/25¢ respectively. (Table 12) In the 15 years that followed, Adult Fare remained virtually

Table 12: Winnipeg Transit Fares in Effect - 1951 to 1976

Date of Fare Change	Adults		Children, Students & Senior Citizens*		Monthly Pass	Weekly Permit
	Cash	Tickets	Cash	Tickets		
August 13, 1951	10¢	5/50¢	5¢	6/25¢	$ 9.00	--
July 10, 1955	15¢	2/25¢	no change	no change	$ 9.65	25¢ plus 10¢ per ride
April 14, 1957	no change	7/$1.00	10¢	5/30¢	$ 10.50	45¢ plus 10¢ per ride
March 1, 1963	no change	no change	no change	no change	$ 10.00	--
April 1, 1969	25¢	5/$1.00	no change	5/50¢	$ 12.00	--
September 1,1974	no change	no change	no change	no change	$10 or $110 yearly pass	--
1976	no change on regular buses. 35¢ on Dial-a-bus.		no change	no change	$ 10.00	--

Source: Streets and Transportation Division, The City of Winnipeg
* Special Senior Citizens Fare Established October 1, 1969.

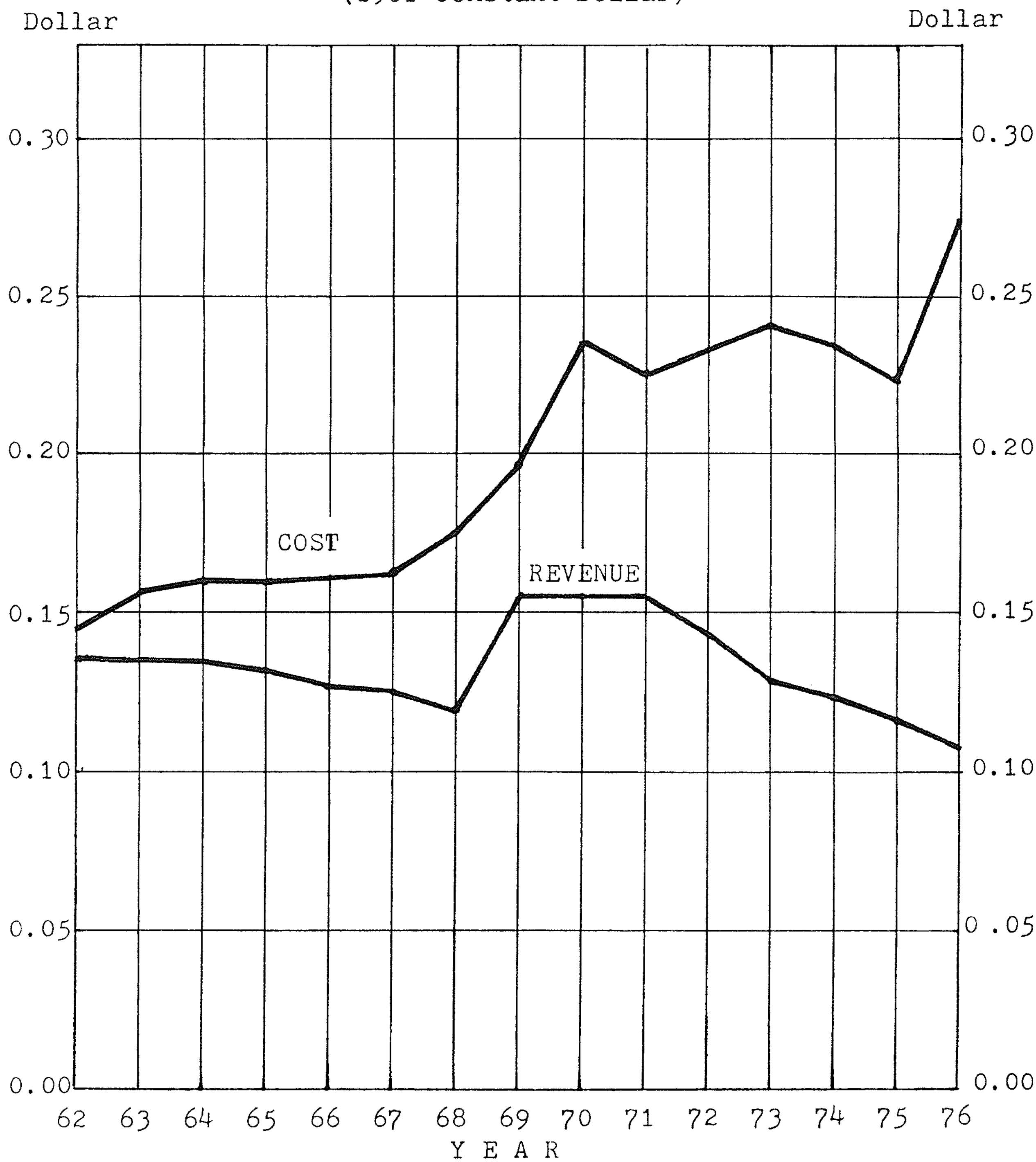
unchanged. As it has been mentioned earlier, the first transit deficit occurred in 1961. This deficit could have been avoided if the municipal government chose to increase transit fare at that time. The municipal government, however, maintained the fare structure in an attempt to halt the decline in transit patronage. During the same period, there have been very little changes in children and student fares as well as the price of monthly passes.

Average fare per revenue passenger (in 1961 constant dollar) has fallen steadily from 13.7¢ to 11.9¢ per passenger carried between 1962 and 1968, 13% reduction. On the other hand, cost per passenger rose from 14.6¢ to 17.6¢ per passenger during the same period (21% increase in cost).

The widening gap between transit revenues and transit costs prompted a 66.6% increase in Adult Cash Fare and a 40% increase in adult ticket fare in 1969. Ticket fare for children and students rose to 10¢ per ticket which was the same as paying cash fare. A special senior citizen fare was established in October, 1969. The fare for senior citizens was the same as the children and student fare. As well, the price for a monthly pass went up by two dollars.

Average fare per revenue passenger increased by 20% as a result of this fare hike. Average fare remained at 14.3¢ per passenger for three years and started to fall in 1972. The provincial government began to share a larger proportion of the transit deficits in 1973; in return, the Winnipeg Transit would maintain the fare structure. Despite increased

FIGURE 16
THE CITY OF WINNIPEG
Transit Cost and Revenue Per Revenue Passenger
(1961 Constant Dollar)



Sources: From Tables 9 and 19

subsidies from the province, transit ridership has only grown marginally. Average fare fell lower and lower while average cost climbed higher and higher. Thus, the gap between average fare and average cost per passenger widened drastically by the end of 1976. (Figure 16) The overall decrease in average fare was 20% and the overall increase cost was 89%. These were real increase and decrease because the effects of inflation were removed from the raw cost and revenue data.

The policy of maintaining transit fare has contributed to the decline in average fare per passenger and total system revenues between 1962 and 1976.

4.3.2 Addition and Extension of Suburban Transit Services

It has been ascertained in section 4.2.1 that, there have been significant increases in service additions and expansions, especially in the suburban areas. Transit ridership in suburban areas is usually very low because of longer trip length, longer trip time, infrequent services and most important of all, a high incidence of automobile owner. These factors have been shown in many empirical studies to be critical determinants of transit ridership.[1] We would therefore expect lower ridership and revenues on suburban bus routes.

A route-by-route analysis on passenger revenues is presented in Table 13; these statistics are compiled from a

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1. For examples: Frankena (19), McFadden (46) and Schmenner (63).

typical week in May, 1976. All suburban transit routes are denoted by an "(S)" in Table 1 . It is evident from this route-by-route analysis that suburban transit routes exhibited a much lower revenue per hour than their counterparts (urban routes). The average revenue per hour on a city wide basis was $8.45. The majority of these suburban routes, however, had revenues less than three dollars per hour compared to many of the urban transit routes which had revenues in excess of nine dollars per hour. In comparison to transit operating costs, revenues for suburban feeder routes ranged from 4.7% (Crestview and South St. Vital) to 20.1% (Maples) of the total costs in providing the transit services. The average revenue per hour for all routes was 43.0% of total costs.

Bus schedules were used to estimate the total number of hours of suburban transit services, which is presented in Table 12. Total suburban transit services are estimated to be 952.1 hours or 20.5% of total operating hours.[1] The total revenues generated by suburban routes only amounted to 9.6% of total system passenger revenues. It is estimated that passenger revenue per hour for suburban routes equaled $3.98 as compared to $9.60 for urban routes.

The above route-by-route analysis on passenger revenues indicates that suburban transit routes generated significantly

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1. The procedures and assumptions of this estimation are presented in Appendix IV.

TABLE 13: Route-by-Route Analysis on Transit Operating Revenue

NAME OF TRANSIT ROUTE	ALL TRANSIT ROUTES				SUBURBAN ROUTES		
	%REV	REVENUE	HOURS	REV /HOUR	REVENUE	HOURS	REV /HOUR
ABERDEEN	15.67	40.0	13.0	3.08	4.0	2.6	1.54
ARCHIBALD	15.92	100.0	32.0	3.13	5.0	3.2	1.56
ARLINGTON (S)	24.58	502.0	104.0	4.83	125.5	52.0	2.41
AULNEAU	32.19	158.0	25.0	6.32	0.0	0.0	0.00
BERRY-LOGAN	30.46	395.0	66.0	5.96	0.0	0.0	0.00
CATHEDRAL	27.25	107.0	20.0	5.35	0.0	0.0	0.00
CHARLESWOOD (S)	37.15	423.0	58.0	7.29	84.6	23.2	3.65
CONISTON	20.09	71.0	18.0	3.94	0.0	0.0	0.00
CORYDON-NORTH MAIN	58.04	3396.0	298.0	11.40	0.0	0.0	0.00
CRESCENT	27.62	244.0	45.0	5.42	0.0	0.0	0.00
CRESTVIEW (S)	4.73	13.0	14.0	0.93	13.0	14.0	0.93
E.KILDONAN-PORTAGE	55.96	4608.0	412.0	11.15	460.8	82.4	5.59
E. KILDONAN EXPRESS	48.26	199.0	21.0	9.48	19.9	4.2	4.74
GRANT	42.89	1238.0	147.0	8.42	123.8	29.4	4.21
GREY	41.75	746.0	91.0	8.20	74.6	18.2	4.10
KENASTON	14.43	17.0	6.0	2.83	1.7	1.2	1.42
KING'S PARK EXP (S)	38.70	585.0	77.0	7.60	146.2	38.5	3.80
MCGREGOR-STAFFORD	40.46	2146.0	270.0	7.95	107.3	27.0	3.97
MAPLES (S)	20.07	67.0	17.0	3.94	67.0	17.0	3.94
MARION	39.06	1020.0	133.0	7.67	0.0	0.0	0.00
MOUNTAIN-SARGENT	51.09	2207.0	220.0	10.03	110.3	22.0	5.02
MORLEY-JUBILEE	25.31	152.0	30.0	5.07	0.0	0.0	0.00
NESS	46.45	1450.0	159.0	9.12	217.5	47.7	4.56
NOTRE DAME-LOGAN	43.99	1382.0	160.0	8.64	0.0	0.0	0.00
NORTH KILDONAN(S)	22.41	330.0	75.0	4.40	66.0	30.0	2.20
OSBORNE-SELKIRK	50.77	2771.0	278.0	9.97	277.1	55.6	4.98
PT. ROAD-BEAUMONT(S)	14.94	44.0	15.0	2.93	11.0	7.5	1.47
PORTAGE EXPRESS	56.79	2821.0	253.0	11.15	423.1	75.9	5.58
PULBERRY-BELIVEAU(S)	21.65	51.0	12.0	4.25	51.0	12.0	4.25
ST. ANNE'S	47.43	922.0	99.0	9.31	46.1	9.9	4.66
ST. MARY'S-ELLICE	43.59	2071.0	242.0	8.56	103.5	24.2	4.28
SALTER	48.20	758.0	80.0	9.47	18.9	4.0	4.74
SHERBROOK	39.50	729.0	94.0	7.76	0.0	0.0	0.00
TALBOT (S)	33.66	529.0	80.0	6.61	529.0	80.0	6.61
TRANSCONA	45.40	1312.0	147.0	8.93	131.2	29.4	4.46
TRANSCONA SHUTTLE(S)	18.66	99.0	27.0	3.67	99.0	27.0	3.67
TYNDALL PARK (S)	15.67	40.0	13.0	3.08	40.0	13.0	3.08
UNIVERSITY	47.10	1489.0	161.0	9.25	0.0	0.0	0.00
WATT STREET	36.89	594.0	82.0	7.24	0.0	0.0	0.00
WAVERLEY	30.56	144.0	24.0	6.00	0.0	0.0	0.00
WILLIAM-VALOUR	46.62	1080.0	118.0	9.15	0.0	0.0	0.00
WOLSELEY	38.79	1150.0	151.0	7.62	0.0	0.0	0.00
DIAL-A-BUS (S)	12.97	270.0	106.0	2.55	270.0	106.0	2.55
JEFFERSON SHUTTLE(S)	10.19	20.0	10.0	2.00	20.0	10.0	2.00
RACES	56.41	587.0	53.0	11.08	0.0	0.0	0.00
SOUTHDALE (S)	11.64	32.0	14.0	2.29	32.0	14.0	2.29
SOUTH CHARLESWOOD(S)	5.09	21.0	21.0	1.00	21.0	21.0	1.00
SOUTH TRANSCONA (S)	6.91	19.0	14.0	1.35	19.0	14.0	1.36
SOUTH ST. VITAL (S)	4.70	12.0	13.0	0.92	12.0	13.0	0.92
WESTWOOD (S)	13.51	61.0	23.0	2.65	61.0	23.0	2.65
TOTAL	43.04	39222.0	4641.0	8.45	3792.3	952.1	3.98

Source: See Appendix IV

Legend: %REV - Revenue as a Percentage of Cost

Revenue - Fare-box Revenue of a Transit Route per Day

HOURS - Hours Operated

REV/HOUR - Revenue per Hour of a Transit Route lower revenues in relation to the amount of transit service rendered, and to revenues produced by urban transit routes. Expansion of these suburban transit service additions and extensions thus contributed substantially to the decline in system revenues between 1962 and 1976.

4.4 Effectiveness and Efficiency of Winnipeg Transit

It can be observed from Table 2 (p.41) that transit system revenues have increased marginally (36%) as compared to the growth in total transit operating costs. (223%) When cost-of-living increases were removed from the data, the average cost per revenue passenger rose by 89% while average fare shrank by 20%. The discrepancy between costs and revenues thus created transit deficits. Transit deficits rose drastically in recent years as the gap between costs and revenues widened, and Government transit subsidies were required to pay for these deficits. The widening gap between transit costs and revenues indicates that the transit operators in Winnipeg are investing in inefficient or ineffective transit services, but they might be justified on social and political grounds. The efficiency of transit operations may be defined as the cost per unit of output (in bus mile, bus hour or revenue passenger), while the effectiveness of those operations may be defined in terms of passengers carried or passenger revenues generated per unit of output.

4.4.1 Efficiency of Winnipeg Transit

The efficiency of public transit can be defined as the cost of providing per unit output of transit services. Vehicle hour and revenue passenger are the standard unit measurements of transit services. There is an inverse relationship between cost per unit output and efficiency. The higher the cost of providing an unit of transit services, the lower the efficiency. Conversely, the lower the cost, the higher the efficiency. Table 14 presents transit costs (1961 constant dollar) on a per vehicle mile, vehicle hour and revenue passenger basis.

The three sets of efficiency indicators exhibit similar increasing cost trend but with different magnitude of growth. Cost per passenger displayed the highest increase of 88.6%, which was largely due to a decline in the effectiveness of transit discussed in the next section. Cost per vehicle hour showed the lowest overall increase of 68% because of improved operating efficiency, which when measured by vehicle mile per vehicle hour, increased by 5.7%. (Table 17) The increase in operating speed was largely a result of suburban and express transit service expansions. Since express buses make fewer stops and suburban buses have a lower incidence of boarding and alighting due to lower transit demand.[1] Cost per

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1. According the IBI Report (88), p.33, feeder has the highest average speed (13.6 m.p.h.) as compared to 9.2 m.p.h. of the regular bus.

Table 14

The City of Winnipeg
Transit Cost per Vehicle Mile, Vehicle Hour and
Revenue Passenger
(1961 Constant Dollar)
1962 - 1976

Year	Cost per Vehicle Mile	Cost per Vehicle Hour	Cost per Revenue Passenger
1962	0.6466	6.7377	0.1457
1963	0.6700	7.0372	0.1573
1964	0.6639	6.9522	0.1603
1965	0.6476	6.8153	0.1558
1966	0.6733	7.0950	0.1608
1967	0.6727	7.1602	0.1619
1968	0.7329	7.7789	0.1755
1969	0.7946	8.5676	0.1965
1970	0.9659	10.3307	0.2377
1971	0.9057	9.8454	0.2255
1972	0.9329	10.2235	0.2319
1973	0.9489	10.4672	0.2401
1974	0.9616	10.6508	0.2314
1975	0.9296	10.1874	0.2221
1976	1.0911	12.0140	0.2748

Sources: Computed from Tables 9 and 19.

vehicle mile had the second lowest increase of 78%. In short, the transit operations in Winnipeg have been encountering declining efficiency over the study period.

It is interesting to note that cost per unit output of transit services rose very modestly between 1962 and 1968, but accelerated after 1969. Coincidently, trolley services were cut substantially during the same year and terminated in 1970.[1] Efficiency of the system continued to decline until 1974. The 7 week transit strike in 1976 pushed the cost per unit output to its highest level.

Addition and extension of suburban transit services also contributed greatly to the decline in efficiency of Winnipeg Transit. Using the route-by-route analysis on revenue passenger, (Table 15) the cost per passenger for suburban and urban routes on a typical weekday in 1976 can be estimated.[2] The cost providing transit service to suburban travellers was 88¢ per passenger and the cost to urban travellers was 36¢ per passenger.

Furthermore, longer trip length consumed by suburban travellers also contributed to the decline in efficiency.

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1. Because separate cost data is not available for trolly services, it is not possible to compare efficiency between motor bus and trolly coach. From the available ridership statistics, trollies were more effective (as measured by revenue passengers per vehicle mile or hour) than motor buses. The effectiveness of trollies was probably due to the location of trolly routes.

2. Cost per passenger is computed by dividing the total cost per hour ($19.634) by the number of passengers per hour.

TABLE 15: Route-by-Route Analysis on Transit Revenue Passengers

NAME OF TRANSIT ROUTE	ALL TRANSIT ROUTES			SUBURBAN ROUTES		
	HOURS	REVPASS	REVPASS /HOUR	HOURS	REVPASS	REVPASS /HOUR
ABERDEEN	13.0	224.2	17.2	2.6	22.4	8.6
ARCHIBALD	32.0	560.5	17.5	3.2	28.0	8.8
ARLINGTON (S)	104.0	2813.9	27.1	52.0	703.5	13.5
AULNEAU	25.0	885.7	35.4	0.0	0.0	0.0
BERRY-LOGAN	66.0	2214.1	33.5	0.0	0.0	0.0
CATHEDRAL	20.0	599.8	30.0	0.0	0.0	0.0
CHARLESWOOD (S)	58.0	2371.1	40.9	23.2	474.2	20.4
CONISTON	18.0	398.0	22.1	0.0	0.0	0.0
CORYDON-NORTH MAIN	298.0	19035.9	63.9	0.0	0.0	0.0
CRESCENT	45.0	1367.7	30.4	0.0	0.0	0.0
CRESTVIEW (S)	14.0	72.9	5.2	14.0	72.9	5.2
E.KILDONAN-PORTAGE	412.0	25829.6	62.7	82.4	2583.0	31.3
E. KILDONAN EXPRESS	21.0	1115.5	53.1	4.2	111.5	26.6
GRANT	147.0	6939.5	47.2	29.4	693.9	23.6
GREY	91.0	4181.6	46.0	18.2	418.2	23.0
KENASTON	6.0	95.3	15.9	1.2	9.5	7.9
KING'S PARK EXP (S)	77.0	3279.1	42.6	38.5	819.8	21.3
MCGREGOR-STAFFORD	270.0	12029.1	44.6	27.0	601.5	22.3
MAPLES (S)	17.0	375.6	22.1	17.0	375.6	22.1
MARION	133.0	5717.5	43.0	0.0	0.0	0.0
MOUNTAIN-SARGENT	220.0	12371.1	56.2	22.0	618.6	28.1
MORLEY-JUBILEE	30.0	852.0	28.4	0.0	0.0	0.0
NESS	159.0	8127.8	51.1	47.7	1219.2	25.6
NOTRE DAME-LOGAN	160.0	7746.6	48.4	0.0	0.0	0.0
NORTH KILDONAN(S)	75.0	1849.8	24.7	30.0	370.0	12.3
OSBORNE-SELKIRK	278.0	15532.5	55.9	55.6	1553.3	27.9
PT. ROAD-BEAUMONT(S)	15.0	240.6	16.4	7.5	61.7	8.2
PORTAGE EXPRESS	253.0	15812.8	62.5	75.9	2371.9	31.3
PULBERRY-BELIVEAU(S)	12.0	285.9	23.8	12.0	285.9	23.8
ST. ANNE'S	99.0	5168.2	52.2	9.9	258.4	26.1
ST. MARY'S-ELLICE	242.0	11608.7	48.0	24.2	580.4	24.0
SALTER	80.0	4246.9	53.1	4.0	106.2	26.6
SHERBROOK	94.0	4066.3	43.5	0.0	0.0	0.0
TALBOT (S)	80.0	2965.2	37.1	80.0	2965.2	37.1
TRANSCONA	147.0	7354.3	50.0	29.4	735.4	25.0
TRANSCONA SHUTTLE(S)	27.0	554.9	20.6	27.0	554.9	20.6
TYNDALL PARK (S)	13.0	224.2	17.2	13.0	224.2	17.2
UNIVERSITY	161.0	8346.4	51.8	0.0	0.0	0.0
WATT STREET	82.0	3329.6	40.6	0.0	0.0	0.0
WAVERLEY	24.0	807.2	33.6	0.0	0.0	0.0
WILLIAM-VALOUR	118.0	6053.8	51.3	0.0	0.0	0.0
WOLSELEY	151.0	6446.2	42.7	0.0	0.0	0.0
DIAL-A-BUS (S)	106.0	1513.5	14.3	106.0	1513.5	14.3
JEFFERSON SHUTTLE(S)	10.0	112.1	11.2	10.0	112.1	11.2
RACES	53.0	3290.4	62.1	0.0	0.0	0.0
SOUTHDALE (S)	14.0	179.4	12.8	14.0	179.4	12.8
SOUTH CHARLESWOOD(S)	21.0	117.7	5.6	21.0	117.7	5.6
SOUTH TRANSCONA (S)	14.0	106.5	7.6	14.0	106.5	7.6
SOUTH ST. VITAL (S)	13.0	67.3	5.2	13.0	67.3	5.2
WESTWOOD (S)	23.0	341.9	14.9	23.0	341.9	14.9
TOTAL	4641.0	219653.1	47.4	952.1	21257.5	22.3

Source: See Appendix IV

Legend: HOURS- Hours Operated by a transit route

REVPASS - Revenue Passengers

REVPASS/HOUR - Revenue Passengers per Hour

Although trip length data are not available, a crude measure of trip length can be obtained by comparing cost per vehicle mile and cost per revenue passenger.[1] If trip distance does not have nay effect, then we would expect the growth rate of these two indicators to be equal. Between 1962 and 1976, cost per vehicle mile rose by 78% while cost per revenue passenger grew at a higher rate of 89%. The higher cost per passenger thus indicates longer trip length.

Suburban transit routes were less effective and less effecient than their counterparts. As a result, they incurred much higher deficits. A route-by-route- analysis on transit deficits is presented in Table 16. Many of the suburban routes incurred deficits as high as 95% of total operating cost. One would expect the deficits would be much higher for suburban transit services during the off-peak hours. The average deficits for suburban routes was $15.7 per hour while urban routes had a lower average deficit of $10 per hour. Finally, 29% of the total operating deficit was attributed to the provision and extension of suburban transit services.

4.4.2 Effectiveness of Winnipeg Transit

The effectiveness of transit operations can be defined as the number of passenger carried or the amount of revenues generated per unit input of transit services. Vehicle mile and vehicle hour are the most common unit measurement of

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1. Sale & Green (62), p.24.

TABLE 16: Route-by-Route Analysis on Transit Operating Deficit

NAME OF TRANSIT ROUTE	ALL TRANSIT ROUTES				SUBURBAN ROUTES		
	%DEF	DEFICIT	HOURS	DEF /HOUR	DEFICIT	HOURS	DEF /HOUR
ABERDEEN	84.33	215.2	13.0	16.56	47.0	2.6	18.10
ARCHIBALD	84.08	528.3	32.0	16.51	57.8	3.2	18.07
ARLINGTON (S)	75.42	1539.9	104.0	14.81	895.5	52.0	17.22
AULNEAU	67.81	332.8	25.0	13.31	0.0	0.0	0.00
BERRY-LOGAN	69.52	900.8	66.0	13.65	0.0	0.0	0.00
CATHEDRAL	72.75	285.7	20.0	14.28	0.0	0.0	0.00
CHARLESWOOD (S)	62.85	715.8	58.0	12.34	370.9	23.2	15.99
CONISTON	79.91	282.4	18.0	15.69	0.0	0.0	0.00
CORYDON-NORTH MAIN	41.96	2454.9	298.0	8.24	0.0	0.0	0.00
CRESCENT	72.35	639.5	45.0	14.21	0.0	0.0	0.00
CRESTVIEW (S)	95.27	261.9	14.0	18.71	261.9	14.0	18.71
E.KILDONAN-PORTAGE	43.04	3481.2	412.0	8.45	1157.0	82.4	14.04
E. KILDONAN EXPRESS	51.74	213.3	21.0	10.16	62.6	4.2	14.90
GRANT	57.11	1648.2	147.0	11.21	453.4	29.4	15.42
GREY	58.25	1040.7	91.0	11.44	282.7	18.2	15.54
KENASTON	85.57	100.8	6.0	16.80	21.9	1.2	18.22
KING'S PARK EXP (S)	61.30	926.8	77.0	12.04	609.7	38.5	15.84
MCGREGOR-STAFFORD	59.52	3155.2	270.0	11.69	422.8	27.0	15.66
MAPLES (S)	79.93	266.8	17.0	15.69	266.8	17.0	15.69
MARION	60.94	1591.3	133.0	11.96	0.0	0.0	0.00
MOUNTAIN-SARGENT	48.91	2112.5	220.0	9.60	321.6	22.0	14.62
MORLEY-JUBILEE	74.19	437.0	30.0	14.57	0.0	0.0	0.00
NESS	53.55	1671.8	159.0	10.51	719.0	47.7	15.07
NOTRE DAME-LOGAN	56.01	1759.4	160.0	11.00	0.0	0.0	0.00
NORTH KILDONAN(S)	77.59	1142.6	75.0	15.23	523.0	30.0	17.43
OSBORNE-SELKIRK	49.23	2687.3	278.0	9.67	814.5	55.6	14.65
PT. ROAD-BEAUMONT(S)	65.06	250.5	15.0	16.70	136.3	7.5	18.17
PORTAGE EXPRESS	43.21	2146.4	253.0	8.48	1067.1	75.9	14.06
PULBERRY-BELIVEAU(S)	78.35	184.6	12.0	15.38	184.6	12.0	15.38
ST. ANNE'S	52.57	1021.8	99.0	10.32	148.3	9.9	14.98
ST. MARY'S-ELLICE	56.41	2680.4	242.0	11.08	371.6	24.2	15.36
SALTER	51.74	812.7	80.0	10.16	59.6	4.0	14.90
SHERBROOK	60.50	1116.6	94.0	11.88	0.0	0.0	0.00
TALBOT (S)	66.32	1041.7	80.0	13.02	1041.7	80.0	13.02
TRANSCONA	54.54	1574.2	147.0	10.71	446.0	29.4	15.17
TRANSCONA SHUTTLE(S)	61.32	431.1	27.0	15.97	431.1	27.0	15.97
TYNDALL PARK (S)	84.33	215.2	13.0	16.56	215.2	13.0	16.56
UNIVERSITY	52.90	1672.1	161.0	10.39	0.0	0.0	0.00
WATT STREET	63.11	1016.0	82.0	12.39	0.0	0.0	0.00
WAVERLEY	69.44	327.2	24.0	13.63	0.0	0.0	0.00
WILLIAM-VALOUR	53.38	1236.8	118.0	10.48	0.0	0.0	0.00
WOLSELEY	61.21	1814.7	151.0	12.02	0.0	0.0	0.00
DIAL-A-BUS (S)	67.03	1811.2	106.0	17.09	1811.2	106.0	17.09
JEFFERSON SHUTTLE(S)	89.81	176.3	10.0	17.63	176.3	10.0	17.63
RACES	43.59	453.6	53.0	8.56	0.0	0.0	0.00
SOUTHDALE (S)	88.36	242.9	14.0	17.35	242.9	14.0	17.35
SOUTH CHARLESWOOD(S)	94.91	391.3	21.0	18.63	391.3	21.0	18.63
SOUTH TRANSCONA (S)	93.09	255.9	14.0	18.28	255.9	14.0	18.28
SOUTH ST. VITAL (S)	95.30	243.2	13.0	18.71	243.2	13.0	18.71
WESTWOOD (S)	86.49	390.6	23.0	16.98	390.6	23.0	16.98
TOTAL	56.96	51899.3	4641.0	11.18	14901.1	952.1	15.65

Source: See Appendix IV

Legend: %DEF - Deficit as a Percentage of Cost

DEFICIT - Total Deficit of a Transit Route per Day

HOURS - Hours Operated

DEF/HOUR - Deficit per Hour of a Transit Route transit services. The relationship between effectiveness and output is a positive one. The more passengers carried or the greater revenues generated, the more effective is the transit system.

Despite the fact that transit fare in Winnipeg stabilized between 1962 and 1968, revenue passenger per vehicle mile(RPVM) dropped slightly. (-6.3%) The 10¢ (66.7%) increase in basic adult fare in 1969 had a very marginal effect on transit ridership,[1] and RPVM declined modestly by 3%. Transit patronage remained quite stable through 1973 and increased marginally in 1974 and 1975. The overall decrease in effectiveness of the transit system was 10% in 15 years. (Table 17)

Revenue passenger per vehicle hour (RPVH) also exhibited a similar trend as RPVM, but the decline was slower. Between 1962 and 1968, RPVH only decreased by 4% as compared to 6.3% and the overall decrease amounted to 5.4% as compared to 10%. The slower rate of decline was attributed to a slight increase in operating efficiency, mentioned previously.

It can be concluded from the above analysis that maintaining a low transit fare did not have any impact on transit ridership. The provincial and municipal grants used to cover transit deficits incurred partly by this policy had no impact

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1. Revenue passenger per vehicle hour and mile are used as the unit measurement of transit services because they are positively correlated to transit revenues. The amount of transit revenues generated is dependant on the transit fare. Since there has been changes in fares during the study period, the use of transit revenue as a measurement of effectiveness is misleading in this analysis.

TABLE 17

THE CITY OF WINNIPEG

Transit System Statistics

1961 - 1976

Year	Rev. Pass. Per Veh. Mile	Rev. Pass. Per Veh. Hour	Veh. Mile Per Veh. Hour
1961	4.4301	45.8958	10.3600
1962	4.4371	46.2323	10.4196
1963	4.2581	44.7267	10.5039
1964	4.1410	43.3637	10.4717
1965	4.1555	43.7330	10.5240
1966	4.1871	44.1228	10.5379
1967	4.1535	44.2054	10.6430
1968	4.1749	44.3119	10.6139
1969	4.0436	43.6025	10.6948
1970	4.0645	43.4695	10.6948
1971	4.0166	43.6632	10.8706
1972	4.0232	44.0922	10.9594
1973	3.9528	43.6024	11.0309
1974	4.1558	46.0317	11.0765
1975	4.1840	45.8588	10.9590
1976	3.9700	43.7166	11.0116

Source: Computed from Table 9

on transit patronage. Revenue passengers per vehicle mile and per vehicle hour have actually decreased in the two periods examined above while transit fare structure remained unaltered. The transit fare increase which occurred in 1969, on the other hand, only reduced transit ridership very marginally. This finding coincides with other empirical studies.[1] Transit subsidies used to maintain low transit fares have failed to improve the effectiveness of transit operations in Winnipeg over the 15 year period (1962-1976).

Another factor contributing to the decline in effectiveness of public transit was the provision and extension of suburban transit services. The route-by-route analysis on transit ridership presented in Table 15 showed that suburban transit routes carried fewer passengers than urban routes On an average, the Crestview and South St. Vital carried only 5 passengers per hour while the Corydon-North Main carried 64 passengers per hour. The average revenue passengers per hour for suburban routes was 22.3 which is significantly lower than 53.8 revenue passengers per hour for the urban routes. Transit subsidies used to finance suburban transit service additions and expansions also have failed to improve the effectiveness of public transit operations in Winnipeg.

It is also evident that the productivity (as measured by effectiveness) of transit operation has declined at an annual rate of 0.7% (as measured by revenue passenger/ bus mile) or 0.3% (as measured by revenue passenger/ bus hour). As has been demonstrated earlier in section 4.2.2, increases in employee wages and benefits were major contributing factors (apart from inflation) for the rapid increase in transit operating costs. The higher employee benefits and wages (i.e. over and above the cost-of-living increases) appeared to be unjustified because of the decline in productivity and it also responsible for the decline in efficiency. However, the decline in productivity and efficiency is in part due to poor transit planning and ineffective political decisions.

4.5 Summary

Three major factors are responsible for the enormous growth in transit deficits in Winnipeg during the 15 year period; they are : (1) the extension and addition of transit routes, especially in the suburban areas, (2) inflation and higher labour compensations, and (3) the policy to maintain a low transit fare. Despite the substantial increases in government grants offered to Winnipeg Transit, the effectiveness and efficiency of transit operations have declined to some extent. The extension and addition of suburban transit routes have resulted in these declines because of the higher costs of providing services and the low demand for public transit in these areas. The subsidized transit fare policy is also responsible for these declines due to its marginal impact on levels of transit ridership and automobile travel. Higher labour compensation and ineffective transit planning have also contributed to the growth in transit deficits.

CHAPTER V

ALTERNATE TRANSIT AND TRANSIT SUBSIDY POLICIES

5.1 Introduction

Despite the substantial increases in government grants offered to Winnipeg Transit, the goals and objectives adopted by City Council and other transit subsidy advocates were not achieved. The failures of existing transit and transit subsidy policies are evident and have been identified in Chapter Four. In an attempt to respond to their shortcomings, alternate transit and transit subsidy policies are formulated with respect to the empirical evidence presented in the preceding two chapters, and to the current transportation literature. These policies are designed to improve the effectiveness and efficiency of transit operations.

In light of the worsening energy crisis and peak hour congestion, transit subsidies are essential in system improvements aimed at promoting transit patronage. Transit subsidies should not be eliminated, but existing transit subsidy policies should be overhauled if the goals and objectives of public transit are to be realized. The possible impacts of these policies are evaluated and summarized in a goals-achievement matrix in the last section.

5.2 Alteration of Transit Fare Structure

The implicit policy of maintaining low and uniform transit fares has been responsible for the decline in passenger revenues (in constant dollars) over the 15 year period from 1962 to 1976. When passenger revenues do not increase at the same rate as operating costs, deficits result. As it has been shown earlier in section 4.3.1, the average fare (in 1961 constant dollars) has fallen steadily from 13.7¢ to 11.9¢, while average costs rose from 14.6¢ to 17.4¢ per passenger over the study period. The 13% reduction in passenger revenues and the 21% increase in transit costs thus contributed to the escalation of transit deficits. The transit subsidies granted by the municipal and provincial government have been used to a large extent to cover the shortfalls in transit revenues.

However, the transit subsidies used to maintain a low transit fare have not been effective in increasing transit patronage. The policy of subsidizing transit fares has been determined in many empirical studies to be an ineffective means of achieving the above objective.[1] Transit fare is found to be inelastic with respect to the demand for transit, and the price of transit fare comprises only a tiny fraction of a traveller's total cost of travel; therefore subsidized transit fare will have very little effect on the demand for public transit. (Figure 17, Case 1) Furthermore, the general belief that subsidized transit fare will benefit the poor has been disputed by Frankena.[2] He finds that municipal tax

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1. Kraft (31), Frankena (19), Dewees (15), Sherman (68), & Baum (7).

2. Frankena (18).

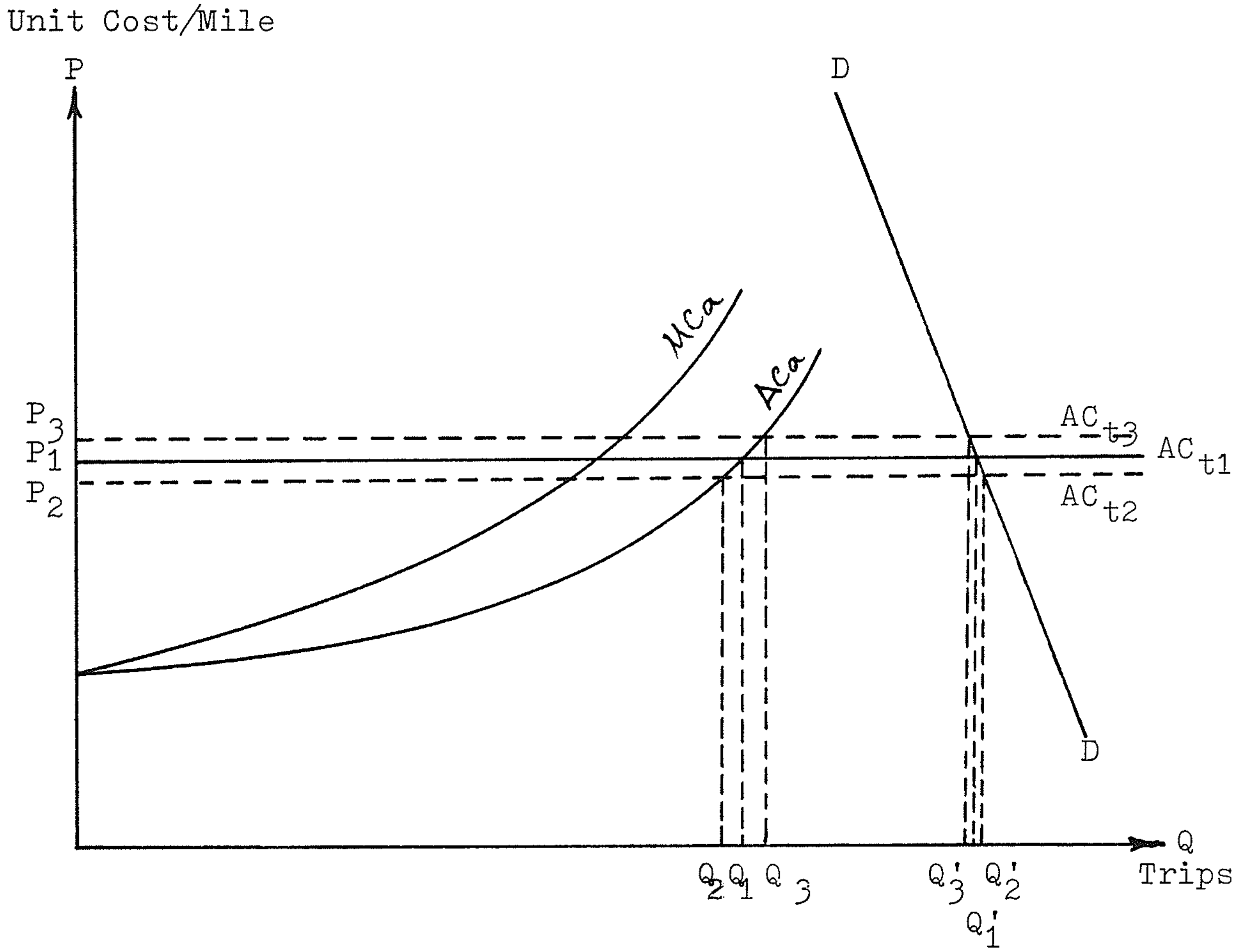

Figure 17: The Effects of Subsidized and Indexed Transit Fare

Legend: AC_{t1} - Average costs of using the transit mode

AC_{t2} - Average costs of using the transit mode with a subsidized transit fare

AC_{t3} - Average costs of using the transit mode with an indexed transit fare

AC_a - Average Costs of using the private automobile

MC_a - Marginal Costs of using the private automobile

Case 1 : The Effects of a Subsidized Fare

Increase in Transit Trips = $(Q_1 - Q_2) + (Q_2' - Q_1')$

Decrease in Auto Trips = $(Q_1 - Q_2)$

Case 2 : The Effects of an Indexed Fare

Decrease in Transit Trips = $(Q_3 - Q_1) + (Q_1' - Q_3')$

Increase in Auto Trips = $(Q_3 - Q_1)$

revenues used in the subsidization of public transit have a regressive impact on income distribution. The benefits of subsidized transit are enjoyed more by higher income groups than the lower income groups; therefore, the net effect of subsidized transit is the redistribution of income from the poor to middle income groups.

5.2.1 Indexing Transit Fare

An alternate transit fare policy is to index transit fares to the rate of cost-of-living increases, so that the gap between operating costs and passenger revenues can be narrowed and transit subsidies can be invested in improvements in system characteristics, as described in section 2.3.4. The negative impact on transit ridership would be marginal, because transit demand is inelastic with respect to fare. (Figure 17, Case 2) Furthermore, indexing transit fares to the rate of inflation would not result in any drastic fare hikes. In fact, Winnipeg Transit has adopted a similar transit fare policy, but its sole purpose is to increase passenger revenues in order to reduce the size of transit deficit and subsidy. The policy recommended here is one designed to increase passenger revenues so as to free up a portion of transit subsidy, and not to replace them. This subsidy should be invested in programs geared to improve the mobility and welfare of a particular group (e.g. lower income earners and senior citizens) or an area with greater needs for public transit services (e.g., the inner area and the downtown of Winnipeg). Transit subsidies used to finance these programs would be more effective in attracting transit patrons than the uniform subsidization of transit fare . (Figure 18)

5.2.2 Differential Transit Fares

Another transit fare policy is to relate trip distances to transit fares. The uniform fare policy has resulted in a form of cross-subsidization in which urban transit riders are paying much more for their trips (in relation to the full cost per trip) than suburban riders. In other words, a disproportionate amount of transit subsidies has been spent in subsidizing suburban transit users. In a typical weekday in 1976, an average deficit of $16 per hour was estimated for suburban routes, as compared to $10 for urban routes. A differential fare policy would undoubtedly increase passenger revenues and eliminate the cross-subsidization of transit revenues. The impacts of this policy on transit ridership would again be marginal, because of the inelasticity of transit fare discussed earlier.

5.2.3 Peak Load Transit Fare

Finally, a peak load pricing policy for public transit together with a program to promote staggered work hours among employers in the downtown area would eliminate the problem of overcapitalization of transit equipment due to concentrated demand for transit during the peak hours. Also, traffic congestion in and around the downtown area would be reduced as the result of a staggered work hours program.

A peak load fare may take the form of a higher transit fare during the peak hours (i.e., 7:30 a.m. to 8:30 a.m. and 4:30 p.m. to 5:30 p.m.) than the off peak hours. A higher transit fare during the peak hours is also justified because of the higher costs of providing peak hour transit services. If a peak load transit fare is implemented, then the peak hour demand for public transit would be spread over a longer period of time, and the productivity of transit vehicles and personnel would improve significantly. This policy would increase the capacity and the level of service of public transit during the peak hours.

5.3 Rationalization of Transit Operations

Declining efficiency and effectiveness of transit operations in Winnipeg have also contributed to the widening gap between transit costs and revenues. The role of transit subsidy has been primarily responsible for these declines by tacitly supporting the addition and extension of suburban transit routes, increasing employee compensation, and ineffective transit planning.

5.3.1 Rationalization of Suburban Transit Services

A policy to rationalize transit services in suburban areas would be very effective in reducing the cost (and therefore the deficit) of transit operation. Suburban transit routes have failed to attract transit riders and resulted in much lower passenger revenues in relation to the cost of operation. The longer trip length of suburban trips also adds to the higher cost of providing services to the suburban areas.

Empirical evidence indicates that automobile travel is very closely related to car ownership and income level[1]; therefore, the addition and extension of transit services to suburban areas characterized by a high incidence of car ownership and high income levels would have a minimal effect in attracting new transit patrons or restraining automobile usage.[2]

In order to increase the efficiency and effectiveness of suburban transit routes, regular transit service should only be provided during the peak hour or when the demand for public transit is justified on economic grounds. Fiscal standards relating the costs of operation to passenger revenues for different types of transit routes should be implemented to ensure effective transit planning.

It is important to minimize the impacts of this policy on area residents; therefore, alternate transportation modes such as jitney (private minibus) bus pooling, and taxi pooling services should be allowed to operate in the affected areas to replace or to complement regular bus services. As well, more 'park-and-ride' or 'kiss-and-ride' facilities should also be constructed to encourage suburban auto users to use public transit.

The curtailment of inefficient and ineffective suburban transit services would lead to a significant reduction in the

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1. McFadden (46), Quarmby (55) and Dewees (16).
2. Additional empirical evidences can be found in section 3.3.

the total costs of operation, and suburban residents would also enjoy the more efficient services provided by the private as well as the public mode.

5.3.2 Productivity of Transit Drivers and Vehicles

Because of the labour intensive nature of transit, higher labour compensation coupled with declining productivity (revenue passengers per bus hour/bus mile) has been a major factor in increasing operating costs. Ineffective transit planning was in part responsible for the decline in productivity.

a) Employment of part-time transit drivers - A policy to employ less expensive part-time drivers, especially during peak hour operations, would result in an increase in productivity and would reduce the frustrations experienced by many full time employees who are presently working on split shifts. Part-time bus drivers have been successfully employed by the school bus system for many years. Without the services of these part-time drivers, the cost of providing school bus services would be very much higher. The use of part-time labor arrangements would be quite advantageous to the transit industry.[1] However, the present transit labour relations problem in Winnipeg may prevent the implementation of such policy.

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1. Sale and Green (62, p.26) consider the labor contract which allows for part-time employment in Seattle a significant breakthrough in the transit industry.

b) Effective Transit Planning - A policy designed to improve the general effectiveness and efficiency of transit operations would increase the productivity of transit drivers and vehicles. Operating efficiency and effectiveness can be achieved by fine tuning of transit routes and schedules through the use of computer programs.[1] The installation of onboard computers in transit buses to report accurate scheduling information has proven to be very effective in attracting transit riders because of the minimization of waiting time.[2] The use of exclusive bus lanes during the peak hours has also proven to be effective in reducing transit travel time, especially in the congested areas in many cities in Canada.[3] A reduction in travel time and waiting time as a result of an increase in operating efficiency would have a more significant impact on transit ridership than subsidized transit fares because the major components of a traveller's total cost of travel are travel time cost, walking time cost, and waiting time cost - not the transit fare itself (Figure 18).[4]

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1. Sale and Green (62,p.26) report that 21 transit systems in the U.S. have indicated increases in efficiency as a result of this fine tuning of routes and schedules by a computer softward package (RUCUS) developed by UMTA.
2. The City of Waterloo has reported increases in transit ridership because of the installation of these computers. The driver would be able to report their actual arrival time at a particular stop and the onboard computer can relay this information to a central computer for processing. Transit users would be able to obtain very accurate scheduling information by telephone so as to minimize their waiting time. This service would be invaluable to transit users, especially during the winter time.
3. For example: Vancouver, Toronto and Ottawa.
4. See Dewees (15), pp.60-66.

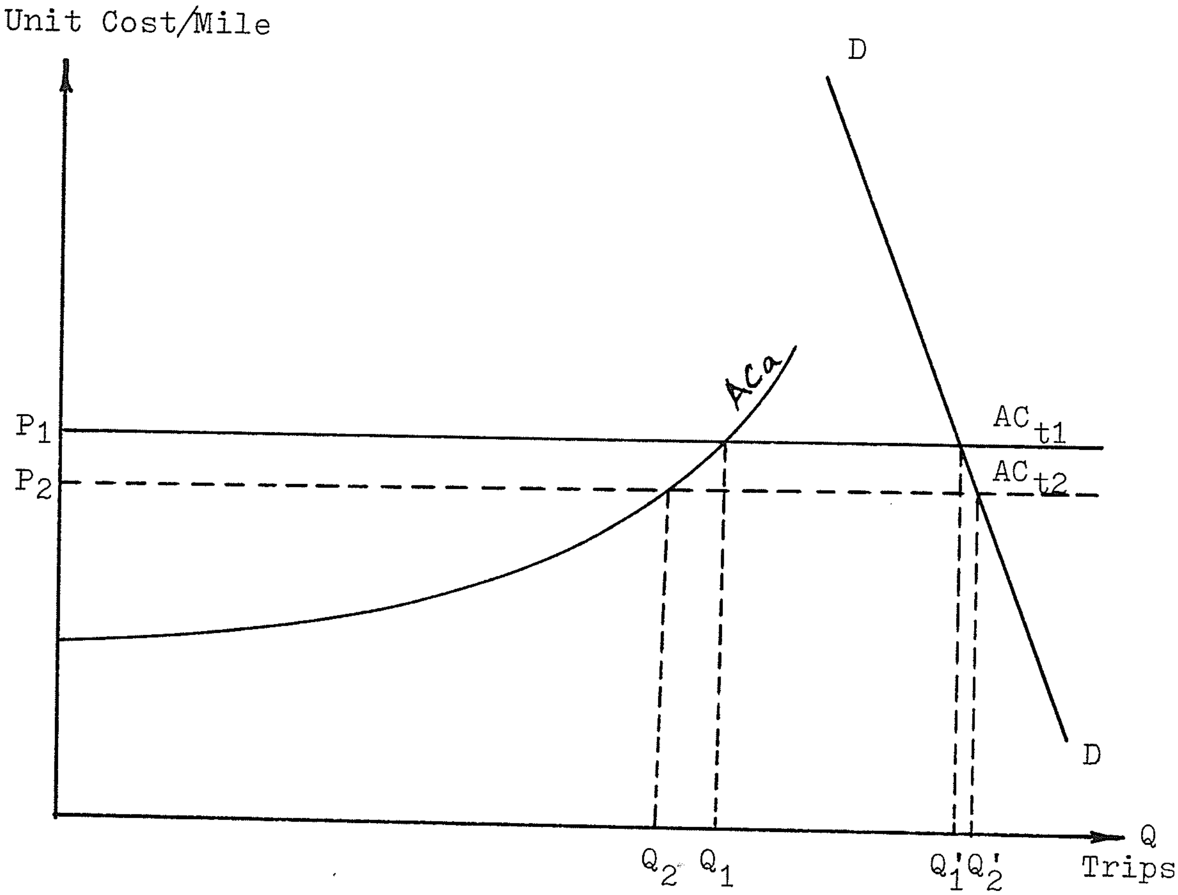

Figure 18: The Effects of System Improvements Financed by Transit Subsidy

Legend:

AC_{t1} - Average costs of using the transit mode

AC_{t2} - Average costs of using the transit mode after system improvements

AC_a - Average costs of using the private automobile

D-D - Demand for trips as a function of cost

The Effects of System Improvements

Increase in Transit Trips $= (Q_1 - Q_2) + (Q_2' - Q'_1)$

Decrease in Auto Trips $= (Q_1 - Q_2)$

5.4 Road Pricing Scheme to Subsidize Public Transit

In Winnipeg, automobile related subsidies amounted to over 10% of the total public expenditures in 1976. This percentage would be much higher if direct and indirect automobile subsidies, provincial grants for the construction of regional streets, and the cost of AUTOPAC were included in the accounting. In contrast, the municipal transit subsidies only amounted to 2.5% of the total spending in 1976.[2] Thus the private automobile is heavily subsidized in comparision to public transit.[3]

As has been illustrated earlier in section 2.2, private automobiles also incur externalities such as congestion, air pollution, and noise pollution which are not captured by the present road pricing scheme. The theoretical arguments for the imposition of a congestion toll strongly indicate that such tolls are an effective means of relieving peak hour congestion in urban areas, in terms of economic efficiency. However, the imposition of congestion tolls has been rejected because of political reasons,[4] and subsidization of public

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1. In San Francisco, direct and indirect automobile related expenditures amounted to 30% of the total city budget. See Lee (41).

2. A comparision of the total transit subsidies and the total budgeted programs for roads between 1962 and 1976 is presented in Figure in Appendix II.

3. It can be argued that part of the province gasoline tax revenues are channelled to subsidize private auto users, and therefore the automobile users are in fact paying some of these subsidies. However, one should also remember that the price of gasoline in Canada is being heavily subsidized in comparision to other countries because of federal regulations.

4. See Section 2.2.4.

transit is considered to be the second-best solution.

The recent decision by the federal government to speed up increases in the price of oil towards the world level in an effort to make Canada more self-sufficient in energy and to promote the conservation of energy, would undoubtedly benefit the transit industry in Canada. An increase in the gasoline tax implies that many of the direct and indirect subsidies, as well as the social costs of the private automobile, can be recovered to a large extent by this tax. As a result, the private automobile users will be forced to pay for the true cost (or close to the true cost) of using the road infrastructure for the first time. The impacts of this policy on automobile usage and transit ridership would be very significant. (Figure 19, Case 1)

The Clark government is at the present trying to find more effective ways of disposing and investing these revenues. A road pricing policy to use a portion of these tax revenues to subsidize public transit through system improvement (as discussed earlier) would result in a substantial increase in transit ridership[1] and a corresponding decrease in auto travel, energy consumption, and peak hour congestion. (Figure 19, Case 2) As well, the financial burdens of the city governments would also be lessened.

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1. Frankena estimated the elasticity of gasoline with respect to the demand for public transit in Canadian cities are 0.37 and 0.89. However, he considers the elasticities are too high when compared to other findings. See Frankena (19) pp.298-299.

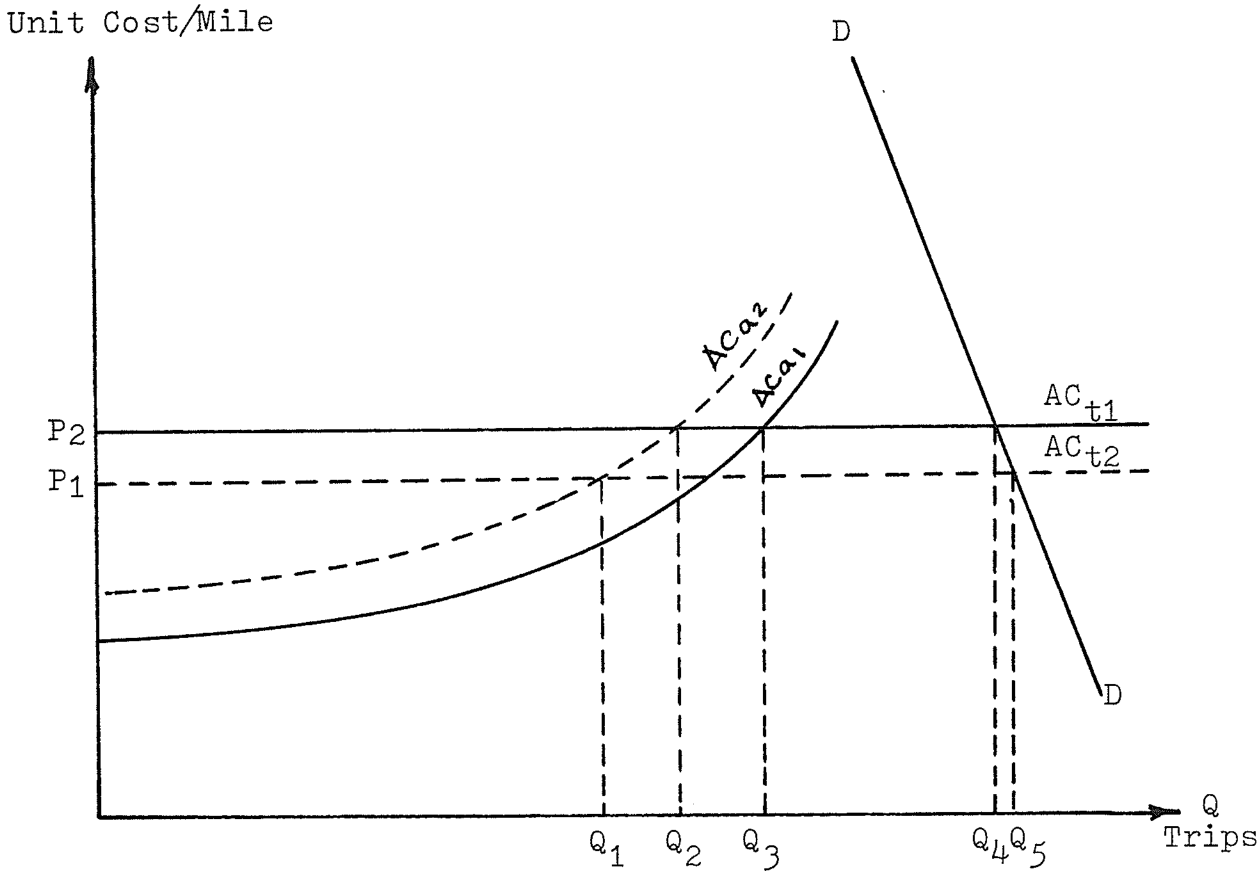


Figure 19: Road Pricing Scheme to Subsidize Public Transit

Legend: AC_{t1} - Average costs of using the public mode

AC_{t2} - Average costs of using the public mode with subsidy from gasoline gas tax revenue

AC_{a1} - Average costs of using the private automobile with subsidy

AC_{a2} - Average costs of using the private automobile with a gasoline taxing scheme

Case 1: Removal of automobile subsidy by imposing a gasoline tax

Increase in Transit Trips/Decrease in Auto Trips $= (Q_3 - Q_2)$

Case 2: Public Transit is subsidized by Gasoline Tax Revenue

Increase in Transit Trips $= (Q_3 - Q_1) + (Q_5 - Q_4)$

Decrease in Auto Trips $= (Q_3 - Q_1)$

5.5 Summary

Three general sets of alternate policies have been formulated in this chapter and the effects of these policies are summarized in a goals-achievement matrix. Although the assessments of these policies are most often subjective in nature, they are, however, supported by both empirical and theoretical investigations discussed in the preceding chapters. Further quantitative research into the possible ramifications of these policies is essential. Nevertheless, the goals-achievement matrix may prove useful as a guide for policymakers.

Rating Scheme: 3 Significant Positive Effect 2 Moderate Positive Effect 1 Marginal Positive Effect 0 No Effect at all -1 Marginal Negative Effect -2 Moderate Negative Effect -3 Significant Negative Effect	Increase Transit Ridership	Reduce Automobile Travel	Relieve Peak Hour Congestion	Income Distribution	Reduce Energy Consumption	Reduce Tax Burdens	Revitalize Downtown	Political Acceptance
1. Alteration of Transit Fare Structure a. Indexing Transit Fare	-1	-1	-1	2	-1	3	-1	-1
b. Differential Transit Fare	-1	-1	-1	3	-1	2	0	-1
c. Peak Load Transit Fare	0	0	1	2	0	2	1	-1
2. Rationalization of Transit Operations a. Rationalization of Suburban Tran. Ser.	-1	-1	-1	3	-1	3	-1	-1
b. Employment of Part-Time Drivers	0	0	0	0	0	3	0	2
c. Effective Transit Planning	2	2	2	3	2	-2	3	2
3. Road Pricing Scheme to Subsidize Transit	3	3	3	3	3	3	3	2

Table 18: Summary of the Possible Effects of Alternate Transit and Transit Subsidy Policies

CHAPTER VI

CONCLUSIONS

Subsidization of public transit has become a standard practice in Winnipeg since the early sixties. Although the magnitude of transit subsidy has increased quite drastically between 1962 and 1976 as a result of a rapid growth in transit costs coupled with a slow growth in system revenues, its impacts on increasing transit ridership, restraining automobile travel, reducing peak hour congestion, reducing air and noise pollution, lowering the level of gasoline consumption and car ownership, as well as revitalizing downtown area have been insignificant.

The extension and addition of suburban transit service, the inflation of wages and the cost of goods, higher labor compensations, and the policy of maintaining low transit fares have all contributed to the growth of the transit deficit(and subsidy) and to the decline in the effectiveness and efficiency of transit operations.

The failures of existing transit and transit subsidy policies are evident. In an attempt to address their shortcomings, three sets of alternate policies relating to transit cost, revenue, efficiency, and effectiveness of transit operations are formulated, and an alternate source of subsidy is suggested.

Subsidized transit fare has proven to be ineffective in attracting new transit riders and it also tends to redistribute income from the lower to the middle income groups. Therefore an indexed transit fare would significantly increase transit revenues, and these addition receipts could then be used to improve transit services to those groups with limited mobility. A differential transit fare relating trip length to the private fare cost would also increase revenues and eliminate cross-subsidization. A peak load fare together with a staggered work hours program would reduce the problem of overcapitalization.

Because of the inelasticity of transit fare with respect to transit demand, moderate alterations of transit fare structure would result in very marginal effects on transit ridership.

Extension and addition of suburban transit routes have also contributed to declining efficiency and effectiveness; therefore a selective withdrawal of transit services in the suburban areas coupled with the provision of transportation modes and facilities would result in more efficient and more effective transit service throughout the city.

The use of part-time labour would result in an increase in productivity and reduce the need for split shifts. Fine tunning of schedules and routes as well as system improvement such as exclusive bus lanes would also increase the efficiency and the effectiveness of transit operations.

Alternate sources of transit subsidy should come from the 'windfall gasoline tax fund' contemplating by the federal government in an effort to make Canada more self-sufficient in energy and to promote the conservation of energy. The net effect of the gasoline tax if applied in the above manner would reduce automobile travel significantly. However, if a portion of the wind-fall tax were to be channelled to subsidize public transit, the resultant impact on transit ridership, auto travel, peak hour congestion and energy consumption would be very significant.

Finally, the possible impacts of these alternate policies are summarized in a goals-achievement matrix. The matrix represents a tentative theoretical framework for these policies only and is subject to practical constraints; therefore, further research and impact assessment must be undertaken to select those policies which are most likely to have the most favourable effect in the Winnipeg context.

APPENDIX I

CITY OF WINNIPEG

Transportation Policies and Guidelines

Adopted by Council on July 18th,73

TRANSPORTATION POLICY

I. THE CITY ENDORSES THE PRINCIPLE OF THE NEED FOR PLANNED PUBLIC TRANSIT AND ROADWAY SYSTEMS WHICH WILL BE SCALED TO PROVIDE FOR THE REGIONAL TRANSPORTATION REQUIREMENTS OF THE URBAN AREA.

GUIDELINES:

1. The City shall approve a regional transportation plan as part of its plans for future development and recognizing that objectives are achieved incrementally, the City shall adopt a five-year program of implementation. This five-year program will be reviewed on a continuing basis and will be updated and extended yearly. This review shall take into consideration overall changes in its development plan and technological changes in urban transportation and the results of demonstration or experimentation in this and other centres.

2. The City endorses the concept of a balanced transportation system in which public and private modes complement each other by fulfilling those functions which are best suited to each.

3. The City supports the position that a choice of modes should be available to its citizenry and both public and private modes should be structured to provide for both area wide and local needs. In this regard, both modes should contain facilities structured to provide the level of service best suited to both the distance and purpose of the trip.

4. The City recognizes that in the development of its regional transportation plans the realities of the established urban patterns including its neighbourhoods, communities and its transportation networks must be acknowledged as representing legitimate constraints on alternatives which might be evaluated.

5. The City recognizes that the cost of urban transportation systems are directly related to the peak loads which must be accommodated. It therefore pledges to vigorously pursue and adopt methods of reducing peak loading of its transportation systems in order to reduce the capital and operating costs of these systems.

II. THE CITY SUPPORTS THE PRINCIPLE OF EMPHASIZING THE ROLE OF PUBLIC TRANSPORT FOR THE MOVEMENT OF PERSONS TO AND FROM DOWNTOWN AREA AND OTHER CENTRES WHCIH ATTRACT LARGE CONCENTRATIONS OF PEOPLE, AND ENDORSES THE PRINCIPLE OF EXPLORING ALL METHODS OF PUBLICLY OWNED AND OPERATED TRANSPORTATION SYSTEMS, INCLUDING UNDERGROUND, GRADE-LEVEL, AND ABOVE GRADE, TOGETHER WITH CONTINUING NEGOTIATIONS WITH SENIOR LEVELS OF GOVERNMENT TO FINANCE SAME IN BOTH EXPERIMENTAL STAGES AND ON A PERMANENT BASIS.

GUIDELINES:

1. The City shall encourage the use of public transport and recognizes that travel patterns in the urban area change with time and it shall investigate whether the transit system adequately provides for the present travel needs of this community and shall implement changes in level and direction of service where studies indicate that improvements are desirable, and in the interests of the travelling public.

2. The City shall consider the use of new public transport systems and hardware and shall monitor the results of demonstration projects in other areas to determine their applicability to the Winnipeg situation. The City is prepared to undertake public transport demonstration projects of a reasonable scale and will pursue financial support for such projects from senior levels of government.

3. As one mode of a broad public Transit program, the bus mode should be made more available to the public by considering the following possibilities:

   (a) The introduction of such schemes as more express bus routes utilizing the existing and planned road network and by the development of transportation corridors which incorporate exclusive rights of way for public transit vehicles.

   (b) The City recognizes that convenient access to the regional public transport system is necessary to make transit an attractive alternative to the automobile. The City shall pursue methods of ensuring access by implementing improvements in the collection and distribution functions of the system and by planning, complementing high density and intensive use developments adjacent to present and proposed public transit passenger collection nodes so as to locate large numbers of potential riders in close proximity to such facilities.

(c) The City recognized that our Winter climatic conditions are sometimes detrimental to the use of public transport particularly where transfers from one mode or route to another are required. The City therefore endorses the principle of improving the environment for the transit passenger.

(d) The City is prepared to implement such measures on regional streets as shall optimize street operation in the interests of improving transit service and where necessary will introduce the necessary design to give transit vehicles priority in the use of streets.

III. THE CITY SUPPORTS THE NEED TO PROVIDE A MAJOR ROAD NETWORK WHICH WILL SIGNIFICANTLY REDUCE THROUGH TRAFFIC IN THE DOWNTOWN AREA AND WILL MAINTAIN A REASONABLE STANDARD OF TRAVEL BETWEEN ALL PARTS OF THE CITY FOR THE MOVEMENT OF ITS PEOPLE AND PRODUCTS: SUCH MAJOR ROAD NETWORK WILL NOT INCLUDE FREEWAYS, DEFINED AS "AN EXPRESSWAY INTENDED TO MOVE HIGH VOLUMES OF TRAFFIC OVER LONG DISTANCES AT HIGH SPEEDS WITH FULL CONTROL OF ACCESS AND NO AT-GRADE INTERSECTIONS".

GUIDELINES:

1. The City recognizes that the regional street system as may be approved by Council from time to time, determines the size and shape of the living areas. The City believes that such areas should be free of unnecessary and hazardous through traffic and therefore supports the principle that the plan for the regional street network should by design discourage, where possible, the use of local streets by vehicular through traffic and encourage traffic to use the network provided for this purpose.

2. The City supports the need to establish or designate routes which would incorporate some measure of access control to ensure the safe and efficient movement of vehicular traffic. Where deemed necessary the City supports the inclusion of selected grade separations on such routes to eliminate conflicts between particularly heavy traffic movements and between street and railway traffic.

3. Although the City recognizes that its two major rivers are its greatest and most important natural assets, it is also aware that they represent major constraints to urban movement. The City therfore supports the concept of providing additional river crossings and approach roadway systems in order to relieve the radial street network of increasing traffic loads and to provide greater opportunities for its citizens to move freely between all communities which make up the urban area.

4. The City is aware that in order to enhance and make the Downtown Area more 'liveable' for the pedestrian and centre city dweller, unnecessary automobile and truck traffic should be discouraged form through the City Centre by the provision of more attractive alternatives.

5. The City supports the principle of making maximum use of the existing regional street system by introducing appropriate traffic management programs. However, the City recognizes that among its manmade attractions are its scenic streets and it therefore strongly supports the principle of maintaining the scale of roadway to right-of-way in such proportions as to ensure the existing regional streets continue to play an important role in the City's appearance.

6. The City discourages the building of single-family dwellings fronting on regional streets.

IV. WHILE THE CITY RECOGNIZES THAT NEW TRANSPORTATION CORRIDORS WILL BE REQUIRED, IT STRONGLY SUPPORTS THE CONCEPT THAT THESE MUST BE DESIGNED AND DEVELOPED IN SUCH A MANNER THAT THEY WILL NOT ONLY PROVIDE FOR SAFE AND EFFICIENT MOBILITY, BUT WILL CONTRIBUTE TOWARDS AND, IN FACT, ENHANCE THE URBAN ENVIRONMENT.

GUIDELINES:

1. The City supports the principle that in the development of new transportation facilities the alignments of such routes should, wherever possible, make maximum use of undeveloped corridors and have a minimum effect on park and residential land.

2. The City believes that sufficient right-of-way should be acquired in order that adequate landscaping can be accommodated along the transportation corridors including the provision of planting screens and noise-abatement devices where these are deemed desirable for the protection of abutting properties. The corridor design should insure that the scale of the transportation facility within the corridor is in harmony with adjacent existing or planned development.

3. The City believes that the use of joint corridors for separate transportation mode facilities should be considered where this is practical and beneficial to the City.

4. In high density areas where rights-of-way are limited the City believes that consideration should be given to the integration of land use and transportation corridors by the use of air rights for development purposes.

5. The City supports the concept that in the planning of new transportation corridors in undeveloped or sparcely developed areas such plans should be integrated with plans for adjacent land use development so that each urban form reflects the existence of the other and compliments it to the greatest degree possible.

6. The City believes that major developments generating significant traffic volumes should be sited in such a manner that the public investment in adjacent regional transportation facilities is protected. The City supports the principle that where such development will concentrate large volumes of vehicular traffic which may have a detrimental localized effect on the adjacent transportation facilities that the developer will be required to provide special access facilities or participate in remedial measures to ensure that the operation of the City's transportation system does not suffer from traffic surcharges directly related to the development.

Downtown Policy Guideline 3

3. Circulation

(a) The City shall plan and develop a system of segregated pedestrian walkways between various nodes of activities in the downtown. The proportion of the cost of individual segments of a walkway system to be borne by the City is subject to negotiation with the private sector.

(b) In keeping with its policy to emphasize the role of public transportation to and from the downtown area, the City shall provide a convenient system of public transportation for the collection, distribution and circulation of persons within the downtown area.

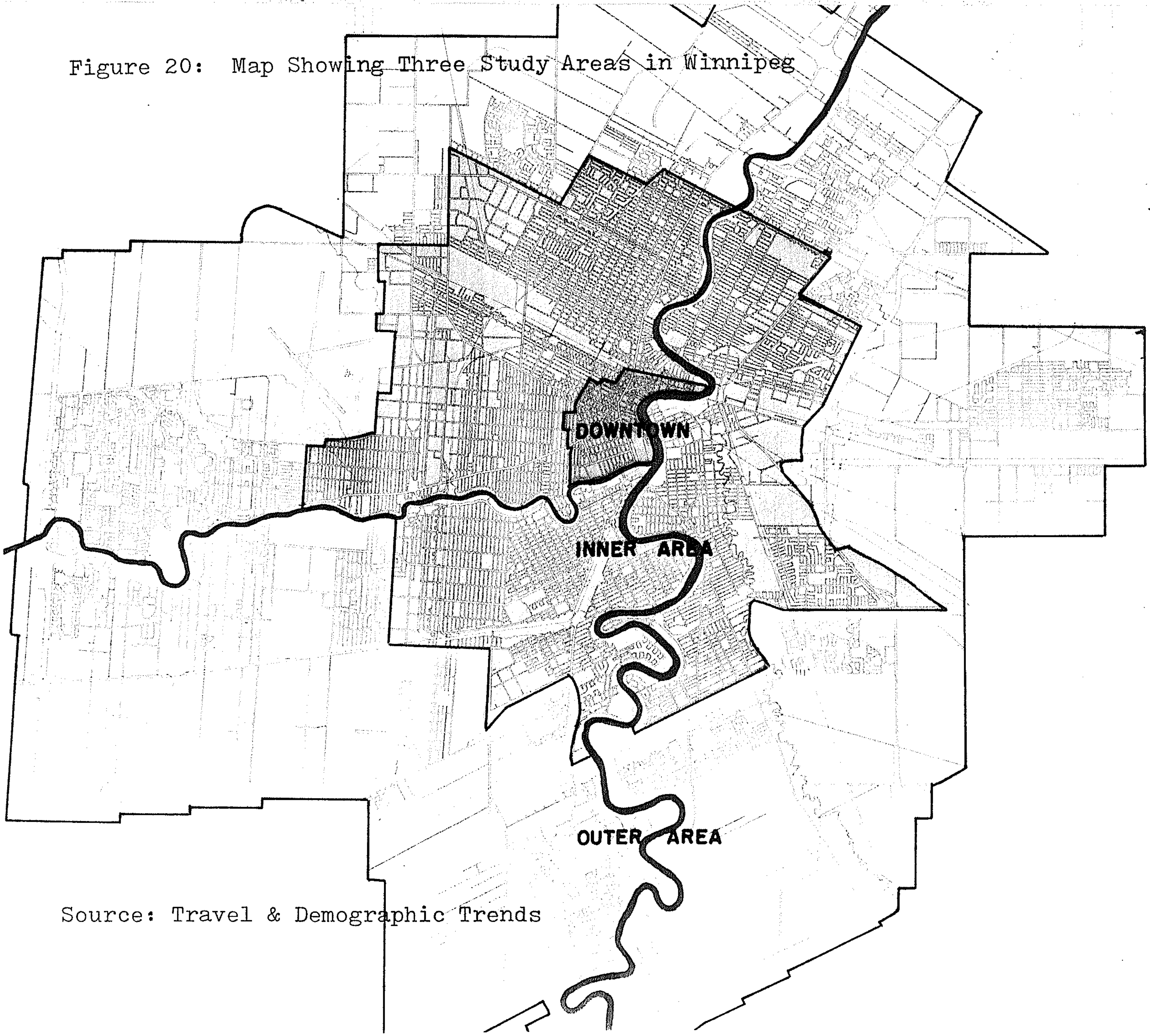
(c) The City shall ensure that plans for downtown circulation shall include 'mode-mix' facilities which shall provide for the convenient interchange of persons between various modes of travel.

(d) The City shall pursue a policy for the programmed removal of on-street parking in the downtown area and shall plan and encourage the establishment of sites for the construction of parking structures in peripheral areas of the downtown.

APPENDIX II

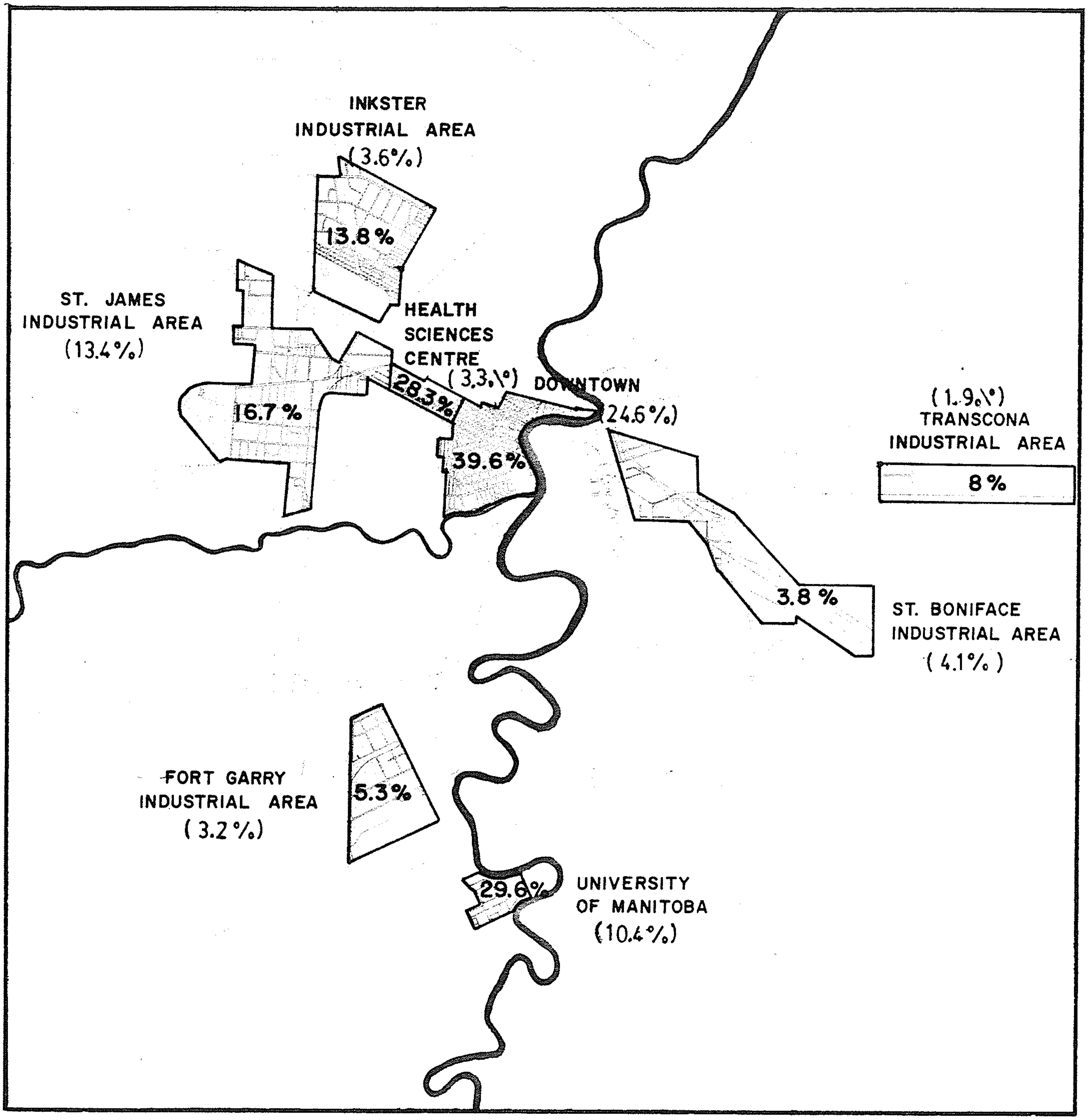
Maps and Diagrams

Figure 20: Map Showing Three Study Areas in Winnipeg



Source: Travel & Demographic Trends

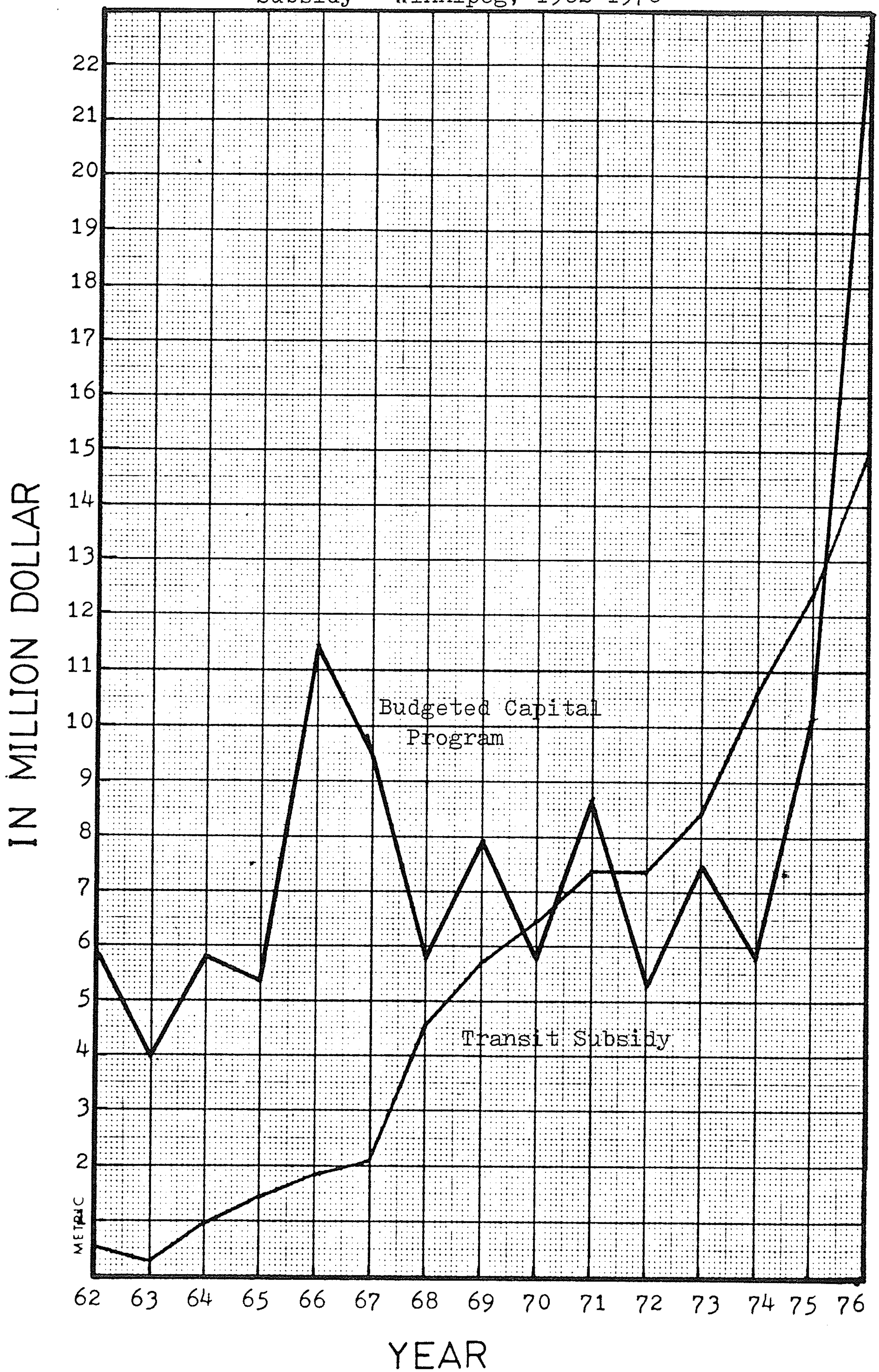
Figure 21: Major Employment Centres in Winnipeg



Sources: Public Transit Study (85) and Travel and Demographic Trends (84)

Notes:-% in parentthesis showing modal split of that centres
-% inside the boundaries showing % of total City employment of that centres

Figure 22: Budgeted Capital Program and Transit Subsidy - Winnipeg, 1962-1976



Sources: Tables 2 and 22

APPENDIX III

Transit Statistics

Table 19: Transit Cost, Revenue, Deficit, and Subsidy (1961 Constant Dollars)*
Winnipeg, 1960-1976

Year	Operating Cost	System Revenue	Deficit	Provincial Subsidy	Municipal Subsidy	Total Subsidy
1960	9,922,792	9,731,478	191,314	---	191,314	191,314
1961	8,304,246	7,749,069	555,177	---	555,177	555,177
1962	8,229,183	7,709,712	519,471	---	519,471	519,471
1963	8,940,441	7,725,835	1,214,606	---	270,276	270,276
1964	9,111,355	7,708,289	1,403,066	---	929,775	929,775
1965	9,086,503	7,679,737	1,406,766	---	1,372,651	1,372,651
1966	9,692,855	7,686,215	2,006,640	219,053	1,480,193	1,699,246
1967	9,999,891	7,672,423	2,327,468	218,951	1,635,128	1,854,079
1968	10,811,427	7,328,113	3,483,314	216,635	3,637,902	3,854,537
1969	11,564,540	8,421,905	3,142,635	345,193	4,285,946	4,631,139
1970	13,944,303	8,389,595	5,554,708	400,870	4,666,929	5,067,799
1971	13,095,323	8,350,985	4,744,337	407,154	5,331,586	5,738,740
1972	13,522,148	8,073,262	5,448,886	576,130	4,929,237	5,505,367
1973	13,925,596	7,519,151	6,406,445	1,472,057	4,482,237	5,954,294
1974	14,345,660	7,587,092	6,758,568	2,660,020	4,098,548	6,758,568
1975	14,807,801	7,818,643	6,989,158	2,843,924	4,145,234	6,989,158
1976	15,247,098	6,040,850	9,206,248	4,021,608	4,421,838	8,443,446

Source: Computed from Table 2
* Deflated by the Consumer Price Index for Winnipeg (Base year=1961)

Table 20: Breakdown of Total Transit Operating Costs - Winnipeg 1962, 1971 and 1976

Cost Components	1962		1971		1976	
	Actual $	Constant $	Actual $	Constant $	Actual $	Constant $
General Adminstration	99,003	97,732	190,277	147,960	169,622	88,345
Maintenance	1,837,832	1,814,247	2,979,622	2,316,969	4,697,134	2,446,424
Fuel and Power	749,358	739,741	1,035,452	805,173	1,988,750	1,035,807
Electrical Distribution	114,498	113,029	--	--	--	--
Transportation	3,612,492	3,566,132	7,285,896	5,665,548	12,503,523	6,512,252
Schedule	64,544	63,716	132,868	103,315	219,164	114,147
Information & Publicity	75,500	74,531	174,672	135,826	283,282	147,543
Claims Cost	58,776	58,021	117,984	91,745	47,000	24,479
Employee Benefits	308,525	304,565	1,011,157	786,281	2,057,345	1,071,534
Municipal Taxes	109,149	107,748	285,441	221,960	465,939	242,676
Gen. Gov't Charge	398,188	393,078	705,565	548,651	904,774	471,236
Interest Charge	194,672	192,174	1,270,276	987,773	1,048,901	546,303
Depreciation	677,483	668,789	1,054,902	820,297	1,126,824	586,887
Miscellaneous	32,114	31,702	105,770	82,247	149,385	77,805
TOTAL	8,332,134	8,225,206	16,349,877	12,713,746	26,941,622	14,032,095

Source: Extracted and Computed form "Financial Results from Transit Operations" compiled by the Research Department, The City of Winnipeg.

Note: Actual Dollar is deflated by using the Consumer Price Index (1962=100).

TABLE 21

THE CITY OF WINNIPEG

Transit Revenue, Deficit, and Subsidy

As a % of Total Operating Cost

1960 - 1976

Year	System Revenue	System Deficit	Provincial Subsidy	Municipal Subsidy	Total Subsidy
1960	98.1	1.9	--	1.9	1.9
1961	93.3	6.7	--	6.7	6.7
1962	93.7	6.3	--	6.3	6.3
1963	86.4	13.6	--	3.0	3.0
1964	84.6	15.4	--	10.2	10.2
1965	84.5	15.5	--	15.1	15.1
1966	79.3	20.7	2.3	15.3	17.5
1967	76.7	23.3	2.2	16.4	18.6
1968	67.8	32.2	2.0	33.6	35.6
1969	72.8	27.2	3.0	37.1	40.1
1970	60.2	39.8	2.9	33.5	36.4
1971	63.7	36.3	3.1	40.7	43.8
1972	59.7	40.3	4.3	36.5	40.8
1973	54.0	46.0	10.6	32.2	42.8
1974	52.9	47.1	18.5	28.6	47.1
1975	52.8	47.2	19.2	28.0	47.2
1976	39.6	60.4	26.4	29.0	55.4

Source: Computed from Table 2

TABLE 22

THE CITY OF WINNIPEG

Budgeted Capital Program

1962 - 1976

Year	Metro/City	Province	Total
1962	4,176,260	1,759,000	5,935,260
1963	2,754,540	1,171,650	3,926,190
1964	4,139,760	1,674,840	5,814,600
1965	2,681,300	2,681,300	5,362,600
1966	4,087,900	7,363,900*	11,451,800
1967	4,261,620	4,011,620**	9,430,500
1968	2,877,100	2,877,100	5,754,200
1969	3,970,100	3,970,100	7,940,200
1970	2,376,350	3,199,950***	5,576,300
1971	4,546,900+	4,109,550	8,656,450
1972	2,612,750	2,612,750	5,225,500
1973	3,743,500	3,743,500	7,487,000
1974	2,886,900	2,886,900	5,773,800
1975	5,057,000	5,057,000	10,114,600
1976	11,552,700++	11,141,000	22,693,700

* Includes 3,276,000 for PTH 59 relocation which is not cost shared by Metro.

** Includes Federal Contribution 1,073,600, CPR 62500, and Utilities 21,160 for the construction of Nairn Overpass.

*** Includes 823,000 for Condordia which is not cost shared by Metro.

\+ Includes 437,000 for 50% share of Concordia.

++ Includes 411,700 for the construction of Pedestrian and Cycle facilities which are not cost shared by the Province.

Source: Streets and Transportation Division, The City of Winnipeg.

TABLE 23

HOURS OPERATED BY TYPES OF VEHICLES

WINNIPEG TRANSIT SYSTEM

1950 - 1977

Year	Street Cars	Trolley Buses	Motor Buses	Total
1950	516,472	397,633	525,683	1,439,788
1951	416,078	453,243	554,768	1,424,089
1952	344,403	421,597	544,855	1,310,855
1953	277,641	437,540	553,608	1,268,789
1954	247,435	440,597	560,745	1,248,777
1955	172,465	488,054	598,130	1,258,649
1956	-	509,061	847,644	1,356,705
1957	-	499,954	800,113	1,300,067
1958	-	496,766	771,239	1,286,005
1959	-	499,666	778,607	1,278,273
1960	-	477,408	820,993	1,298,401
1961	-	435,666	799,800	1,235,466
1962	-	423,441	797,930	1,221,371
1963	-	416,455	853,993	1,270,448
1964	-	405,602	904,973	1,310,575
1965	-	402,767	930,490	1,333,257
1966	-	331,191	1,034,967	1,366,158
1967	-	352,121	1,044,479	1,396,600
1968	-	323,510	1,066,323	1,389,833
1969	-	147,753	1,223,701	1,371,454
1970	-	56,236	1,293,559	1,349,795
1971	-	-	1,330,096	1,330,096
1972	-	-	1,322,649	1,322,649
1973	-	-	1,330,401	1,330,401
1974	-	-	1,346,915	1,346,915
1975	-	-	1,453,545	1,453,545
1976	-	-	1,269,021	1,269,021
1977	-	-	1,448,484	1,448,484

Source: Streets and Transportation Division,
The City of Winnipeg.

TABLE 24

REVENUE PASSENGERS CARRIED
BY TYPES OF VEHICLES
TRANSIT SYSTEM - YEARS 1950-1973

Year	Street Cars	Trolley Buses	Motor Buses	Total
1950	34,971,690	28,759,330	27,900,584	91,631,604
1951	27,369,917	31,213,880	27,177,119	85,760,916
1952	23,074,598	29,254,755	26,637,056	78,966,409
1953	19,222,176	29,997,227	26,400,235	75,619,638
1954	18,118,887	29,612,008	26,067,192	73,798,087
1955	12,070,128	31,300,502	27,173,661	70,544,291
1956	-	29,765,874	41,223,399	70,989,273
1957	-	27,261,644	36,424,771	63,686,415
1958	-	26,074,829	34,111,968	60,186,797
1959	-	25,961,415	35,276,047	61,237,462
1960	-	24,396,015	35,249,833	59,645,848
1961	-	22,118,037	34,584,697	56,702,734
1962	-	21,824,793	34,641,954	56,466,747
1963	-	20,764,469	36,058,528	56,822,997
1964	-	20,203,157	36,628,251	56,831,408
1965	-	19,918,603	38,388,698	58,307,301
1966	-	15,977,013	44,301,645	60,278,658
1967	-	17,082,016	44,655,285	61,737,301
1968	-	15,459,185	46,126,963	61,586,148
1969	-	8,854,986	49,999,423	58,854,409
1970	-	3,983,361	54,691,626	58,674,987
1971	-	-	58,076,195	58,076,195
1972	-	-	58,318,554	58,318,554
1973	-	-	58,008,666	58,008,666
1974	-	-	62,000,815	62,000,815
1975	-	-	66,657,764	66,657,764
1976	-	-	55,477,270	55,477,270
1977	-	-	65,592,630	65,592,630

Source: Streets and Transportation Division,
City of Winnipeg

APPENDIX IV

Definitions and Formulations of the Transit Route-by-Route Analysis

The route-by-route analyses on transit costs, revenues, deficits,and revenue passengers presented previously are based on the definitions and formulations described in this appendix.

Data on average daily transit passenger revenue and hours operated for an average weekday in May 1976 is employed in these analyses.[1] The proportion of a transit route operating in suburban areas is estimated from bus schedules. A Suburban area is defined as an area which was totally or largely undeveloped prior to 1962. A transit route which operated 50% or more of its operating time in the suburban areas is designated as a suburban route and is denoted by an "S" in Tables 13, 15, and 16. However, many other transit routes might have a portion of their service operating in these areas; therefore, in the computation of revenue for the suburban portion of a transit route, the average revenue per hour for the entire route is divided by 2 and multiplied by the total number of hours of suburban service. It can be argued that revenue generated by the suburban portion of a transit route is significantly lower than the average revenue for the entire route because of the longer journey taken by suburban transit riders and the fewer passengers carried on the suburban portion of the route. An assumption that the suburban portion of a

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1. Source of data: Research Department, City of Winnipeg. The revenue and hours operated for the Jefferson Shuttle were for an average Sunday in May 1976. The inclusion of this route would affect the route-by-route analyses on an average week day basis very marginally because of the insignificantly number of hours operated by this route (10 hours).

route generates only half as much revenue as the entire route is made here due to the lack of dissaggregate revenue data. This assumption is not applicable to routes operating exclusively in the suburban areas.

The average cost per hour of operation is assumed to be equal for all transit routes and is equal to \$19.634. The average revenue per passenger is again assumed to be equal for all routes and is equal to \$0.1784. These two constant functions are obtained from the entire transit operation in 1976. Deficits incurred and revenue passengers carried by all transit routes can be estimated from the revenues by using these two constant functions.

The various formulae used in the route-by-route analyses are presented as follows:

$$\text{Revenue per Hour (RevHour)} = \frac{\text{Total Revenue}}{\text{Hours Operated}} \quad \ldots\ldots\ldots\ldots \quad (1)$$

$$\underset{\text{(\%Revenue)}}{\text{Revenue as a \% of Total Cost}} = \frac{\text{RevHour}}{19.634} \times 100 \quad \ldots\ldots\ldots\ldots \quad (2)$$

$$\begin{array}{l}\text{Hours Operated in}\\ \text{Suburban Areas}\\ \text{(SubHour)}\end{array} = \text{Hours Operated} \times \frac{\text{Est. \% of Suburban Operation}}{100} \quad . \quad (3)$$

$$\begin{array}{l}\text{Revenue per Hour for}\\ \text{Suburban Portion of}\\ \text{a Route (SubRevHour)}\end{array} = \frac{\text{RevHour}}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\begin{array}{l}\text{Total Revenue for a}\\ \text{Suburban Route (SubRevenue)}\end{array} = \text{SubRevHour} \times \text{SubHour} \quad \ldots\ldots \quad (5)$$

$$\text{Revenue Passengers per Hour (RevPassHour)} = \frac{\text{RevHour}}{0.1784} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

$$\text{Total Revenue Passengers (RevPass)} = \text{RevPassHour} \times \text{Hours Operated} \quad (7)$$

$$\text{Revenue Passengers per Hour for a Suburban route (SubRevPassHour)} = \frac{\text{SubRevHour}}{0.1784} \quad \ldots\ldots\ldots \quad (8)$$

$$\text{Total Suburban Revenue Passengers (SubRevPass)} = \text{SubRevPassHour} \times \text{SubHour} \quad \ldots\ldots \quad (9)$$

$$\text{Deficit per Hour (DefHour)} = 19.634 - \text{RevHour} \quad \ldots\ldots\ldots \quad (10)$$

$$\text{Total Deficit of a route} = \text{DefHour} \times \text{Hours Operated} \quad \ldots \quad (11)$$

$$\text{Deficit as a \% of Total Cost (\%Deficit)} = 100 - \text{\%Revenue} \quad \ldots\ldots\ldots \quad (12)$$

$$\text{Deficit per Hour for a Suburban Route (SubdefHour)} = 19.634 - \text{SubRevHour} \quad \ldots\ldots \quad (13)$$

$$\text{Total Deficit of a Suburban Route (SubDeficit)} = \text{SubdefHour} \times \text{SubHour} \quad \ldots\ldots \quad (14)$$

The route-by-route analytical framework developed in this research could be refined subject to the availability of dissaggregate data on passenger counts and passenger revenue on different portionsof a route and different periods of the day. Further research into similar types of route-by-route anlysis and demand study would have important policy implications on the improvement of the effectiveness and efficiency of the transit system in Winnipeg.

B I B L I O G R A P H Y

B I B L I O G R A P H Y

1. Abe, M.A.: "The Peak Load Pricing Problem in Urban Transportation." Economic Studies Quarterly, 24(3), Dec. 1973, pp. 54-62.

2. "Distributional Equity and Optimal Pricing of Urban Transport." Journal of Transport Economics and Policy, 9(2), May 1975, pp. 178-185.

3. Agnew, C.E.: The Dynamic Control of Congestion-Prone Systems Through Pricing. Standford University Ph.D. Dissertation and Report No. 6 of the Program in Information and Technology and Telecommunications, Stanford University, No. 1973.

4. "Dynamic Modelling and Control of Congestion-Prone Systems." Operation Research, 24, 1976, pp. 400-419.

5. "The Theory of Congestion Tolls." Journal of Regional Science, Vo. 17 (3), 1977, pp. 381-393.

6. Anderson, F.J. and N.C. Bonsor: "Pricing and Valuation of Transport Facilities in the Presence of Congestion." Economica, No. 1974.

7. Baum, H.F.: "Free Public Transport." JTEP, 7(1), Jan. 1973, pp. 3-19.

8. Becker, G.S.: "A Theory of the Allocation of Time." Economic Journal, December 1971, pp. 828-846.

9. Beesley, M.E. and G.J. Roth: "Restraint of Traffic in Congested Areas." The Town Planning Review, 33,1962.

10. Beesley, M.E.: "The Value of Time Spent in Travelling: Some New Evidence." Economica, Vol. 32, 1965, pp. 174-185.

11. Urban Transport: Studies in Economic Policy, London, Butterworth, 1973.

12. Boardman A. and L. Lave: "Highway Congestion and Congestion Tolls." Journal of Urban Economics, 4, 1977, pp. 340-359.

13. Bohley, P.: "Free Transit in Metro Areas", Kyklos, 26(1), 1973, pp. 113-142. (German)

14. Boyd J. Hayden, N.J. Asher and E.S. Wetzler: "Non-Technical Innovation in Urban Transit - A Comparision of some alternatives." Journal of Urban Economics, 5, 1978, 5, 1978, pp. 1-20.

15. Dajani J., M.M. Egan and M.B. McElroy: "The Redistributive Impact of the Atlanta Mass Transit System." Southern Economic Journal, July 1975, 42(1), pp. 49-60.

16. Dewees, D.: "Travel Costs, Transit and Control of Urban Motoring." Public Policy, 24(Winter), 1976.

17. Foster, C.D.: Evidence to the Greater London Development Plan Inquiry on the Regressiveness of Road Pricing. GLDP Inquiry, B654, 1972.

18. Frankena, M.: "Income Distributional Effects of Urban Transit Subsidies." JTEP, 7(3), Sept. 1973, pp. 215-230.

19. "The Demand for Urban Bus Transit in Canada." JTEP, 1978, pp. 280-303.

20. Friedmann, John & Barclay Hudson: "Knowledge and Action: A Guide to Planning Theory." JAIP, Vol. 40, No.1, Jan. 1974, pp. 2-16.

21. Gakenheimer, Ralph & Michael Meyer: "Urban Transportation Planning in Transition: The Sources and Prospects of TSM." APA Journal, Jan. 1979, pp.28-35.

22. Glaister, S.: "Transport Pricing Policies and Efficient Urban Growth." Journal Public Economics, Jan.-Feb. 1976, 5(1-2), pp. 103-117.

23. "Peak Load Pricing and the Channel Tunnel, A Case Study." Journal of Transport Economics and Policy, 10(2), May 1976, pp. 97-112.

24. Goodwin, P.R.: "Generalized Time and the Problem of Equity in Transport Studies." Transportation, Vol. 3, 1974, pp.1-23.

25. "Human Effort and the Value of Travel Time." JTEP, 10(1), Jan. 1976, pp.3-15.

26. Haveman, R.H.: "Common Property, Congestion and Environmental Pollution." Quarterly Journal of Economics, May, 1973.

27. Heads, John: Economic Basis for Transport Subsidy, Canadian Transport Commission, Economic and Social Analysis Branch, Ottawa 1975.

28. Heggie, Ian G. ed.: Modal Choice and the Value of Travel Time, Clarendon Press, Oxford, 1976.

29. Hensher, D.A.: "Review of Studies Leading to Existing Value of Travel Time." Valuation of Travel Time, Transportation Research Board Special Report, Washington, D.C., 1975.

29a. "The Value of Commuter Travel Time Saving: Empirical Estimation Using an Alternative Valuation Model." JTEP, 10(2), May 1976, pp. 167-176.

30. Hirten, John E.: "Needed - A New Perception of Transportation." JAIP, 39, July 1973, pp. 277-282.

31. Hutchinson, B.G.: Principles of Urban Transport Systems Planning, New York: McGraw-Hill Book Co.,1974.

32. Inman, Robert P.: "A Generalized Congestion Fuction For Highway Travel." Journal of Urban Economics, 5, 1978, pp.35-45.

33. Jackson, Raymond: "Optimal Subsidies for Public Transit." JTEP 9(1), Jan. 1975, pp.3-15.

34. Johnson, M.B.: "On the Economics of Road Congestion." Econometrica, 32, 1964, pp.137-150.

35. Kain, J.F.: "How to Improve Urban Transportation at Practically No Cost." Public Policy, 20(3), Summer 1972, pp.335-358.

36. Keeler, T.E. and K.A. Small: "Optimal Peak-Load Pricing, Investment and Service Level on Urban Expressways." Journal of Political Economy, Feb. 1977, 85(1), pp. 1-25.

37. Knight, Frank H.: "Some Fallacies in the Interpretation of Social Cost." Quarterly Journal of Economics, 1924, pp. 582-606.

38. Kraft, G. and M. Wohl: "New Directions for Passenger Demand Analysis and Forcasting." Transportation Research, 1968, pp. 205-30.

39. Kraft, G.: "Free Transit Revisited", Public Policy, 21(1), Winter 1973, pp. 79-105.

40. Lane, R., T.J. Powell & P.P. Smith: Analytical Transport Planning, London: Gerald Duckworth and Co. Ltd., 1971.

41. Lee, Douglas B. Jr.: The Cost of Private Automobile Usage to the City of San Francisco, Berkeley: Institute of Urban and Regional Development, U. of California, 1972.

42. Lerch, G.W.: A Study of the Speed and Volume Relationship on High Speed Highway, Unpublished Master's Dissertation, The Catholic University of America, Washington D.C., 1970.

43. Lee, N. and M.Q. Dalvi: "Variations in the Value of Travel Time." Manchester School of Economic and Social Studies, Sept. 1969, pp. 213-236.

44. Littlechild, S.C.: "Myopic Investment Rules and Toll Charges in a Transport Network." JTEP May 1973, 7(2), pp. 194-204.

45. Lipsey, R.G. & R.K. Lancaster: "The General Theory of Second Best", Review of Economic Studies, No.1, 1956.

46. McFadden, D.: "The Measurement of Urban Travel Demand." Journal of Public Econ., Nov. 1974, 3(4), pp. 303-328.

47. Millard, Robert: Public Expenditure Economics, Mcgraw-Hill: London, 1971.

48. Mishan, E.J.: "Interpretation of the Benefits of Private Transport." Journal of Transport Economics and Policy, May 1967, pp. 184-189.

49. Mohring, Herbert: Transportation Economics, Cambridge, Mass. 1976.

50. Nelson, J.P.: "Accessibility and the Value of Time in Commuting." Southern Economic Journal, Jan.1977, 43(3), pp. 1321-29.

51. Oron, Gitzhak, D. Prices and E. Sheshinski: "Optimum vs. Equilibrium Land Use Pattern and Congestion Toll." Bell Journal, Autumn 1973, 4(2), pp. 619-636.

52. Ortner, James & Martin Wachs: The Cost-Revenue Squeeze in American Public Transit, APA Journal, Jan. 1979, pp. 10-21.

53. Pigou, A.C.: Wealth and Welfare, 1st Edition, 1920.

54. Porter, Richard C.: "The Economics of Congestion: A Geometric Review." Public Finance Quarterly, Vol. 6, No. 1, Jan. 1978, pp. 23-52.

55. Quarmby, D.A.: "Choice of Travel Mode for the Journey to Work," JTEP, 1967.

56. Renshaw, E.F.: "A Note on Mass Transit Subsidies." National Tax Journal, Dec. 1973, 26(4), pp.638-644.

57. Richardson, H.W.: "A Note on the Distributional Effects of Road Pricing." JTEP, Jan. 1974, 8(1), pp. 82-85.

58. Robinson, Ira M., ed.,: Decision-Making in Urban Planning. Beverly Hills, California Sage Publication, 1972.

59. Roth, G.J.: "An Economic Approach to Traffic Congestion." Town Planning Review, 1965, 36, pp. 49-61.

60. RTAC Project Committee on Urban Transporation Planning: Urban Transportation Planning Guide, Toronto,77.

61. Rothenberg, J.: "The Economics of Congestion and Pollution: An Intergrated View." American Economic Review, May 1970.

62. Sale James, E, & Bryan Green : "Operating Costs & Performance of American Public Transit System." APA Journal, Jan, 1979.

63. Schemenner, R.W.: "The Demand for Urban Bus Transit" JTEP, Jan. 1976.

64. Seneca, R.: "Inherent Advantage, Costs and Resource Allocation in the Transport Industry." American Economic Review, Dec. 1973.

65. Sharp, C.: "Congestion and Welfare Reconsidered." JTEP, Jan. 1968, pp. 119-125.

66. "Congestion Charges and Welfare - An Examination of the Case for a Congestion Tax." Economic Journal, 1966, 76, pp. 806-817.

67. Sherman, R.: "Congestion Interdependence and Urban Transit Fares." Econometrica, May 1971, 39(3), pp. 565-576.

68. Sherman, R.: "Subsidies to Relieve Urban Traffic Congestion." JTEP, Jan. 1972, 6(1), pp. 22-31.

69. Smeed, R.J.: "Traffic Studies and Urban Congestion." JTEP, May 1968, pp. 30-70.

70. Snell, Bradford C.: American Ground Transport, Washington D.C.: Subcommittee on Antitrust and Monopoly, Committee on the Judiciary, United States Senate, 1974.

71. Stano, M.: "Consumption Externalities in Models of Urban Transportation." Public Finance Quarterly, Apr. 1977. 5(2) pp. 231-246.

72. Thomson, J.M.: "An Evaluation of Two Proposals for traffic Restraint in Central London." Journal of Royal Statistical Society, Vol. 130, No. 3, 1967, pp. 327-377.

73. Modern Transport Economics, Penguin Education, 1974.

74. Train, Kenneth: "Optimal Transit Price." JTEP, May 1977, 11(2), pp. 185-194.

75. Turvey, R. and H. Mohring: "Optimal Bus Fares." JTEP, Sept. 1975. 9(3), pp. 280-286.

76. Vickery, W.: "Optimization of Traffic and Facilities." JTEP, May 1967, pp. 123-136.

77. "Congestion and Welfare." JTEP, Jan. 1968, pp. 107-118.

78. "Breaking the Traffic Bottleneck Sophisticated Pricing of Roadway use."

79. Walters, A.A.: "The Theory and Measurement of Private and Social Costs of Highway Congestion." Econometrica, 29, 1961, pp. 676-699.

80. The Economics of Road User Charges, IBRD, World Bank Staff Occassional Paper No. 5, John Hopkins Press, Baltimore, 1968.

81. Watson, P.L. and E.P. Holland: "Congestion Pricing - The Example of Singapore." Finance Development, Mar. 1976, 13(1), pp. 20-23.

82. Watson, P.L.: <u>The Value of Time; Behavioral Models of Modal Choice</u>, Lexington Books, 1974.

83. Williamson, O.E.: "Peak Load Pricing and Optimal Capacity under Indivisibility Constraints," <u>American Economic Review</u>, 56, 1966, pp. 810-827.

84. Winnipeg, the City of, Streets and Transportation Dvision, <u>Travel and Demographic Trends</u> 1962-1976, 1978.

85. <u>Public Transit Study: Progress Report, 5 Year Program</u>, Jan. 1974.

86. <u>Public Transit Study</u>: Appendix A, Background Materials, Jan. 1974.

87. <u>Winnipeg Area Transportation Study</u>,

88. Winnipeg Tri-Level Committee on Urban Affairs: <u>Transportation System Measurement Characteristics</u>, Prepared by IBI Group, October 1978.