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ISLAND COUNTY PUBLIC TRANSPORTATION BENEFIT AREA
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and Official Public Hearings
August 13, 1999

Presentation by:
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Belfair, WA

“TRANSIT RIDERSHIP EFFICIENCY
AS A FUNCTION OF FARES”

MR. MOORE’S QUALIFICATIONS

• Mr. Moore spent approximately 35 years with Boeing as a Systems Engineer and Systems Analyst where he compiled mathematical modeling of different systems.

• In 1988 he was appointed by Booth Gardner to the Expert Review Panel for the Central Puget Sound High Capacity Transit (now Sound Transit).

• At the same time he was appointed again by Governor Gardner to the High Speed Rail Commission, a commission that studied the high speed rail that connects Vancouver, BC, with Portland, OR. The result of that commission can now be seen in the trains that are operated by Amtrak and owned by the State of Washington.

• While on the expert panel, Mr. Moore retired from Boeing and moved to Mason County, where he was appointed by County Commissioners as a member of the Mason County Citizens’ Advisory Committee.

• Mr. Moore was also appointed by Governor Gardner to sit on the expert panel on the Washington Environmental Council with regard to transit planning.

• Mr. Moore’s study was presented at the annual meeting of the Transportation Research Board (TRB) in Washington D.C. this year. The National Transportation Research Board is a part of the National Research Council, which is part of the National Academy of Science. Their charge by Congress is to promote research in the area of transportation, which is of national interest. The paper was submitted, went through peer review and was accepted.
HIGHLIGHTS OF PRESENTATION

• Washington State has a great law which implements transit and implements funding - the State does not set up any requirement on fare box return for the local transit systems, which allows Washington State to have pre-paid, fare free transit.

• Marketplace demand is a strong negative function of price - the price goes down, demand goes up; the price goes up, demand goes down.

• The different transits in Mr. Moore’s study were tied together by using the concept of ridership efficiency, which is the ridership of a transit system for a given year divided by the ratio of urban population to median income.

• When ridership efficiency is calculated, Island County and the three other fare free systems in the state rank in the top four, way above all the others; for its population, transit investment and wealth, it is one of the most affluent in the state of Washington.

• Island Transit is very clearly doing something right in terms of utilizing public funds - spending public funds in a very intelligent way.

• If a system demands that patrons do something in order to ride transit (such as charge a fare) then people will stay away, because people are not able to meet confrontation - having the correct fare, knowing whether they pay when they get on or get off, whether or not they have to speak English, etc. Bus drivers do not always have the time to properly greet patrons and answer questions because they are most concerned with looking in the rearview mirror and maintaining schedules.

• Systems are fairly insensitive to fares out to around .25 cents. But when we get around .30 cents and up, this is where the major decisions are being made about whether a person will ride transit or not. We begin to loose ridership down to around .40 cents.

• From .41 cents on is where you have your captive audience - people who have no choice but to ride transit because they don’t have the financial resources to own a car, or cannot drive for health or age reasons. Mr. Moore expressed his opinion that this does not speak well about our society because we have public institutional systems that are milking people who have the least ability to resist it.

• The impact of this study is what the effects of charging fares are. Operating costs are proportional to the revenue service miles and proportional to the ridership.

• Island Transit imposes a very low tax burden on our population.

• Fare charging transits have cost elements that fare free transits do not: the costs associated with collection of the fare (such as, but not limited to: a fare box for each bus, at an average of $4,500 each; fare box maintenance; state law requires 2 people count monies every night - more salary and benefit costs; a special account is needed for fare box revenue, etc.).
• Safety of riders and operators becomes an issue.

• If collecting a fare, Island Transit would not be able to maintain it’s current schedules in synch with the ferry system.

• In 1994, Island Transit had 543,000 rides. Had fares been charged, ridership would have dropped to 15,800 rides.

• The return income Island Transit would receive from the fare box (working with .30 cents per ride, which would be the most efficient) would only be 6%.

• A minimum of 15% is needed just to break even for collecting the fare.

• The conclusion is that Island Transit would loose money if fares were charged.

• There is no way a small system such as Island Transit could make money from the fare box.

• In state audits of some other transit systems across the state, their fare collection was not even equal to the amount of money spent on charging the fares.

• Island Transit is in a position where it is operating in the most efficient and effective way it can.

• Counties with transit had an approximately 16% higher growth rate than those without transit.

• Transit provides access to jobs; reduces unemployment; workers get better jobs; people have flexibility; access to healthcare and shopping; riders get and stay more independent; riders can shop where costs are lower; riders save on their travel costs when using transit; local businesses increase their level of activity; more money is spent locally, and visitors and businesses are attracted to the community; communities benefit from the best use of their unique environment (raises community awareness).

• On an average, the benefit to the community is up to three times the cost of operating transit. When you have fare free, you have increased ridership, and the benefits are increased proportionately.
Transit Ridership Efficiency as a Function of Fares

For

Public Transportation Systems in Washington State for 1994

By

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ABSTRACT

The purpose of this study is to assist in the development of transit fares policies which exploit the benefits of public transit in the mix of transportation options for Washington State. The study relates fares to Ridership Performance and Farebox Recovery parameters.

The Ridership Efficiency of each transit system is estimated by multiplying the ridership (unlinked trips) by the median income, and dividing by the urban population of the service area and the service investment (peak seats) of the system. A mathematical model is developed which relates fares to Ridership Efficiency. The Ridership Efficiency function follows a Weibull distribution with the tail being reached at $0.41. Higher fares have little impact on Ridership Efficiency. An operating cost model is developed from the transit data in which the independent variables are ridership and revenue distance traveled. This model is used to estimate the farebox recovery and operating cost subsidy.

Ridership and Farebox Recovery estimates are made for selected transits. Farebox Recovery reaches a maximum at $0.30, then decreases to a minimum at $0.50. With Urban systems, fares above $0.30 appear to result in a nearly constant subsidy requirement.

The conclusion of the study suggests that a significant percentage of urban trips can be captured by transit if appropriate fares policies are established. A reduced fare experiment is recommended for a congested service area or traffic corridor to determine the effect on traffic counts and ridership to form the basis of traffic management policies by government agencies.

Key Words: Transit, Ridership, Fares, Regression, Cost

BACKGROUND

The thrust of most investigations is to improve the farebox contribution to meeting operating costs rather than finding a balance between fares and overall community benefits. Reference (1) discusses various fare options but only addresses ridership impacts in an anecdotal manner. It mentions that “Ridership increases of 20 – 40% have been seen with free fares … however, that such a policy does not by itself generate long-term increases in ridership, but loses considerable revenue as well.” On the other hand, K. Grace King, et al. in, “Long-term Impact of Fare Free Policy on Bus Ridership: A Case Study of WRTD Bus Service,” University of Connecticut Departments of Civil and Environmental Engineering and Statistics, Storrs, Connecticut, describe the long term impact of fare-free policy on bus ridership for a mid-sized Connecticut bus service as providing a sustained ridership increase.

Generally, investigators in (2) and (3) have identified values of fare elasticity varying from -0.17 to -0.4. These studies mostly have been longitudinal. That is, they have examined single transit systems with relatively small fare changes over limited durations. This has the advantage of studying a system with consistent marketing methods in a defined community. However, these studies have the disadvantage of examining a narrow range of fares and might miss regions of high volatility where blocks of rider population choose or reject transit over time on the basis of fares.

SOURCE DATA

The source data for this study are given in TABLE I.
RIDERSHIP EFFICIENCY and EFFECTIVE FARES

If the different transit systems in Washington State are to provide a common model of ridership demand, a method is required for relating them which accounts for community characteristics and transit investment. A parameter of performance called Ridership Efficiency provides this relationship which is given in Equation 1.

\[
R_n = \frac{R M_I}{(P_u S A_0)}
\]  

Equation 1

Where:

- \(R_n\) = the Ridership Efficiency,
- \(R\) = ridership (unlinked trips),
- \(M_I\) = community income measure (median income),
- \(P_u\) = urban population in the service area,
- \(S\) = service infrastructure (peak service seats),
- \(A_0\) = constant of proportionality,

\(P_u\), the urban population in the service area, along with the reciprocal of median income, \(M_I\), is the potential driver of ridership. The more people in an area, the greater demand on all modes of transportation, including transit. The urban population of the service area is the population of those jurisdictions and Census Designated Places (CDP) within the service area with densities
greater than one thousand persons per square mile. Ridership is generated in areas which have a high number of trip origins and destinations. The inverse of median income, \( M \), is part of the potential driver of Ridership because lower income people are less likely to afford a choice in transportation mode.

\( S \), the service infrastructure, is the capacity of the system to meet the ridership demand of the population \( (P_u) \). The studies, referenced above, generally use revenue service miles for the measure of service infrastructure. For all the Washington agencies, peak seating capacity has a slightly higher correlation to ridership than revenue service miles.

The constant of proportionality \( (A_0) \) and the fare functions are determined as a part of the data analysis, described below.

The complicated fare pricing policies with zone pricing, congestion pricing, transfers, etc., have been simplified by using the farebox revenue divided by the ridership. This is called Effective Fares.

Table II shows the input data, and the calculation of Effective Fares and Ridership Efficiency from the basic input data. The table column headings show the calculation steps. Here, the constant of proportionality, \( A_0 \), is selected so that the ridership efficiency has an average value of one where the Effective Fares are zero.

Gerrit Moore

<table>
<thead>
<tr>
<th>Agency</th>
<th>Ref. 3</th>
<th>Farebox Income</th>
<th>Ridership R</th>
<th>Effective Fares FBR</th>
<th>Urban Population Pu</th>
<th>Peak Seats</th>
<th>Median Income</th>
<th>R * M/P = S</th>
<th>R * M/P = S/A0</th>
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<td>842</td>
<td>$25,692</td>
<td>1274.17</td>
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<td>2,067,000</td>
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<td>730</td>
<td>$34,922</td>
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<td>145</td>
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<td>1,468,601</td>
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<td>50,515</td>
<td>432</td>
<td>$30,754</td>
<td>2069.67</td>
<td>0.5713</td>
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</tbody>
</table>

\[ A_0 \] (Average Zero Fares) = 3622.71
There are five transit systems in TABLE II which were not used in the subsequent regressions. These are agencies which are identified in (4) as having school or college transportation functions or where the fixed route component is not clear. Data points from these agencies do not represent a free market for fixed route service.

The transit agencies listed in TABLE II which charge the highest fares serve the highly urbanized regions. These are regions with the highest congestion and the most limited parking. The transit agencies that charge the lower fares serve communities which do not have high congestion and have the easiest parking. Yet, these are the transit agencies with the highest Ridership Efficiency. Therefore, the examination of such typical cross products as congestion and parking costs is not relevant to this study.

**Ridership Efficiency and Fares Relationship**

The relationship between Effective Fares and Ridership Efficiency is defined by a function which is fitted to these date points by Ordinary Least Squares techniques. Equation 2 is a function which fits a wide range of geometries including linear functions and cumulative probability functions.

\[ R_n = B_1 \exp(B_2 F^{B_3}) + B_4 \]  

**Equation 2**

Where:

- \( B_n \) are constants which are determined in the least squares fitting operation,

- \( \exp(f) \) = the base of the natural logarithm raised to the “f” power,

- \( F \) = effective fare cost,

- \( B_1 + B_4 \) = fraction of rides which take place if fares are charged,

- \( B_4 \) = the minimum fraction of rides which take place if any fares are charged, and

- \( B_2 \) and \( B_3 \) define the geometry of the function.

The Ridership Efficiency relationship to Effective Fares data might be considered in two ways:

- There is a sensitivity to the confrontational act of collecting fares and to the fare price or

- The only sensitivity of ridership efficiency to fares is in the price.

If the regression is made with the consideration that ridership efficiency sensitivity is related to the confrontational aspect of demanding fares as well as the fare price, the confrontational change component is along the zero-fares axis. The fare price sensitivity component is in the region where the fares are greater than zero. Then the regression of Ridership Efficiency as a function of Effective Fares does not include the $0.00 fare subset. The difference between the average of the zero fares \( R_n \) values (in this case, one) and the intersection of the regression with the $0.00 fare axis would be the estimate of the fare demand loss because of the confrontational aspect of demanding fares. TABLE III lists the result of fitting Equation 2 to the data set, excluding the zero fare data set.
If the regression is made with the consideration that ridership efficiency sensitivity is related only to the fare price, the following are the sample standard deviation of regression residuals:

- Over the total data set = 0.1613399,
- Over the non-zero fare data set = 0.1190923.

The standard deviation of regression residuals is slightly less for the non-zero regression than for the regression which smoothed over the total data set. This suggests that the confrontational-price loss model is a better reflection of the input data.

---

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- Over the total data set = 0.1613399,
- Over the non-zero fare data set = 0.1190923.

The standard deviation of regression residuals is slightly less for the non-zero regression than for the regression which smoothed over the total data set. This suggests that the confrontational-price loss model is a better reflection of the input data.

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**TABLE III- Ridership Efficiency Model Smoothed on Non-Zero Fares (Monetary Component of the Confrontational Loss Model)**

<table>
<thead>
<tr>
<th>Agency</th>
<th>Effective Fares Data</th>
<th>Ridership Efficiency Data</th>
<th>Regression Model Estimate</th>
<th>Residuals</th>
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<td>$0.00</td>
<td>1.05648</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skagit</td>
<td>$0.00</td>
<td>1.21692</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Link</td>
<td>$0.00</td>
<td>0.57131</td>
<td></td>
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</tr>
</tbody>
</table>
FIGURE 1 is a plot of the Ridership Efficiency data set and the regression curve.

There appears to be four different regions of fare impact:

- The first region is along the zero fare axis where the ridership efficiency changes with the confrontation of fare demand.

- The second region extends from $0.00 to $0.21 fares. Ridership seems fairly insensitive to fare changes (everyone has two dimes or a quarter).

- The third region extends from $0.21 to $0.41 fares. Here, ridership is very sensitive to the fare levels charged.

- The fourth region, the toe of the curve, extends from $0.41 to $0.95 fares. The slope is nearly zero. People seem willing to pay any fare demanded. Probably, this is because the agencies charging these fares are the larger urban systems where the passenger loads are defined by the diurnal commute patterns. Here, patrons consider the fare costs as a part of the employment investment or they are the patrons who do not have the means to invest in other transportation options.
The third and fourth regions in the fare function are suggested in (3), Appendix A. This quotation is from a paper given by Daniel K. Boyle in 1985 at the 64th Annual Meeting of the Transportation Research Board, Washington, DC:

“A second interesting point concerns the concept of a fare threshold. This concept postulates that, as fares rise beyond a certain threshold level, ridership behavior changes significantly [...] Elasticities are increasingly negative at higher values of the original fare up to the "over 60 cent" category. In this category, ridership response becomes less elastic than the "51 to 60 cent" category. The explanation driving this version would be that by the time a relatively high fare level is reached, most of the "choice" riders have already abandoned transit for another mode, and so further increases have less impact on ridership. While the data in Table 1 does not provide conclusive proof that a fare threshold of this nature actually exists, further research into this concept would be useful.”

In Washington State, the less elastic response region begins at $0.41 rather than $0.60, as discussed above. This difference might be due to the increased competition between modes because of the more automobile centered community design in the Western states.

The regression function follows a Weibull distribution. This would imply that the transportation mode choice should be modeled as a probability function. Equation 2 could be considered a cumulative probability function that transit is chosen by the transit using population if the fare costs are less than a given value.

**Operating Cost Model**

An operating cost model is required to evaluate the fiscal impacts of changes in ridership. The four fare-free transits are not included in this analysis. The cost model used in this analysis is regressed from Ridership \(R\) and Revenue Service Miles \(RSM\). The source data are given in Table I. The operating cost model is given in Equation 3.

\[
Cost = RSM^{C_1+R^{C_4}} + C_5
\]

Equation 3

The concept for this regression model is as follows:

- If \(RSM\) approaches zero, then \(Cost\) approaches a minimum (the only costs being overhead, \(C_5\)),

- If \(R\) approaches zero, then \(Cost\) approaches a function of \(RSM\) (the vehicles would still operate over the designated routes, but with the number of passengers approaching zero),

- Economies of scale might be expected with \(RSM\) and \(R\) so those parameters are allowed to be raised to some exponent (\(C_1\) and \(C_4\), respectively).

The results of the operating cost regression are given in Table IV. In addition, the **Operating Cost per Person** (Operating Cost divided by Served Population, Table 1) and **Subsidy per Person** (the difference between Operating Costs and Farebox Income, divided by Served Population) are given to show the relative cost and tax burden carried by the service area populations. The subsidy in Washington State is achieved through a special sales tax and a portion of the motor vehicle excise tax collected in the transit service area.
Ridership estimates for particular transits are made from the Ridership Efficiency \((R_e)\) function. The base ridership value (in this case, 1994) is divided by Ridership Efficiency \((R_e)\) (Equation 2) for the corresponding Effective Fare. This gives the estimate for zero-fare ridership. The ridership as a function of a fare price is estimated by multiplying the zero-fare ridership by the Ridership Efficiency \((R_e)\) (Equation 2). The following estimates are based on the 1994 ridership performance as the point of departure. They are statements of what might have happened with the particular agencies under different fare policies.

Farebox Recovery is calculated by dividing the product of Effective Fares and the resulting ridership estimates by Operating Cost (Equation 3). \(R\), required in this model, is given by the ridership estimate. The RSM estimate requires a further assumption.
In the ridership estimate, the *urban population* and *median income* are functions of the served community so a change in $R_n$, for a community is a change in the ratio of ridership to seats (see Equation 2 description, above). The number of seats, or vehicles remains constant in this estimate. It is the way they are used that changes. As $R_n$ increases with decreasing fares, more vehicles are used in the non-peak parts of the day until all vehicles (and all seats) are used throughout the service period. $RSM$ increases with the increased utilization of vehicles. This can be estimated from the transit Peak to Base Ratio. Appendix A, *The National Transit Profile*, of (7) gives the value for the peak to base ratio as 1.8. This is used in the following estimate. $RSM$ is assumed to change according to Equation 4.

$$RSM(F) = RSM(d) \times (1 + (P-1) \times (R_n(F) - R_n(d)))$$

Equation 4

Where:

- $RSM(F)$ = Revenue Service Miles at Effective Fare ($F$),
- $RSM(d)$ = Revenue Service Miles input value (TABLE I),
- $P$ = Peak to Base Ratio
- $R_n(F)$ = Ridership Efficiency at Effective Fare ($F$) (Equation 2 with regressed constants),
- $R_n(d)$ = Ridership Efficiency input value (TABLE II).

Since changes in transit performance with changes in Effective Fares ($F$) involve people moving in and out of the transit riding population set, it must be assumed that there is a lag between a change in $F$ and a change in $R$. There is a paucity of data on these phenomena. However, the time constant, with 63% of the change, appears to be around 2.5 years (if an exponential model is assumed). This is not an accurate estimate but it gives some idea of the time involved.

**Examples**

In Washington there are four transits which operate with zero-fares. The oldest of these is Island Transit which serves Whidbey and Camano Islands in Puget Sound. The fare-free transits are the most efficient systems as measured by Ridership Efficiency. The prepaid fares policy promotes an egalitarian operation; everybody is invited. Upon entering the vehicle, the patron has only a welcoming experience. There is no question of having the exact change or speaking English when the fare is to be paid. The service tends to be Spartan. Island Transit has next to the lowest *cost per person* of Washington State transits (TABLE IV). There is a high community involvement in support of the fare-free agencies.

**FIGURE 2** shows the performance estimate for Island Transit.
FIGURE 2 - 1994 Performance Estimates as a Function of Effective Fares for Island Transit

Except for the vertical scales, the Ridership Estimate and Farebox Recovery curves shown in Figure 2 are typical for all transits. The Operating Cost Estimate is not shown but it has the same shape as the Ridership Estimate curve relative to the Effective Fare Cost.

In the Fare region of $0.00 to $0.21, the Farebox Recovery increases in proportion to Effective Fare Cost because, here, R and Cost undergo little change. Between $0.21 and $0.30, R begins its sharp decline as Effective Fare Cost increases. The first maximum in Farebox Recovery occurs at $0.30. It then decreases to a minimum at $0.50. Here, R becomes asymptotic with the Effective Fare Cost axis so there is slight change to both R and Cost with increasing fares. From this point the Farebox Recovery increases as a near linear function of Effective Fare Costs. A transit system operating in this fare’s region could increase farebox recovery by increasing fare prices without a significant decrease in ridership.

References (9) and (10) estimate the cost of fare collection varies from 3 percent to 7 percent of the operating cost. Island Transit could charge fares and have sufficient Farebox Recovery to cover the cost of collection. However, the ridership as a minimum would be reduced to 35 percent of the fare-free ridership.

Figure 3 shows the ridership and farebox recovery estimate for C-TRAN, which serves all of Clark County, including the City of Vancouver. The actual 1994 Farebox Recovery point, 14.6%, is greater than the estimate curve. This is because the 1994 operating cost is less than the Model Estimate value given in TABLE IV. The Costs per Person, and the Subsidy per Person (TABLE IV) are also significantly lower than the other urban transit agencies in Washington State. These three conditions suggest that C-TRAN is under-funded for the population being served and, therefore, cannot deliver the service which would result in the expected normalized ridership of 0.2 rather than the actual 0.11136.

![Figure 3](image)

FIGURE 3 – 1994 Performance Estimate as a Function of Effective Fares for C-TRAN

Portland, across the Columbia River, has no sales tax, which places C-TRAN at a competitive disadvantage for subsidizing effective operations. If it did meet the average transit efficiency for
$0.33 effective fares, the estimated ridership would be approximately 8,500,000, or twice the actual 1994 level. The $0.33 Effective Fare Cost places C-TRAN Farebox Recovery near the first maximum value. A change in fares would require a corresponding change in the subsidy. The ridership range of C-TRAN is not large enough to offset the operating cost changes with the farebox income. However, if the fares were reduced, Figure 3 suggests improvement in ridership. The C-TRAN operating conditions are near optimum, given the financial constraints on this system.

FIGURE 4 gives the Ridership and farebox recovery estimate curves for Spokane Transit, which serves a 372.5 square mile area, including the City of Spokane. This is the second largest urban center in Washington and the transit reflects the characteristics of a larger urban system.

FIGURE 4 – 1994 Performance Estimate as a Function of Effective Fares for Spokane Transit

The 1994 Spokane Transit fare is at the toe of the ridership curve, where ridership becomes inelastic with fares. At this point, most of the ridership potential is lost. Also, the fare is near the minimum for Farebox Recovery. If the Effective Fare cost is decreased from $0.52 to $0.30, R and Farebox Recovery would be expected to increase. Spokane Transit has sufficient ridership to offset the operating cost changes with the farebox income so the change to the $0.30 effective fare eventually would result in a slight reduction in the required tax subsidy. This occurs with Spokane and not with C-TRAN because of the economies of scale reflected in the operating cost model (Eq.3) TABLE V lists fares and the corresponding estimated tax subsidies and riderships. This performance is characteristic (with appropriate changes in scale) of the four largest transit systems in Washington. A $0.52 fare places Spokane Transit performance at the least efficient locus. However, the 1994 Spokane Ridership Efficiency is almost twice the Model Estimate so it would appear there is very effective management of the system.
TABLE V – Spokane Transit Subsidy and Ridership Estimates

<table>
<thead>
<tr>
<th>Fares Estimate</th>
<th>Subsidy Estimate</th>
<th>Ridership Estimate</th>
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<tbody>
<tr>
<td>$0.20</td>
<td>$26,884,856</td>
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<td>$0.30</td>
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<td>$0.40</td>
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<td>$0.52</td>
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<td>7,485,275</td>
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**Conclusion**

This study concludes that *Ridership Efficiency* is primarily a function of the fare charged. *Ridership Efficiency* function can be described as a probability function. This is the probability that people who are potential transit users will choose transit over other modes or not travel given particular fare values. This function has three components:

1) The probability that a trip by transit is chosen if any fares are charged (0.33, if fares are >0.00),

2) The probability that a trip by transit is chosen if the fare is a particular value (0.33 to 0.022, if fares are between $0.00 and $0.65),

3) The probability that a trip by transit is chosen if fares exceed a limiting value (0.022, if fares are $0.65 and greater).

Fare-free transit agencies would experience a sharp decrease in ridership (67%) if any fares are charged. If it becomes agency policy to collect fares, the fare-free ridership should exceed 700,000 unlinked trips for a farebox recovery greater than 3 percent, the minimum estimate for fare collection costs given in (9) and (10). The maximum farebox recovery is achieved with a fare of $0.30.

Transit agencies which collect fares in the $0.20 to $0.40 range are in the steepest part of the *Ridership Efficiency* curve given in Figure 1. Here, small increases in *effective fares* can result in marked decreases in ridership.

Fare-free transit agencies would experience a sharp decrease in ridership (67%) if any fares are charged. If it becomes agency policy to collect fares, the fare-free ridership should exceed 700,000 unlinked trips for a farebox recovery greater than 3 percent, the minimum estimate for fare collection costs given in (9) and (10). The maximum farebox recovery is achieved with a fare of $0.30.

Transit agencies which collect *effective fares* exceeding $0.45 are the urban agencies service communities with heavy traffic and increased air pollution. A change in fares has little impact on ridership if the fare remains in excess of $0.45. If an agency in this group were to adopt a policy to reduce traffic congestion and air pollution through increasing transit mode share, the most direct way is to reduce fares. The *Effective Fares* would have to be reduced below $0.45 to have even a beginning effect on ridership. The *effective fares* for these transits could be reduced to $0.30 (the maximum *Farebox Recovery* point) without a significant increase in tax subsidy support.

Regressions are tools for data summary and not prediction unless there is some knowledge of the similitude of each member of the data set. The assumption here is that the people in Washington have a common ethos about using transit. Before any heavy investment is made in radical fare change that assumption should be tested in a limited experiment. It might be implemented in a total service area of a medium size system, or in a definable service area sub-region or in a congested traffic corridor for a large transit system where the problems are most
egregious. Careful counts of ridership and traffic volumes would be made both before and during the experiment. The effective fares would be reduced in annual steps until the desired traffic and air quality goals are realized. For example, the fare might be reduced to $0.40 for a year and then the results evaluated. About a third of the total expected increase in ridership should be realized in that period. Then, the fares might be held at that level or reduced another step, depending on the outcome. The results of the experiment could be applied to the regional systems with some confidence in the outcomes.

Any large scale capture of ridership from other modes can be done only through economic competition that is consistent with the public’s perception of the transportation market. This study presents a measure of that perception with the variation of ridership efficiency over the regime of effective fares in Washington State for 1994.

References


6) *1994 Data Tables, National Transit Database, FTA.*

7) *Transit Profiles for the 1994 National Transit Database, FTA.*

