Portland State University

PDXScholar

2-2002

Analysis of Transit Fare Evasion in the Rose Quarter

Shimon Isreal
Portland State University

James G. Strathman
Portland State University

Analysis of Transit Fare Evasion in the Rose Quarter

Shimon A. Israel
James G. Strathman

February 2002

Background

Tri-Met collected fare evasion data for buses and MAX trains passing outbound through the Rose Quarter Monday, June 11 through Saturday, July 7. Beginning September 2001, Tri-Met's "Fareless Square's" free zone was extended towards the Lloyd District, with an eastern boundary of NE 14th. Prior to this, all trips between the Central Business District and Lloyd Center required a full Zone 1 fare. The June fare evasion study selected the Rose Quarter as a survey point of special consideration for two reasons:

1) The Rose Quarter is a large hub through which MAX and many bus routes run. It is a significant transfer point and carries a large volume of passengers. Additionally, it is both an origin and destination with heavy transit ridership because of its housing and commercial density. Given the large number of short trips taken in this corridor, there is not a comparable origin-destination pair anywhere else in the system.

Figure 1: Rose Quarter

2) The extension of the Fareless Square into the Lloyd District. This study provides some idea of the likely effect of fare evasion on revenue, recognizing that what may have been a significant problem is now mitigated through the extension of Fareless Square. The fare evasion problem, however, will require further study, as now the new free zone provides an additional incentive for people to possibly evade further on the system, such as on to the Hollywood stop or north on the Interstate MAX, once construction on that line is complete.

Given past Tri-Met experiences, and for the reasons described above, we would expect a greater rate of fare evasion in the Rose Quarter. This is particularly the case on MAX, because it operates as a self-service fare collection (SSFC) facility, and fare payment does not have ongoing verification by train operators.

Methodology

Surveyors accompanied fare inspectors as they boarded outbound buses and MAX trains at the Rose Quarter station and checked passengers' fares. Surveyors recorded the number of passengers and those who had the correct fare, noting the number of passengers who had no proof of payment or an incorrect fare. Surveyors did not interact with passengers; rather they simply acted as recorders for the fare inspectors.

Five categories of evasion were recorded:

- *No Proof of Payment* – Passenger has no proof of payment. This category includes PASSport passes being used by someone other than the person whose picture appears on the PASSport ID pass, and forged fare instruments.
- *Unvalidated Ticket* – Passengers with a ticket that has not been validated. This category also includes a Day ticket or Adventure Pass for which the days have not been selected.
- *Zone Violation* –Passengers riding with a Zone 2-3 pass at Rose Quarter (which is in Zone 1) and no upgrade.
- *Expired Time* – Passengers presenting a transfer or ticket with the incorrect date or with an expired time. Also included are passengers with monthly passes for a month

2

other June or July (the months of the study), and Day tickets or Adventure Passes selected for the wrong day.

- **>18 on Youth Fare/No Youth ID** – Inspectors do not usually require ID for youths clearly 18 or less. If the inspector suspects that a person riding on a youth fare is older than 18, proof of age with some sort of ID can be requested. Persons older than 18 using a youth fare, or with no Youth ID when requested, are in violation.

- **No Honored Citizen's ID and Less than 65** – Senior citizens and persons with disabilities are allowed to ride on an Honored Citizen fare. Fare inspectors do not generally require ID for passengers who are clearly senior citizens or who are clearly disabled. When the inspector suspects that the person is under 65 years of age and is not obviously disabled, he will request appropriate ID. Persons who do not have this ID are in violation.

If the type of fare evasion was unknown, it was noted as No Proof of Payment. Passengers who fare inspectors were not able to check were considered "missed passengers" and their numbers were tallied.

Results

Individuals noted as "missed passengers" were excluded from analysis; it was unknown whether they paid their full fare or what type of evasion they may have committed. As with the April 1997 fare evasion study for Portland Trailblazer Games, the fare evasion rate, by type, is calculated as:

Fare Evasion Rate = <u>Number of Surveyed Riders Who Evaded, by Type</u>
Total Number of Riders Surveyed

The basic sampling unit is a scheduled trip intercepted at the Rose Quarter stop. The total number of trips sampled was 1331, of which 1261 were MAX trips, 68 were bus trips, and 2 that could not be used because of incomplete information. This study differs from the 1990 KPMG Peat Marwick study and 1997 Trailblazer study in that they used the passenger as the sampling unit. Because riders on the same bus or train share common characteristics, the statistical assumption of independence is violated under the passenger-counting regime; using the scheduled trip as the sampling unit achieves more conservative confidence intervals for fare evasion rates.

A breakdown of the fare evasion rates is presented in Tables 1 and 2. Rates associated with correct fare payment and each of the 6 evasion categories are distinguished by time period, mode and day of service. The tables also report the number of passengers and trips sampled by mode, time period and day of service. Some time periods had either no scheduled trips or no samples taken. These are denoted as "N/A."

Higher rates of evasion occur on MAX during early morning, late evening and weekend hours, with the highest rates of fare evasion occurring between 9:30 p.m. and 2:00 a.m. on Sundays (35.3%). As might be expected, the lowest rate of fare evasion occurred on weekdays between 6:00 a.m. 9:30 a.m. (10.6%), the time when the passenger load is comprised more of regular commuters. Because of fewer samples, the bus data are inconclusive with respect to time-related evasion patterns.

Table 1: Ratio of Fare Evasion Type to Total - MAX

Weekdays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid	Total	Number of Scheduled Trips Sampled	Number of Passengers Sampled
5:00 - 5:59 am	0.8518	0.1213	0.0108	0.0081	0.0000	0.0054	0.0027	1.00	31	371
6:00 - 8:59 am	0.8940	0.0713	0.0054	0.0140	0.0032	0.0027	0.0095	1.00	187	2217
9:00 - 2:59 pm	0.8530	0.0857	0.0194	0.0102	0.0109	0.0107	0.0102	1.00	275	5318
3:00 - 5:59 pm	0.8874	0.0763	0.0131	0.0069	0.0056	0.0065	0.0042	1.00	280	6422
6:00 - 9:29 pm	0.8210	0.1273	0.0196	0.0089	0.0089	0.0106	0.0036	1.00	171	3017
9:30 - 2:00 am	0.7338	0.1997	0.0278	0.0084	0.0211	0.0051	0.0042	1.00	73	1187
Totals	**0.8570**	**0.0955**	**0.0159**	**0.0091**	**0.0083**	**0.0078**	**0.0064**	**1.00**	**1017**	**18532**
Saturdays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid			
5:00 - 5:59 am	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
6:00 - 8:59 am	0.7783	0.1222	0.0362	0.0181	0.0000	0.0181	0.0271	1.00	22	221
9:00 - 2:59 pm	0.8753	0.0959	0.0168	0.0024	0.0048	0.0048	0.0000	1.00	22	417
3:00 - 5:59 pm	0.8261	0.1454	0.0150	0.0060	0.0075	0.0000	0.0000	1.00	29	667
6:00 - 9:29 pm	0.8637	0.0733	0.0153	0.0102	0.0170	0.0153	0.0051	1.00	31	587
9:30 - 2:00 am	0.7907	0.1518	0.0160	0.0064	0.0064	0.0256	0.0032	1.00	34	626
Totals	**0.8300**	**0.1199**	**0.0175**	**0.0075**	**0.0083**	**0.0123**	**0.0044**	**1.00**	**138**	**2518**
Sundays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid			
5:00 - 5:59 am	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
6:00 - 8:59 am	0.7037	0.2222	0.0370	0.0000	0.0000	0.0000	0.0370	1.00	2	27
9:00 - 2:59 pm	0.7714	0.1727	0.0411	0.0033	0.0066	0.0016	0.0033	1.00	30	608
3:00 - 5:59 pm	0.7778	0.1613	0.0609	0.0000	0.0000	0.0000	0.0000	1.00	18	279
6:00 - 9:29 pm	0.8257	0.0990	0.0257	0.0158	0.0099	0.0218	0.0020	1.00	30	505
9:30 - 2:00 am	0.6474	0.2675	0.0274	0.0304	0.0000	0.0152	0.0122	1.00	26	329
Totals	**0.7637**	**0.1682**	**0.0372**	**0.0114**	**0.0051**	**0.0097**	**0.0046**	**1.00**	**106**	**1748**
All days	**0.8468**	**0.1038**	**0.0177**	**0.0091**	**0.0080**	**0.0085**	**0.0061**	**1.00**	**1261**	**22798**

Table 2: Ratio of Fare Evasion Type to Total - Bus

Weekdays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid	Total	Number of Scheduled Trips Sampled	Number of Passengers Sampled
5:00 - 5:59 am	0.8333	0.1667	0.0000	0.0000	0.0000	0.0000	0.0000	1.00	1	6
6:00 - 8:59 am	0.9256	0.0000	0.0000	0.0496	0.0000	0.0083	0.0165	1.00	19	121
9:00 - 2:59 pm	0.8741	0.0468	0.0108	0.0108	0.0072	0.0072	0.0432	1.00	23	278
3:00 - 5:59 pm	0.9328	0.0373	0.0000	0.0000	0.0075	0.0149	0.0075	1.00	7	134
6:00 - 9:29 pm	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.00	4	76
9:30 - 2:00 am	0.9722	0.0000	0.0000	0.0000	0.0000	0.0000	0.0278	1.00	4	36
Totals	**0.9155**	**0.0292**	**0.0046**	**0.0138**	**0.0046**	**0.0077**	**0.0246**	**1.00**	**58**	**651**
Saturdays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid			
5:00 - 5:59 am	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
6:00 - 8:59 am	0.7778	0.1111	0.0000	0.1111	0.0000	0.0000	0.0000	1.00	1	9
9:00 - 2:59 pm	0.8571	0.0000	0.0000	0.0000	0.0000	0.0714	0.0714	1.00	2	14
3:00 - 5:59 pm	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.00	1	7
6:00 - 9:29 pm	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
9:30 - 2:00 am	0.9394	0.0303	0.0000	0.0000	0.0000	0.0303	0.0000	1.00	1	33
Totals	**0.9048**	**0.0317**	**0.0000**	**0.0159**	**0.0000**	**0.0317**	**0.0159**	**1.00**	**5**	**63**
Sundays Time	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid			
5:00 - 5:59 am	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
6:00 - 8:59 am	0.8125	0.0625	0.0000	0.0625	0.0000	0.0000	0.0625	1.00	1	16
9:00 - 2:59 pm	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.00	1	31
3:00 - 5:59 pm	0.9545	0.0227	0.0000	0.0227	0.0000	0.0000	0.0000	1.00	3	44
6:00 - 9:29 pm	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
9:30 - 2:00 am	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0	0
Totals	**0.9451**	**0.0220**	**0.0000**	**0.0220**	**0.0000**	**0.0000**	**0.0110**	**1.00**	**5**	**91**
All days	**0.9180**	**0.0286**	**0.0037**	**0.0149**	**0.0037**	**0.0087**	**0.0224**	**1.00**	**68**	**805**

MAX fare evasion rates observed at the Rose Quarter (15.3% overall) are considerably higher than the system-wide fare evasion rates of 5-6% recorded during the self-service fare collection (SSFC) program implemented by Tri-Met between 1982 to 1984 and the 4.81% fare evasion rate reported in the 1990 Peat and Marwick Study, though lower than the 28.3% fare evasion rates experienced during Portland Trailblazer games. System-wide fare evasion rates at this time are unknown, but suspected to be lower than those found in the Rose Quarter. The literature reports that some SSFC programs report considerably lower fare evasion rates; the light rail in Edmonton, Alberta, for example, reported a 1% fare evasion rate in its opening year. [1,2,3]

The 95% confidence intervals (CI) for the fare evasion rates were calculated using the following equation:

$$CI = P_i +/- t_{.025} * \sqrt{P_i * (1 - P_i)/n}$$

where:

P_i = the observed proportion of the correct fare or one of the fare evasion categories.

n = the number of trip observations.

$t_{.025}$ = the critical t value for the given number of observations.

For purposes of comparison, confidence intervals were calculated for weeklong evasion rates, and by weekday, Saturday, and Sunday for MAX (Tables 3 and 4). Because of the smaller sample size, confidence intervals for bus were calculated from weeklong aggregate information, and applied only to the "correct fare" rate (Table 5).

Table 3: 95% Confidence Intervals for Fare Evasion on Rose Quarter Outbound MAX Trains – All Days

	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid	Total
Rate	0.8468	0.1038	0.0177	0.0091	0.0080	0.0085	0.0061	**1.00**
Number of MAX Trains Inspected	1261	1261	1261	1261	1261	1261	1261	
t*(SE)	0.0201	0.0170	0.0074	0.0053	0.0050	0.0051	0.0043	
CI Lower Bound	0.8267	0.0868	0.0104	0.0038	0.0031	0.0034	0.0017	
CI Upper Bound	0.8669	0.1208	0.0251	0.0144	0.0130	0.0136	0.0104	

Table 4: 95% Confidence Intervals for Fare Evasion Rose Quarter Outbound MAX Trains – By Day Type

Weekday	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid	Total
Rate	0.8570	0.0955	0.0159	0.0091	0.0083	0.0078	0.0064	**1.00**
Number of MAX Trains Inspected	1017	1017	1017	1017	1017	1017	1017	
t*(SE)	0.0217	0.0182	0.0078	0.0059	0.0056	0.0055	0.0050	
CI Lower Bound	0.8352	0.0773	0.0081	0.0032	0.0026	0.0024	0.0015	
CI Upper Bound	0.8787	0.1138	0.0237	0.0150	0.0139	0.0133	0.0114	
Saturday								
Rate	0.8300	0.1199	0.0175	0.0075	0.0083	0.0123	0.0044	**1.00**
Number of MAX Trains Inspected	138	138	138	138	138	138	138	
t*(SE)	0.0633	0.0548	0.0221	0.0146	0.0153	0.0186	0.0111	
CI Lower Bound	0.7667	0.0652	0.0000	0.0000	0.0000	0.0000	0.0000	
CI Upper Bound	0.8933	0.1747	0.0396	0.0221	0.0237	0.0309	0.0155	
Sunday								
Rate	0.7637	0.1682	0.0372	0.0114	0.0051	0.0097	0.0046	**1.00**
Number of MAX Trains Inspected	106	106	106	106	106	106	106	
t*(SE)	0.0817	0.0719	0.0364	0.0205	0.0138	0.0189	0.0130	
CI Lower Bound	0.6820	0.0963	0.0008	0.0000	0.0000	0.0000	0.0000	
CI Upper Bound	0.8454	0.2401	0.0736	0.0319	0.0189	0.0286	0.0176	

Table 5: 95% Confidence Intervals for Correct Fare Paid on Rose Quarter Outbound Buses – All Days

	corfare	noproof	unvalti	zonevio	exptime	over18	nohcid	Total
Rate	0.9180	0.0286	0.0037	0.0149	0.0037	0.0087	0.0224	**1.00**
Number of Scheduled Trips	68							
t*(SE)	0.0655							
CI Lower Bound	0.8515							
CI Upper Bound	0.9846							

As explained above, scheduled trips were used as the sampling unit. Using the passenger as the sampling unit would narrow the confidence intervals but introduce sampling bias associated with characteristics shared by passengers within scheduled runs. For example, using the passenger as the sampling unit, the correct fare confidence intervals calculated for all days would be narrowed for buses to 0.8989-0.9372, and 0.8421-0.8516 for MAX.

Estimated Revenue Loss

The amount of revenue loss associated with fare evasion differs by fare evasion type. The projected revenue loss rates were provided by Tri-Met's financial planning department and are listed in Table 6.

Table 6: Average Lost Fare per Evasion Category	
No Proof of Payment	$1.21
Unvalidated Ticket	$1.12
Zone Violation	$0.30
Expired Time	$1.21
>18 on Youth Fare	$0.43
No HC ID on HC Fare	$0.70

Passenger data used to calculate estimated revenue loss for MAX and bus service were provided by Tri- Met, and are reported in Tables 7 and 8.

Table 7: Outbound Rose Quarter MAX Mean Passenger Counts

Time	Weekdays # Trains	Weekdays Avg Load	Weekdays Average # Passengers	Saturdays # Trains	Saturdays Avg Load	Saturdays Average # Passengers	Sundays # Trains	Sundays Avg Load	Sundays Average # Passengers	Weekly Total
5:00 - 5:59 am	3	30	90	2	48	96				
6:00 - 8:59 am	24	48	1152	15	36	540	6	30	180	
9:00 - 2:59 pm	36	76	2736	36	87	3132	24	68	1632	
3:00 - 5:59 pm	25	190	4750	18	119	2142	12	110	1320	
6:00 - 9:29 pm	17	92	1564	17	58	986	14	72	1008	
9:30 - 2:00 am	10	52	520	10	87	870	11	33	363	
Total:			10812			7766			4503	66329

* Average loads per train (not car).

Table 8: Outbound Rose Quarter Bus Mean Passenger Counts

Time	Weekdays # Buses	Weekdays Avg Load	Weekdays Average # Passengers	Saturdays # Buses	Saturdays Avg Load	Saturdays Average # Passengers	Sundays # Buses	Sundays Avg Load	Sundays Average # Passengers	Weekly Total
5:00 - 5:59 am	12	8	96	1	16	16				
6:00 - 8:59 am	93	12	1116	32	11	352	18	10	180	
9:00 - 2:59 pm	158	20	3160	126	16	2016	93	14	1302	
3:00 - 5:59 pm	118	28	3304	63	21	1323	48	20	960	
6:00 - 9:29 pm	86	19	1634	56	19	1064	39	19	741	
9:30 - 2:00 am	41	15	615	38	17	646	26	12	312	
Total:			9925			5417			3495	58537

The estimated revenue loss associated with fare evasion was calculated using the following formula:

ridership evasion rate by type * average originating fare * weightings on different kinds of evasion*

Estimated Rose Quarter fare revenue loss associated with evasion, organized by time of day and day of the week, is given in Tables 9 and 10, for MAX and bus, respectively.

Table 9: Estimated Revenue Loss for MAX

Time	Weekdays						Saturdays						Sundays					
	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID
5:00 - 5:59 am	$13.21	$1.09	$0.22	$0.00	$0.21	$0.17	N/A						$48.40	$7.47	$0.00	$0.00	$0.00	$4.67
6:00 - 8:59 am	99.34	6.98	4.83	4.40	1.34	7.64	$79.83	$21.89	$2.93	$0.00	$4.20	$10.26	341.03	75.16	1.61	12.99	1.15	3.76
9:00 - 2:59 pm	283.87	59.35	8.33	36.11	12.61	19.45	363.52	58.88	2.25	18.18	6.46	0.00	257.61	90.08	0.00	0.00	0.00	0.00
3:00 - 5:59 pm	438.54	69.59	9.76	32.22	13.36	13.98	376.92	35.97	3.85	19.43	0.00	0.00						
6:00 - 9:29 pm	240.87	34.26	4.20	16.94	7.13	3.99	87.40	16.93	3.02	20.32	6.50	3.53	120.76	29.06	4.79	12.08	9.44	1.40
9:30 - 2:00 am	125.63	16.19	1.31	13.25	1.13	1.53	159.75	15.57	1.67	6.73	9.56	1.95	117.48	11.12	3.31	0.00	2.37	3.09
Total:	$1,201.45	$187.45	$28.66	$102.91	$35.78	$46.76	$1,067.42	$149.24	$13.73	$64.66	$26.72	$15.74	$885.29	$212.89	$9.71	$25.07	$12.97	$12.91

MAX Weekly Total $10,511.44

Table 10: Estimated Revenue Loss for Bus

Time	Weekdays						Saturdays						Sundays					
	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID	No Proof	Unvalidated Ticket	Zone Violation	Expired Time	Over 18 on a Youth Pass	No Honored Citizens' ID
5:00 - 5:59 am	$19.36	$0.00	$0.00	$0.00	$0.00	$0.00	N/A						N/A	$0.00	$3.38	$0.00	$0.00	$7.88
6:00 - 8:59 am	0.00	0.00	16.60	0.00	3.97	12.91	$47.32	$0.00	$11.73	$0.00	$0.00	$0.00	$13.61	0.00	3.38	0.00	0.00	7.88
9:00 - 2:59 pm	178.80	38.19	10.23	27.51	9.78	95.48	0.00	0.00	0.00	0.00	61.92	100.80	0.00	0.00	0.00	0.00	0.00	0.00
3:00 - 5:59 pm	149.17	0.00	0.00	29.83	21.20	17.26	0.00	0.00	0.00	0.00	0.00	0.00	26.40	0.00	6.55	0.00	0.00	0.00
6:00 - 9:29 pm	0.00	0.00	0.00	0.00	0.00	0.00	N/A						N/A					
9:30 - 2:00 am	0.00	0.00	0.00	0.00	0.00	11.96	23.69	0.00	0.00	0.00	8.42	0.00	N/A					
Total:	$347.33	$38.19	$26.83	$57.34	$34.95	$137.61	$71.01	$0.00	$11.73	$0.00	$70.34	$100.80	$40.01	$0.00	$9.92	$0.00	$0.00	$7.88

Bus Weekly Total $3,522.99

10

The average originating fare for Tri-Met system-wide – including Day tickets, monthly passes, promotional tickets, etc. – obtained from Tri-Met's financial planning is $0.783 for all trip types. Using estimated ridership volumes from Tables 7 and 8, and an average originating fare of $0.783, the total weekly outbound Rose Quarter revenue for light rail is equal to $51,935.61 and $45,834.47 for bus. The estimated $10,511.44 of light rail weekly revenue lost due to fare evasion represents about 20% of estimated outbound MAX fare receipts at the Rose Quarter. As expected, fare losses associated with outbound bus revenues are measurably less at $3,522.99, though still considerable at roughly 8% of the estimated total outbound bus fare revenue.

When the foregone revenue data are aggregated into all trips by MAX and by bus, and not broken out by day and time, the results are very close to those calculated for disaggregate information. These values are $10,994.01 and $3,928.89 for MAX and bus, respectively.

Conclusions

There is a correlation between increased enforcement and reduction of fare evasion. While some level of fare evasion is expected, the goal associated with an enforcement program is to keep the normally honest passenger from the temptation of cheating the system. The optimal level of enforcement is the point where marginal enforcement cost is equal to marginal foregone revenue associated with evasion. The data analyzed here suggest that increases in inspection should be applied to weekend, late evening and early morning hours for MAX, and is not conclusive for bus.

While opportunities for certain types of fare evasion exist under SSFC, other types of fare evasion – particularly forged passes, short changing, and zone overriding – can be more effectively controlled with fare inspectors. Other benefits associated with fare inspectors include assisting operators to focus on their primary responsibility – driving; fare disputes are the most common source of disagreement between the operator and passengers, and a considerable source of irritation for operators. Fare problems between driver and passenger are found to be main causes of driver stress and absenteeism.[4]

The relatively high rates of fare evasion observed between downtown and the Rose Quarter have implications for other areas of Portland with high circulation just outside of Fareless Square. Examples include PGE Park and the Central Eastside Industrial District.

[1] Cervero, R. (1985): "Normative Framework for Transit Fare Policy-Making." *Journal of Advanced Transportation,* 19, 115-131.

[2] KPMG Peat Marwick, *Tri-County Metropolitan Transportation District of Oregon: Fare Evasion Review*, 1990.

[3] Tri-Met Interoffice Memorandum, *Report on MAX Fare Evasion for Portland Trailblazer Games: Internal Audit No. 97-002,* 1997.

[4] Fox, G. (1982): "Tri-Met's Self-Service Fare Collection Program." *Transportation Research Record*, 857, 32-38.