Original Article

Deterrence and fare evasion: Results of a natural experiment

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Abstract Before 2005, the city of Edmonton's transit security staff served only its Light Rail Transit (LRT) not its buses. During 2005, the city redeployed the security staff to serve the buses as well. This meant that fewer ticket checks could be made on the LRT, which operates an 'honor' system of fare collection. Subsequently, in early 2007, it was decided to issue more fines and fewer warnings for evading fares on the LRT – a decision that was not publicized. Using weekly data for 163 weeks, this study examined the effect of these two changes on rates of LRT fare evasion. By the end of the period the risk of being checked for fare evasion had declined by a factor of nearly four, whereas the risk of being fined, if caught without a valid ticket, increased by a factor of 15. Despite these substantial changes in levels of enforcement, no clear trends were apparent in weekly evasion rates during the entire period. Possible explanations were explored for these results, including that the changes in levels of enforcement were not perceived by potential fare evaders. The implications of the findings are discussed for situational prevention and for transit authorities using 'honor' fare collection systems.
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Introduction

Most public transport systems, even when subsidized by governments, require passengers to pay fares. Fares help to defray system costs and they help to build public support for the system by satisfying demands that those who use a resource should pay for it (that is, the 'user pays' principle). Fare payment can also help to exclude 'undesirables' who might otherwise engulf the system, as occurred in the New York City Subway in the 1970s (Del Castillo and Lindner, 1994).

Unfortunately, fare collection imposes its own costs in terms of paying for staff or machines to issue and check tickets. The money collected can also be the target of theft or robbery (Smith and Clarke, 2000), and ticket collectors and inspectors are sometimes assaulted by the passengers whom they check (Gray, 1971; Clarke, 1993; Del Castillo and

Lindner, 1994). Finally, when fare evaders are prosecuted, additional costs fall on the police and the criminal justice system.

All these costs vary with the fare collection system in use. Automatic fare collection methods, like those currently employed in the large subway systems of New York City, London and Washington DC, have fewer staff costs, but they require a considerable capital investment in the machinery and they are not immune to theft of cash, fraud and fare evasion (Clarke, 1993; Clarke *et al*, 1994). Many light rail systems, such as the one in Edmonton, the site for the study reported here, rely not on machines but on 'honor' systems of fare collection in which entry to the system is unrestricted by gates or turnstiles.[1] Tickets or passes are purchased in advance and must usually be validated on entry to the system by a machine that stamps them with the date and time of entry.

Honor systems have low fare collection costs, but their open access makes them particularly vulnerable to fare evasion. In addition, there is the risk that other passengers who witness fare evasion will imitate the offense with the consequent danger of fare evasion becoming out of control. Most open systems therefore employ staff to inspect tickets and, when necessary, impose fines on passengers found to be without valid tickets. It is not unusual, as in the case reported here, for transit systems to try to tighten ticket checks or improve fine collection and some of these attempts have been evaluated. For example, DesChamps *et al* (1991) found that increased checking and more easily checked tickets reduced fare evasion on Vancouver ferries. Van Andel (1989) and van Dijk and Junger-Tas (1988) found that ticket checks by city guards on public transport in the Netherlands reduced fare evasion. Hauber (1993) found in a careful study of several large European cities that frequent inspection of tickets was the most effective method of cutting fare evasion. The Horizon Research Corporation (2002) found in a study of Southern California's Metro Rail System that fare collection and enforcement on this open system worked well for most riders, but that a small minority (around 6 per cent) regularly avoided paying fares and between them accounted for about 40 per cent of all evasions. The Audit Office of New South Wales (2006) reported that fare evasion rates on the state's metropolitan trains declined from 4.1 per cent of passengers in 2000 to 2.3 per cent in 2005 following a raft of measures to improve detection of fare evasion. It also reported that the proportion of fines paid declined during the same period, which it attributed to an increase in the size of the penalties. Bijleveld (2007) found in a controlled experiment that a greater proportion of fines for fare evasion were collected by the Dutch railways using their usual civil law procedures than in an experimental program using the Dutch Ministry of Justice's fine collection agency. Finally, Killias *et al* (2009) report that greatly increased ticket checks, and a consequent reduction in fare evasion, followed the introduction of attendants on Zurich's suburban trains after 2100 hours. Fare evasion also declined at other times of the day, which the authors attributed to a 'diffusion of benefits' from the ticket checks introduced in the evening hours.

The Edmonton Crackdown on Fare Evasion

The 'crackdown' on fare evasion, which is examined in this article, was launched following a review of fare evasion undertaken by the Edmonton Transit System – a review prompted by an employee's letter to the City Council complaining about fare evasion on the City's

buses. It charged that fare evasion was too easy, that attempts by staff to enforce payment of fares put them at risk of verbal or physical abuse, and that dealing with fare evasion increased sick and stress leave. It further complained that management did not support drivers in their attempts to collect full fares with the result that many of them ignored the problem (Office of the City Auditor, Edmonton, 2005).

The review concluded that the fare evasion rate on the City's buses was in fact considerably less (1.2 per cent of passengers) than on its Light Rail Transit (LRT), which had an evasion rate of 6 per cent – with an estimated loss of US$664 000 per annum.[2] The LRT evasion rate had more than doubled since 1997 (when it was 2.7 per cent) and it was higher than for the Vancouver SkyTrain and the Calgary C-Train, which are comparable transit systems in Canada. It further noted that proactive enforcement in 1994 reduced the C-Train evasion rate from 7 to 3 per cent.

Numerous actions resulted from the review, including the scheduling of a pilot project in 2008 to explore the use of smart card technology for the transit system, which, if fully implemented, would entail capital costs estimated at US$12.8 million. Of greater relevance to the present study was the decision to assign Transit Security officers to serve problem bus routes as well as the LRT – a decision that was gradually implemented through 2005. More Transit Security officers were employed to assist with the additional work starting at the end of 2005, but even with these new officers there was still a substantial reduction in the number of fare evasion checks on the LRT. Somewhat later, the then Director of Edmonton Transit Security, Mike Derbyshire, decided that fines for evading fares on the LRT would be more strictly enforced (the 'crackdown'). This decision was formally announced to all his officers on 7 March 2007 (week 109, see Figures 1–4), but inspection of the data suggested that increased enforcement of fines actually commenced some weeks earlier, from 17 January (week 102), possibly because news of the impending decision had reached the officers. In that week, the fining rate more than doubled from the previous week and, with a few fluctuations, continued to rise thereafter. 17 January 2007 is therefore the date used in the analysis below for the start of the increased enforcement.

The Objectives of the Study

This article seeks to examine the combined effect on LRT fare evasion of the reduction in ticket checks and the increase in likelihood of fining passengers found without a valid ticket. The study has two broad objectives: (1) to contribute to the situational crime prevention literature (Clarke, 1997), and (2) to provide policy feedback to the Edmonton Transit system (and more generally to all transit systems with honor fare collection systems) about the effects of manipulating enforcement variables. According to the theory of situational prevention and, indeed, most of the literature on deterrence (for summaries, see Beyleveld, 1980 and Von Hirsch *et al*, 1999), potential offenders pay greater attention to the certainty of being caught than to the severity of the punishment if caught. Because the risks of being caught without a ticket declined on the LRT, situational prevention theory would therefore predict that fare evasion would increase even though the chances of being fined if caught increased. Much would depend, however, on the relative size of the changes in the two kinds of risk – of being caught and of being fined – in the course of the experiment. Thus, if the risk of being caught without a ticket was reduced only marginally, but the risk of being

fined increased many times over, then it would not be surprising if fare evasion was reduced. Much would also depend on whether the changes in risk were *perceived* by potential fare evaders who would then be able to decide whether to pay their fares or not (Killias *et al*, 2009).

As for transit systems, the lessons of the study might be just as useful if there were no change in the fare evasion as if it increased or decreased. No change in fare evasion would indicate that the cost savings achieved by reduced ticket checks were not offset by higher revenue losses resulting from increased fare evasion.

The degree to which the objectives of the study are met will be discussed below, but it must be acknowledged at the outset that the study employs what would be considered a relatively weak evaluative design – a before-and-after comparison of evasion rates without a control group. Consequently, it would be difficult to attribute any observed changes in evasion rates to the interventions, unless the changes were so marked and so abrupt as to make such inferences almost inescapable. The situational crime prevention literature does include a number of before-and-after studies that meet these criteria, but these generally examine the effect of increasing the difficulty of crime, not its risks. For example, new technologies introduced by cell phone companies in the late 1990s greatly increased the difficulty of phone cloning and almost wiped out the problem (Clarke *et al*, 2001), whereas robberies of bus drivers in New York and 19 other US cities were almost eliminated by the introduction of exact fare systems and on-board drop safes (Stanford Research Institute, 1970; Gray, 1971), which made it impossible for robbers to get the money. The effects of increasing the risks of crime – for example, through the introduction of CCTV (Ratcliffe, 2006) – are generally more variable and less powerful.

The Edmonton Light Rail Transit System

Edmonton, with a population of one million, is the capital city of the western Canadian province of Alberta. The LRT has 11 stations, with a ridership of about 130 000 per week. Fare collection employs an 'honor' system with no gates or turnstiles. Advance purchase of tickets or passes is required at about $2 Canadian per trip, and tickets must be date/time stamped on entering the system. The Transit Security line officers, or 'Community Peace Officers', consist of six teams of five officers each. This allows one team on duty in the day and two at night to provide security for both the bus and LRT systems. As part of their duties, Transit Security officers routinely make 'proof of purchase' checks on the LRT. During the period covered by this study, four uniformed 'Fare Checkers' were also employed to check tickets on the LRT.

Ticket checks are usually made as people leave stations by officers working in pairs. They check all passengers until they find one without a valid ticket. Passengers without a ticket, but with an acceptable excuse are generally warned, which takes about 10 min. Those without an acceptable excuse are issued a fine, which takes about 17 min. Fines are $110 Canadian and are not collected by the transit authorities. Violators can pay the fine by mailing a check or making a credit card payment to the provincial government, or they can contest the violation by appearing in court. Only about 75 per cent of those issued fines pay the fines.[3]

Fare evaders on the LRT employ one of several methods: they do not buy a ticket/pass in hopes they will not be caught; they do not validate tickets with a date/time stamp hoping to

use them on a future occasion; they stamp the back, not the front of tickets; they cover tickets with clear tape to allow the stamp to be wiped off; they fraudulently use senior or student passes instead of adult passes; or they use expired tickets or transfers. No information is available on the relative frequency of the use of these methods.

Research Design

Using before-and-after weekly data, this study examines the combined effect of the increased probability of being fined when caught for fare evasion and the reduction in the number of ticket checks on LRT fare evasion, the latter resulting from the redeployment of Transit Security staff. Specifically, the study sought to answer the following questions:

1. What pattern of changes occurred in enforcement (tickets checked and fines issued) throughout the period of study?
2. What (if any) associated changes occurred in evasion rates?

The study used data supplied electronically by Edmonton Transit Security[4] consisting of weekly counts from 27 January 2005 through 26 March 2008 for the following variables: number of passengers checked; number found without a valid ticket and number of fines imposed.[5] These data yielded weekly evasion rates (per cent of passengers checked who were found without a valid ticket) and weekly fining rates (per cent of passengers without a valid ticket who were fined).

Analysis and Results

Changes in enforcement levels (numbers of tickets checked, fines issued and fines issued as a proportion of tickets checked) are described in the first section below, and associated changes in evasion rates are described in the second section.

Enforcement levels

Figures 1 and 2, respectively, show weekly counts of tickets checked and fines imposed. It is clear from Figure 1 that the numbers of passengers whose tickets were checked declined substantially during the first (nine) months of the period and continued at these reduced levels for the remainder of the period. This reflects the redeployment of Transit Security staff to cover the buses as well as the LRT. Weekly passenger counts were not made for the whole period, but for 2006, the weekly average was 131 671 as calculated from sales of tickets and passes for that year. However, there is no reason to believe that weekly variations in ridership would have contributed greatly to the variations in tickets checked.[6]

Figure 2 shows that the number of fines imposed for those traveling without a valid ticket showed a gradual decline during the first half of the period, reflecting the drop in the number of passengers whose tickets were checked, but begins to increase several months before the official adoption of the increased enforcement policy, and begins to fall again

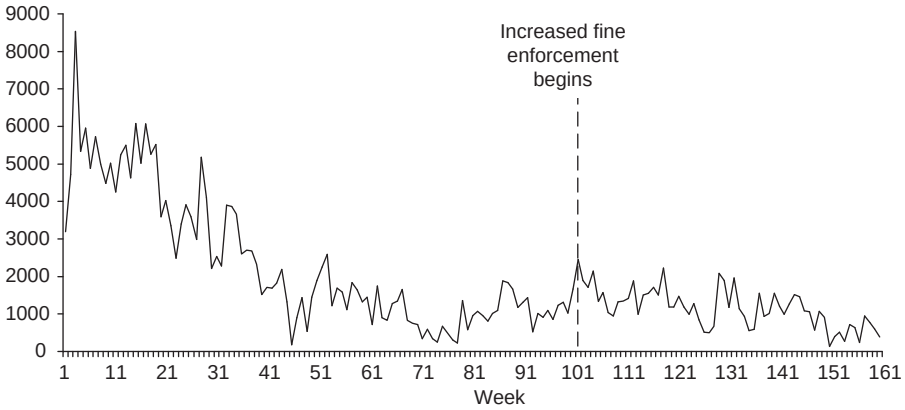

Figure 1: Weekly numbers of passenger tickets checked.
Source: Edmonton light rail transit system, 27 January 2005–26 March 2008.

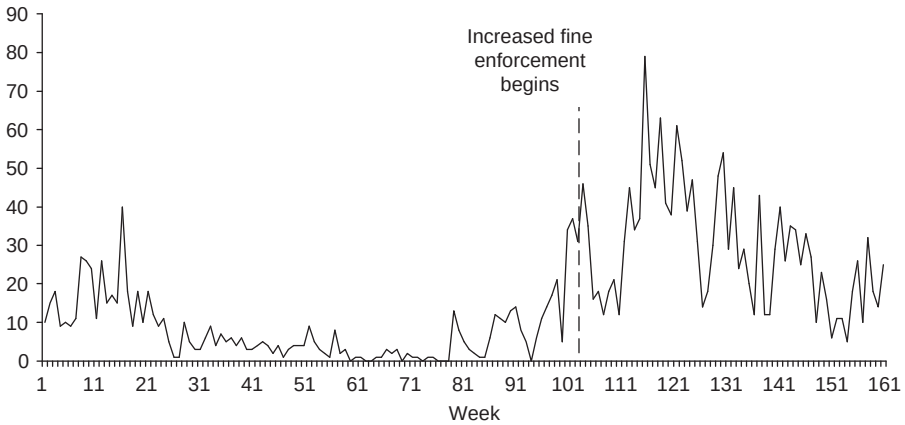

Figure 2: Weekly numbers of fines imposed.
Source: Edmonton light rail transit system, 27 January 2005–26 March 2008.

following the introduction of the stricter enforcement policy. The combined effect on the fining rate (the proportion of those found without a valid ticket who were fined) is shown in Figure 3, where it is clear that there was a substantial increase in the proportion of those found without a ticket who were fined.

Inspection of Figures 1–3 suggests that the time series could be separated into four distinct periods to reflect the different enforcement conditions operating. These four time periods are as follows:

Period One, Weeks 1–45 (27 January 2005 – 7 December 2005) – Highest risk of being caught, low risk of being fined if caught

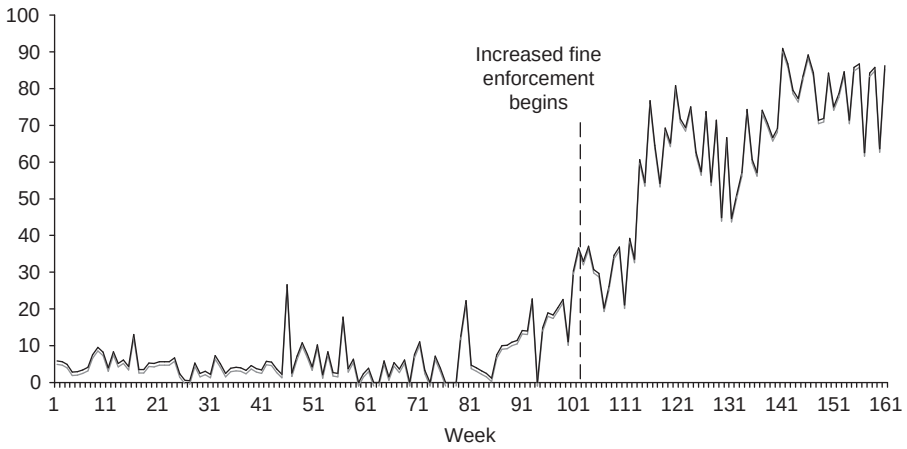

Figure 3: Trend in rates of fines imposed.
Source: Edmonton light rail transit system, 27 January 2005–26 March 2008.

Period Two, Weeks 46–101 (8 December 2005 – 17 January 2007) – Low risk of being caught, low risk of being fined if caught
Period Three, Weeks 102–116 (18 January 2007 - 2 May 2007) – Low risk of being caught, higher risk of being fined if caught
Period Four, Weeks 117–163 (3 May 2007 – 26 March 2008) – Low risk of being caught, highest risk of being fined if caught

The mean weekly values for each of the four periods in the number of tickets checked, number of fines issued and the rates of fining (see Table 1) confirm that enforcement conditions in these periods were meaningfully different. For example, the chances of passengers having their tickets checked fell about fourfold between the first and the last periods: The mean number of passengers checked in Period One was 3913, but this had fallen to 1042 by Period Four. The decline in ticket checks at the LRT resulted from the decision to deploy the Transit Security staff to buses, which was progressively implemented during 2005 – the decline was not reversed by employing more security staff at the end of 2005.

While the risk of being caught was highest during Period One, the enforcement rate was the lowest during that period, with only 4.7 per cent of passengers caught receiving a fine – out of a weekly average of 216.47 evaders, 10.76 received a fine. The fining rate did not increase significantly until Period Three. While the mean number of passengers checked during this period was only about half the number for Period One (1548 versus 3913), passengers found without a valid ticket were seven times more likely to be fined. That is, during Period One, the fining rate was 4.7 per cent, while it increased to 34.9 per cent during Period Three. The highest risk of being fined if caught without fare paid was during Period Four, when the mean number of passengers checked was the lowest of all the periods, but the mean fining rate was the highest (71.6 per cent). Thus, on average 43.77 passengers per week were found without valid tickets in Period Four, of whom an average of 30.02 were fined.

Table 1: Mean weekly values for enforcement variables for each of four time periods

	Mean N. of passengers checked	*Mean N. found without fare paid*	*Mean N. of fines issued*	*Mean fining rate (%)*
Period one, weeks 1–45	3913	216.47	10.76	4.7
Period two, weeks 46–101	1112	57.34	4.59	7.7
Period three, weeks 102–116	1548	82.47	28.47	34.9
Period four, weeks 117–163	1042	43.77	30.02	71.6

Source: Edmonton light rail transit system, 27 January 2005 – 26 March 2008.

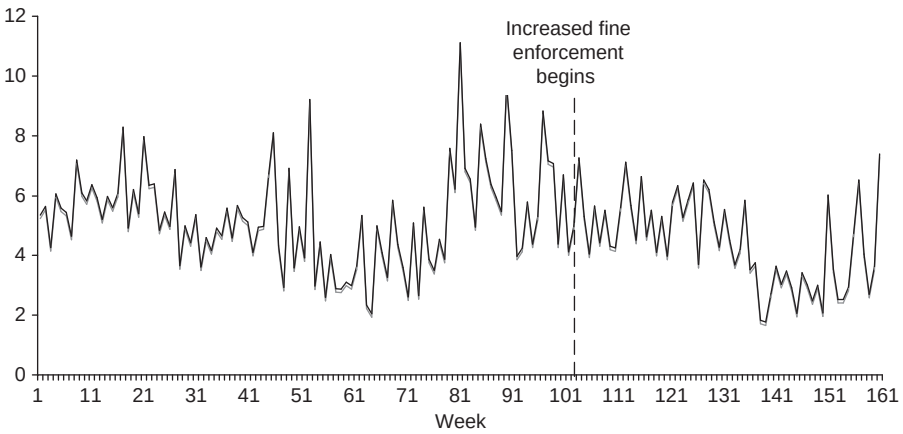

Figure 4: Weekly rates of fare evasion.
Source: Edmonton light rail transit system, 27 January 2005–26 March 2008.

Evasion rates

Given the substantial differences in enforcement for the four periods, it might have been expected that there would also be substantial variation in the fare evasion rates for these periods. However, no clear trends are apparent in weekly evasion rates for the entire period (Figure 4), and the mean weekly evasion rates for the four periods were also found to differ little (Table 2). Perhaps the least expected results were that the evasion rate changed so little between (1) the first and the second period, when the number of passengers checked declined by a factor of 3.5 and, (2) between the second and the third periods, when the rate of fining increased by a factor of 4.5. In fact, the largest change in evasion rates between two consecutive periods, from 5.3 to 4.2 per cent (a reduction of 21 per cent), was between the third and the fourth periods, when the fining rate increased by a factor of 2. These results show that evasion rates were remarkably unaffected by changes in enforcement.

Discussion

Previous studies reviewed above have shown that fare evasion rates are generally responsive to changes in enforcement. There is little reason to believe that the LRT passengers are

Table 2: Fare evasion rates for four periods with differing risks of being caught and fined

	Risk of being caught	*Risk of being fined if caught*	*Mean weekly fare evasion rate (%)*
Period one, weeks 1–45	Highest	Low	5.5
Period two, weeks 46–101	Low	Low	5.1
Period three, weeks 102–116	Low	Higher	5.3
Period four, weeks 117–163	Low	Highest	4.2

Source: Edmonton light rail transit system, 27 January 2005 – 26 March 2008.

any more immune to deterrence than other transit users and it is unlikely that this can explain the relative absence of an effect of the varying levels of enforcement in Edmonton. More likely, perhaps, is that potential fare evaders on the LRT did not learn about or perceive the changes in enforcement. It is not entirely clear how fare evaders might have learned about these changes, but this could have occurred in three main ways: (1) by observing others being stopped and fined; (2) by direct personal experience of being fined; or (3) by hearing about the changes in enforcement policy from the media or word of mouth.

The first possibility, observing others being stopped and fined, does not in fact provide much scope for learning. It would probably have taken some time for fare evaders to realize that the chances of being stopped had been reduced, because the reduction though considerable, took place gradually over a period of about 10 months. In addition, it would have been difficult for fare evaders to tell from a quick passing glance that someone stopped by Transit Security was receiving a fine rather than a warning.

Nor does the second possibility, direct personal experience of being stopped and fined, offer much scope for learning. While the risk of being fined for fare evasion had increased considerably by the final period of the study, it was still very small at about 23 in 10 000 trips, that is, 0.23 per cent. This means that a fare evader could make 10 trips per week for 45 weeks, that is, 450 trips (an average yearly commute), and have his or her ticket checked just once.

Concerning the third possibility, fare evaders might have heard from media reports that Transit Security officers had been deployed to buses, and they might, therefore, have concluded that their tickets were less likely to be checked on the LRT. However, it seems unlikely that many did reach this conclusion because fare evasion did not increase. As for the increased risk of being fined if caught, Mike Derbyshire, then head of Transit Security, deliberately did not communicate the new fine enforcement policy to the public (even though publicity can sometimes enhance deterrence, Sherman, 1990). Derbyshire made this decision because he was 'taking great pains to divorce the enforcement activity from the fine collection activity…. I'm then able to take the moral high road and honestly say that enforcement is not just a revenue-generating activity (i.e., not a cash cow) – and make the argument that we use enforcement strictly as a tool to change behavior – NOT to make our year-end revenue targets' (Mike Derbyshire, 7 December 2007, email communication).

Even so, Derbyshire reports that the increased fine enforcement policy was noticed by many people and he received numerous letters of support for the new policy (Mike Derbyshire, 7 December 2007, email communication). It could be that in a small system, such as

the Edmonton LRT, news about a change in the chances of being fined might more easily spread by word of mouth among fare evaders than would be expected in a larger system. However, it is difficult to speculate about this because there are no available data about the population of fare evaders in Edmonton, though they might be expected to fall into the three groups identified by Bijleveld (2007): (1) accidental (for example, forgot to pay, left money at home); (2) calculating (take the risk and pay if caught) and (3) chronic (criminal, addicted or alcoholic).

Nothing is known about the communication patterns within and among such groups. Nor is anything known about the proportions of fare evaders falling into the groups and what proportion of total evasions each group commits. In Sydney, Australia, it is reliably reported that one persistent fare evader was caught 210 times in a one-year period and that 25 individuals had between them been issued fines on more than 2000 occasions (Audit Office of New South Wales, 2006). This high concentration of offending among a small group of offenders is commonly found in criminological studies, and it is, therefore, possible that a small group of individuals might have been responsible for a large proportion of the fare evasion in Edmonton and that word of the new fining policy might have spread quite quickly among them. It might also be expected that this group would also account for a large number of the fines not paid. As mentioned above, about 25 per cent of fines levied are not paid in Edmonton,[7] which is a considerably lower default level than in some other transit systems (Audit Office of New South Wales, 2006; Pricewaterhouse Coopers, 2007), again, for reasons that are not clear.

Indeed, an important methodological lesson of this research is that future evaluations of fare evasion crackdowns should seek to obtain a broader set of data than in the present study. Not only would it be necessary to collect information about the numbers of tickets checked and fines issued, but also about the amount of the fines, whether these are levied on-the-spot or collected later, and the proportion of fines paid. It would also be important to obtain much fuller information about ridership (at least at the weekly level) than was available for the present study, which was limited to an estimate of ridership based on the annual sales of tickets and passes in one year. Such information is useful for controlling for seasonal effects in the time series. Finally, where possible, data should also be collected about the kinds of groups involved in fare evasion, what methods of fare evasion they favor and how they decide to avoid paying fares and fines.

Whenever possible, future evaluations of fare evasion crackdowns should also use stronger research designs than the one employed in this research, which was a retrospective examination of changes in enforcement that had already occurred. This meant that there was little opportunity to introduce scientific controls or to collect additional information (for example about public knowledge of the changes) that would have helped to interpret the results. As it is, we can only speculate about the reasons why evasion rates failed to increase when the risks of detection were greatly reduced. This finding is contrary to one of the cardinal principles of situational prevention, and the failure to explain it constitutes a worrying limitation on the value of the study. On the other hand, the largely null effects of the changes in enforcement would be of considerable interest to the management of Edmonton public transit, principally because these show that the decision to re-deploy Transit Security staff away from the LRT, to cover the buses, did not lead to an increase in LRT fare evasion. Thus, the same result was achieved, but with a greatly reduced level of expenditure on ticket inspection. It might be said that this benefit was offset by the finding that the increased

use of fines did little to reduce fare evasion. However, the case for fining those traveling without a ticket can be made on grounds of good management and fairness to law-abiding passengers, not simply on grounds of reducing fare evasion.

Conclusions

From one perspective, fare evasion seems a tiny slice of crime and one that does not seem all that important. Levels of evasion are remarkably low, even 6 per cent on an 'honor' system seems low, which is the figure that led to the decision in Edmonton to increase fine enforcement. However, public transport is an important societal resource (Smith and Cornish, 2006), generally subsidized from local taxes, and managers are under constant pressure to safeguard its financial viability. In addition, as mentioned above, fare evasion has other detrimental effects on public transit, including the failure to exclude 'undesirables' and the loss of public support for the system. It seems likely therefore that the managers of public transit systems will continue to seek even lower levels of fare evasion.

If this is to be done, much more needs to be learned about fare evasion. For example, even if the increased use of fines did reduce the evasion rate (and it is not certain that it did), it is unclear how long-lived such an effect might be. Previous research has shown that the effect of deterrent crackdowns can often be short lived – police cannot usually maintain the new levels of enforcement, or offenders discover that the increase in risks of apprehension are smaller than they originally thought (Sherman, 1990). In Edmonton, there is less risk of the former than the latter: the chances of being caught without a valid ticket are still low, though it could possibly be raised by targeted enforcement at hot spots and high risk times for fare evasion. Pricewaterhouse Coopers (2007), Killias *et al* (2009) and Dauby and Kovacs (2007) endorse this approach, though the latter observe that its limits are reached when passenger flows are high in the rush hour.

More generally, it is very unclear what should be the optimum balance between the rate of ticket checking, rate of fining, the amount of the fine and the rate of fine collection if fare evasion on honor systems is to be reduced to the minimum.[8] It is not even clear what the minimum achievable level of evasion is, because reported levels of fare evasion are calculated in different ways, which makes them difficult to interpret or compare (Audit Office of New South Wales, 2006). Finally, it is unclear whether crackdowns are cost effective. Dauby and Kovacs (2007, p. 244) report that of the 18 light rail systems they studied, 'except for two cities, the recovery rate or "return on investment" varies between 17% and 72%. Therefore the extra revenues collected are rarely enough to cover the extra costs incurred'. They provide few details of these calculations, but if their conclusion is correct, it could mean that both in Edmonton and in public transit systems more generally the effectiveness of increased fine enforcement is inherently limited. Instead of pursuing this approach to its logical extreme, alternative means of cutting fare evasion should also be followed.

One alternative is for transit systems to employ more station and vehicle staff (or more 'place managers' in the terminology of situational crime prevention, Eck, 2002), but the costs of this are often judged to be prohibitive. However, these costs have rarely been assessed against possible benefits of additional staffing, including reduced crime on the system, reduced fear among riders, more public confidence in the system and increased

ridership. Standard procedures for use by transit systems to work out these costs and benefits are urgently needed.

Despite the many advantages of honor systems, it seems likely that transit systems will increasingly move to fare collection by machines. This is the solution that the Edmonton LRT is likely to adopt and it is made more attractive by advances in fare collection equipment, which have reduced the costs of the equipment and increased its reliability.[9] Again, however, automatic fare collection might not deliver the wider benefits of increased levels of staffing. Moreover, machines are not infallible, and the adaptive offender (Ekblom, 1999) will continue to find ways to cheat them (Hauber, 1993) – and more research will be needed to defend them.

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Notes

1 Fourteen out of 18 light rail systems, mostly in Europe, surveyed by Dauby and Kovacs (2007) used honor systems.
2 The much lower evasion rate for buses was due to the fact that bus passengers have to pay on boarding the bus or show a pass. The main methods of fare evasion are to 'short' the amount paid into the fare box, rush past the driver or hand the pass used to board out of the bus window for someone else to use.
3 Unpaid fines are registered against vehicle registrations, or proceed to warrants for arrest.
4 Another change resulting from Edmonton's review of fare evasion was the introduction of a detailed weekly record of checks made and fines imposed on the LRT. No similar record system was established for fare evasion on the City's buses because tickets are not checked once passengers have boarded the bus and paid their fares.
5 Two weeks 08/03/06–08/09/06 (evasion rate 25 per cent) and 08/10/06–08/16/06 (evasion rate 14 per cent) were removed from the analysis, because they were outliers. The spikes in values were unrealistically high (for the first week the evasion rate was almost five times higher than the mean value for that period and, for the second week, it was almost three times higher), suggesting a recording error.
6 It might be expected ticket checks in the winter would decrease significantly due to the extreme cold, but an analysis of data showed no seasonal effects.
7 See Bijleveld (2007) for a thoughtful discussion of the reasons why fare evaders might not pay fines.
8 Dauby and Kovacs (2007) conclude from their survey of 18 light rail systems that to achieve a fare evasion rate of less than 5 per cent on an honor system, at least 8 per cent of passengers need to be checked. However, this takes no account of the rate of fines imposed or collected.
9 The Los Angeles County Metropolitan Transportation Authority also recently decided to install automatic ticket gates in its subway and in many light rail stations (Archibold, 2007), after a consultancy study found that about 5 per cent of passengers were evading fares on the Authority's open systems. However, the Toronto Transit Commission (2000, p. 51) concluded after a careful study of fare collection systems in many other cities that 'there is not, at present, business justification for implementing an automatic fare collection system in Toronto'.

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