Measuring and Controlling Subway Fare Evasion

Improving Safety and Security at New York City Transit Authority

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New York City Transit (NYCT) has a comprehensive framework for assessing, managing, and combating subway fare evasion. The automated fare collection system, implemented between 1994 and 1997, features lessons learned from field trials of prototypes specifically designed to limit fare abuse. Subway crime has decreased 68% since 2000, and the annual average subway evasion rate remains low at approximately 1.3%. Today, the transit authority measures fare evasion with independent silent observers who use stratified random sampling techniques and classify passenger entries into 19 categories. Evasion rates peak at 3 p.m., when students are dismissed, but otherwise hover around 0.9% at peak and 1.9% at off-peak hours. Busy times and locations have higher evasions per hour but lower evasions per passenger. More evasions occur in lower-income neighborhoods. Staff presence apparently does not reduce evasions. Results are released to the press on request, which promotes transparency and accountability. As an evasion deterrent, NYCT increased fines from $60 to $100 in 2008. Police issued 68,000 summonses and made 19,000 evasion arrests in 2009. Arrests are a more effective deterrent than summonses; the proportion of arrests versus summonses increased in 2010. Video monitoring equipment is used to identify and apprehend chronic fare abusers, particularly swipers who sell subway entries by abusing unlimited fare media.

Fare evasion is a chronic problem in transit systems, especially large systems like New York's. From classic turnstile vaulting and using slugs instead of legitimate tokens to elaborate schemes involving stolen faregate keys, fraudulent electronic fare media, forgetting proof-of-payment (POP) receipts, or a two-card monte that takes advantage of fare system features, many ways exist to avoid paying fares. Indeed, industry standard revenue leakage is reportedly 3% to 6% (*1*). If there is a way to evade, criminals will exploit it. Evasion is so rampant in some cities that conversion from POP to turnstiles is being proposed (*2*) or seriously considered (*3*).

Research has focused on measuring evasion (*4*) and relationships between automatic fare collection (AFC) and fare evasion (*5–7*) and between evasion and enforcement strategies under POP (*8, 9*). Evasion rate estimates under POP range from 1% to 9% (*10–12*). The many-faceted efforts made by New York City Transit (NYCT) to identify, detect, and combat subway fare evasion and associated issues are the subject of this paper. Nonpaying bus ridership in New York is discussed elsewhere (*13*).

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WHY DISCUSS FARE EVASION PUBLICLY?

Discussions of evasion among transit professionals have traditionally been controversial. Often considered adjunct to research in law enforcement (*5*), security (*14*), or fare collection (*6, 7*), published papers are not widely known among transit planners. However, measurement of and strategies to quell evasion are important topics in transit management for the following reasons:

1. Poorly controlled evasion creates perceptions of an unsafe or insecure transit system for some patrons, which leads to ridership declines;
2. Effective fare enforcement has incidental benefits besides reduction of evasion, such as chance arrests of wanted criminals;
3. Understanding of evasion and fraud methods helps to reduce abuse by improving operating procedures, legal framework, and fare collection equipment design;
4. Apprehension of professional swipers significantly reduces fare system vandalism and revenue leakage, which improves farebox recovery; and
5. Treatment of quality of life issues, such as evasion and panhandling, creates an orderly environment and may deter more serious crimes according to some law enforcement personnel.

In the transit world, fare abuse studies are sometimes shrouded in utmost secrecy and treated like classified information, when the problem is widely discussed in the popular press (*15–19*), local television news (*20, 21*), criminal justice literature (*5, 9, 22*), economics research (*23*), and Internet blogs in New York; New Jersey; Boston, Massachusetts (*1, 19*); Chicago, Illinois (*20*); Atlanta, Georgia (*21*); San Francisco (*12, 18, 24*) and Los Angeles, California; Seattle, Washington (*11*); Vancouver, British Columbia (*4*), and Edmonton, Alberta, Canada (*9, 25*); London (*5*); and Paris (*26*). Three agencies made evasion audit findings public (*4, 11, 25*), San Francisco presented a paper (*12*), Toronto addressed evasion in a fare collection study (*6*), at least one confidential international benchmarking study was published (*8*), and FTA has even requested special studies of nonfarebox passengers within the context of National Transit Database ridership reporting (*13*).

Different observation methodologies have been used to estimate evasions: staff interviews (*25*), operator counts (*11*), surveyor counts (*12, 13*), and third-party audits (*4*). Vendor patents provide fare system technical data (*27*), potential weaknesses are published in computer security literature (*28–30*), and exploits are widely disseminated on the Internet (*28–32*) together with stern warnings and candid discussion of legal frameworks and contextual security making fare evasion not worth it (*31*).

Evaders can already learn to beat the system by consulting public sources (*33–35*) or observing others. Benefits from greater understanding of these issues and effective preventive measures seem to outweigh risks that potential offenders can learn from such research. The Dutch Arnhem Court said it best in denying an injunction sought by vendors looking to obscure security failures: "publication of scientific studies carries a lot of weight in a democratic society, as does informing society about serious issues in the [smartcard], because it allows for mitigating of risks" (*36*).

In contrast to the unsuccessful attempt to obscure information regarding evasion and fraud tactics, the encouragement of open exchange about evasion and fraud tactics will actually make enforcement more effective and next-generation AFC more secure.

HISTORY OF FARE EVASION IN NEW YORK CITY

New York City's transit system in the 1970s was in disarray. Subway ridership was spiraling downwards, and private express buses mushroomed (*37*), which exacerbated the transit authority's (TA) problems. Crime was rampant; derailments, fires, breakdowns, and assaults were commonplace. Trains and stations were covered in graffiti. Passengers were actually afraid to ride the subway. To attract passengers, TA even introduced a premium fare "Train to the Plane" that was staffed by a Transit Police officer at all times. In comparison, fare evasion seemed a small problem. However,

> brazen forms of fare evasion may be especially harmful in evoking fear of crime among riders. Legitimate passengers may perceive . . . that the transit system has no control over these lawbreakers. The literally free access . . . could lead to increased use by vagrants and encourage criminals to favor subways over streets. . . . [O]ne in six fare evaders arrested is wanted on an outstanding warrant for another crime. (*22*)

TA's strategy for restoring riders' confidence took a two-pronged approach. In 1981, TA's first capital program began the system's physical restoration to a state of good repair. Improving TA's image in riders' minds was as important as overcoming deferred maintenance. Prompt removal of graffiti (*38*) and prevention of blatant fare evasion would become central pillars of the strategy to assure customers that the subway was "fast, clean, and safe" (*39*):

> In February 1984, one of our first publicly announced goals was to clean graffiti off our rolling stock. Virtually nobody, inside or outside the Authority, believed it could be done. Yet on May 12, 1989, the last graffiti-covered train [was] taken out of service, marking a 100% clean and graffiti-free subway car fleet. (*40*)

Similarly, fare evasion was taken seriously. TA began formally measuring evasion in November 1988. When TA's fare abuse task force was convened in January 1989, evasion was 3.9%. After a 15-cent fare increase to $1.15 in August 1990, a record 231,937 people per day, or 6.9%, did not pay. The pandemonium continued through 1991: "The Authority's [booth clerk estimate of nonpaying riders] found 187,160 people, or 5.9%, did not pay. . . . Fare evasion had become such a major problem that [the fare abuse task force was] turned over to Transit Police, headed by Chief William Bratton" (*41*).

To combat the mounting problem, fare abuse task force designated 305 target stations with the most evaders for intensive enforcement and monitoring (*42*). Teams of uniformed and undercover police officers randomly conducted minisweeps, swarming and arresting groups of evaders (*43*). Special mobile booking centers in converted city buses allowed fast-track offender processing (*16*). Fare abuse agents covered turnstiles in shifts and issued citations. Plainclothes surveyors collected data for 5 h per week at target locations, predominantly during morning peak hours. Finally, in 1992, evasion began to show a steady and remarkable decline, dropping to about 2.7% in 1994: "Two hundred additional daily patrols were added in 1990 and special procedures established to expedite processing of summonses and fines. . . . Fare evasion arrests soared from 10,268 in 1990 to 41,446 in 1994, a 304% increase, while felonies dropped 50% during the same period" (*44*).

The dramatic decrease in evasion during this period coincided with a reinvigorated Transit Police, a 25% expansion of City Police, and a general drop in crime in U.S. cities. In New York City, the crime rate decline began in 1991 under Mayor Dinkins and continued through the next two decades under Mayors Giuliani and Bloomberg. Some observers credited the "broken windows" approach of law enforcement (*45*), in which minor crimes like evasion are routinely prosecuted, and statistical crime-fighting tools, but others have indicated different reasons for crime reduction (*46, 47*). Regardless of causality, evasion checks resulted in many arrests for outstanding warrants or weapons charges, likely contributing somewhat to public safety improvements.

Arrests were not the only way to combat evasions. The early 1990s TA also examined methods to improve fare-control passenger throughputs, reduce fare collection costs, and maintain control over evasions and general grime. Their secret weapon—the AFC system—was being designed, and evasion-preventing capability was a key consideration.

Design of AFC System

TA's queuing studies concluded purchasing tokens from clerks was not efficient (*48*). Preventing slug use required sophisticated measures such as tokens with metal alloy centers and electronic token-verification devices. To provide better access control, TA experimented with floor-to-ceiling gates and high-wheel turnstiles. Prototypes installed at Lexington Avenue–110th Street in East Harlem during a target-hardening trial reduced evasions compared with nearby control stations (*22*). However, controls consisting entirely of high wheels created draconian, prison-like environments, with detrimental effects on station aesthetics. Compromises with more secure low-turnstile designs were difficult:

> Despite transit officials' promises new turnstiles would virtually eliminate fare evasion [riders used] all the old tricks to slip through the prototype. . . . Within a few minutes, an investigator watched three cheats beat the turnstile [at 18th Street–7th Avenue. . . .] One evader hurdled the bar, one limbo-danced under it, and the third "back-cocked" it, pulling the bar back slightly and slipping through.
>
> Richard Trenery, TA's program manager for AFC, said the agency's investigators had never seen anyone back-cock the T200 turnstile, which has a mechanism meant to prevent that. . . . the turnstile is built narrow at knee level to make crawling under harder, and has slanted edges at waist level to make getting a handhold to hop over harder. (*33*)

Production AFC implementation began in 1994. New turnstiles, including unstaffed high wheels and floor-to-ceiling service gates, featured lessons learned from trials. As AFC equipment was rolled out, evasion plummeted. Fare abuse agents, together with independent monitoring, were eliminated.

Station Agents and Customer Assistants

NYCT had tried to reduce station agent positions since full MetroCard vending machine (MVM) deployment in 1997. Agents whose primary responsibility had been selling tokens now sold MetroCards. However, AFC eliminated long booth queues, so fewer clerks were needed. Passengers now interact with agents only for questions about mutilated farecards, concessionary fares, or travel directions. Clerks were not crosstrained for AFC maintenance; that function was assigned to turnstile maintainers. NYCT determined that each station required only one full-time booth, serving dominant (or both) travel directions.

Some thought the station destaffing plan would lead to potential evasion increases, and consequently more general crime. The original fare abuse task force (1988 to 1997) was reconvened in 2009 to review trends and coordinate mitigation strategies between NYCT and the Transit Bureau of the New York City Police Department. Further confusing the issue, agents themselves historically provided evasion counts in their normal course of duty.

The decision to eliminate agents turned out to be controversial with both the riding public and elected officials. Representatives were concerned about constituents' jobs, and riders were concerned about susceptibility to crime:

> "We don't need those booths now because machines are doing the work of extra clerks," said Albert W. O'Leary, a spokesman for the MTA. . . . [C]utbacks will save $6 million each year. . . . [N]eighborhood groups, rider advocates and the Transport Workers Union, Local 100, which represents the city's 3,500 token booth clerks, say the closings will mean fewer eyes and ears to deter crime. (*49*)

A 2004 compromise converted low-volume booths to high-wheels and high-volume booths to part-time entrances called kiosks (*50*) staffed by station customer assistants. Affectionately called "burgundy jackets," these customer assistants don't sell farecards, but instead walk around solving customers' issues, including fare machine usage.

Naturally, both sides put their story out in the press. Those favoring elimination frequently cite a civil suit concerning the 2005 sexual assault at the 21st Street–Van Alst station, which occurred despite an alarm having been raised by the agent. The lawsuit was dismissed (*51*). The agents' contributions are clear to some: "In 2006, a crazed man wielding two power hacksaws attacked [Michael Steinberg in the 110th Street–Cathedral Parkway station]. If it wasn't for a quick-thinking station agent, [he would have died]. 'They do more than just sell MetroCards and give directions. They saved my life' " (*52*).

The 2009 fiscal crisis necessitated more agent reductions, leaving only one 24-h booth per station complex (*53*). A planned attrition program was converted to layoffs when the fiscal situation deteriorated further in 2010.

Issues with Station Agent Evasion Data

All clerks counted evaders for 1 day each month, and systemwide evasion rates were estimated. However, these data were not independently verifiable. On the basis of the 2008 pilot study (24,175 observed entries), the overall evasion rate was six times the station agent rates. The booth clerk data, collected for the last time in March 2010, showed ludicrously low systemwide evasion rates of 0.2%, even though the monitoring program estimated rates of between 0.9% and 1.6%. What might account for these differences?

Agents have other duties (selling farecards, providing customer information) they must execute while simultaneously counting evaders. Although definitive reasons were never determined, because many evaders are regulars and have a fast technique, distracted clerks could easily miss a few evaders. Even though agents are not supposed to engage evaders and have little power to stop evasions, some may nevertheless see it as a performance measurement of how effectively they are watching fare controls and introduce subconscious reporting biases. Decreasing agent positions further exacerbated undercounting problems.

NEW MEASURE OF FARE EVASION

Evasion measurements are difficult for several reasons. Studies from the 1990s indicated evasions are clustered and show large time and location variability, requiring stratified sampling for accurate estimation. Measurements must be discreet to get true rates, as observer presence may discourage it. The first pilot sample used 100 1-h observation periods, considered too long and easily detected by potential evaders. The second pilot survey used 700 12-min observation bursts, but these too were found to be inefficient. The production compromise was 300 half-hour periods.

The two pilots in 2008 determined the stratification parameters. Observations correlated most strongly with passenger entry rates (activity levels) and adjacent neighborhood income levels (*54*). With the use of these variables, a 40-strata random sample was selected (two income brackets by 20 activity strata). Other variables such as fare control equipment configuration, time of day, day of week, and subway operating division were deemed secondary correlation variables. Survey forms and methods were incrementally improved during these pilot studies.

NYCT designed a random sample capturing 300 location–time combinations per quarter, using dedicated surveyors, to yield approximately 25,000 system entry observations. Sequential observations within half-hour periods were assumed to be independent, even though this is not strictly true because criminal activity (e.g., petty theft) might be subject to coactor effects of social facilitation (see, e.g., Laming [*55*]). Careful sample stratification is believed to provide sufficient coverage to be representative of the underlying population. On the basis of these assumptions, 25,000 observations provide evasion estimates significant at the 95% ± 0.2% level, although actual confidence levels might be somewhat lower. Pilots found evasion rates of approximately 1% to 2%, necessitating measurements down to ±0.2% significance to determine quarterly variations.

What Is Fare Evasion?

To understand evasion, it is imperative to first understand the interactions among fare control hardware, fare tariff, and passengers. Evasion occurs when passengers gain access from the unpaid to the paid side by interacting with fare controls in manners inconsistent with tariff. The transit tariff is complex, sometimes requiring legitimate revenue passengers to defeat fare controls with behaviors that resemble evasion to casual observers. In addition, entry procedures

are not always strictly followed, although usually no actual revenue losses occur. There are, therefore, real debates about what constitutes evasion. Should common behaviors that result in no revenue loss be considered evasion?

Fare Collection Hardware

NYCT has four basic types of fare control equipment: low turnstiles, including agent-operated special-entry turnstiles; high entrance–exit turnstiles (HEETs); high exit turnstiles; and gates, including emergency exit gates (EXG), agent-operated gates, and autonomous farecard access system gates for wheelchair access. Passengers enter the subway by swiping farecards to unlock turnstiles (Figure 1*a* and 1*b*). Typical control areas (Figure 1*a*) feature low turnstiles, one or more EXGs, and a token booth. Unstaffed entrances (Figure 1*b*) feature only HEETs and EXGs. Exit-only locations have only high exit turnstiles and EXGs (Figure 1*c* and 1*d*). All control areas must have at least one EXG per state emergency regulations (*56*).

Systemwide EXG installations since 2006 introduced a weakness into otherwise secure AFC systems (*57*). Gates were originally only unlocked via booth buzzers or employees' keys. After the London Underground's 2005 terrorist attacks, fire codes required panic bars that allow each gate to be opened from the paid side, expediting emergency evacuation. Although a loud, piercing, and warbling alarm sounds whenever EXGs are opened, the general public took to using gates for exiting (substantially reducing queues), especially at unstaffed locations. Panic bars were also installed by the Massachusetts Bay Transportation Authority in Boston and the Chicago Transit Authority (*20*). This caused a renewed interest in evasion, because evaders could enter through gates when they were already opened by exiting passengers (*35*).

Transit Fare Tariff

Per NYCT tariff, exceptions to normal turnstile operations abound. Children under 44 in. (turnstile machines' top height) must crawl under

FIGURE 1 NYCT fare control areas featuring (*a*) three low turnstiles and two EXGs at Cortelyou Road Station on the Brighton Line (paid side), (*b*) two HEETs and one EXG in an unstaffed area at Howard Beach–John F. Kennedy Airport on Rockaway Line (unpaid side), (*c*) exit-only (unpaid side) with one high exit turnstile (HXT) and one EXG, and (*d*) exit-only (paid side) with an older-style painted HXT and one EXG.

when entering with fare-paying adults (not permissible when travelling alone) (*58*). Those with bulk items (bicycles, strollers, packages) must request a station agent to witness that they have swiped their farecard, rotated the turnstile without entering, and then enter through agent-operated gates with their items. Passengers with paper half-fare or block tickets must relinquish them to an agent and enter through a special-entry turnstile. School groups traveling with authorization letters may be admitted through agent-operated gates.

Several unofficial system entry methods that result in no revenue loss but are forbidden by tariff are frequently practiced. At unstaffed locations, fellow passengers often open EXGs for entry by customers with bulk packages after witnessing them rotate turnstiles without entering. Good Samaritans occasionally pay fares for others, which is technically a tariff violation. Children often squeeze through HEETs with paying adults, but if a child is under 44 in., no revenue loss occurs. At token booths, agents often admit passengers through agent-operated gates or special-entry turnstiles for operational reasons. Police in uniform, construction workers, contractors in safety vests, employees, and concession vendors often enter with keys or an agent's permission. Police officers sometimes allow student groups to enter through gates.

Fare Evasion Methodologies and Data Collection

Figure 2 shows different evasion methods recorded by NYCT's 4,313 passenger identification (PID) cameras. Classification provides intelligence to help formulate prevention strategies. Transit developed a systematic method of classifying system entries as illegal, questionable, and legal (Figure 3*b*). Data collection forms capture unusual entries only (Figure 3*a*) to ensure surveyors are not overwhelmed by high volumes of normal turnstile entries. Hash marks reduce miscounting in busy areas. Training includes accurate categorization of entries. Information about police and station agent presence and whether a gate is locked or an alarm is heard is also collected, providing contextual information allowing later data analysis. Surveyors record any unusual circumstances on the form's reverse side. NYCT is currently developing a handheld computer data collection application to replace paper forms.

To determine if surveyors were discouraging potential evaders despite their discreet posture, and to verify field counts, NYCT obtained sample footage at times when surveyors were present at PID-equipped locations and at comparable times (e.g., same time next day) when no surveyors were present. Field counts were compared with

FIGURE 2 Evasion methods recorded by PID camera: (*a*) adolescent passenger not accompanied by adult crawls under turnstile to obtain system access, (*b*) two teenagers share one swipe by bumping the low turnstile, (*c*) passenger jumps over the turnstile, (*d*) passenger backcocks the turnstile.

(continued on next page)

FIGURE 2 *(continued)* Evasion methods recorded by PID camera: (*e*) child backcocks the turnstile to enter the station, and (*f*) moments later returns to emergency exit gate to allow parent to enter with stroller, (*g*) commuter enters by catching the gate left open by passengers illegally using the gate to exit in a nonemergency situation, (*h*) unpaid passenger enters through open unlocked emergency gate, and (*i*) a police officer opens the combined service–emergency exit for a stroller to exit, but (*j*) for unknown reasons, the officer allows a bystander waiting in the unpaid area to enter without paying.

same-day and next-day video counts. No significant discrepancies were found, which validated data collection methods. PIDs are fairly expensive to install and maintain. About half the subway stations—identified as high terrorism risk for large passenger volumes or other reasons—have PID coverage. Because PIDs are not available at all stations, video could not be used to obtain systemwide counts.

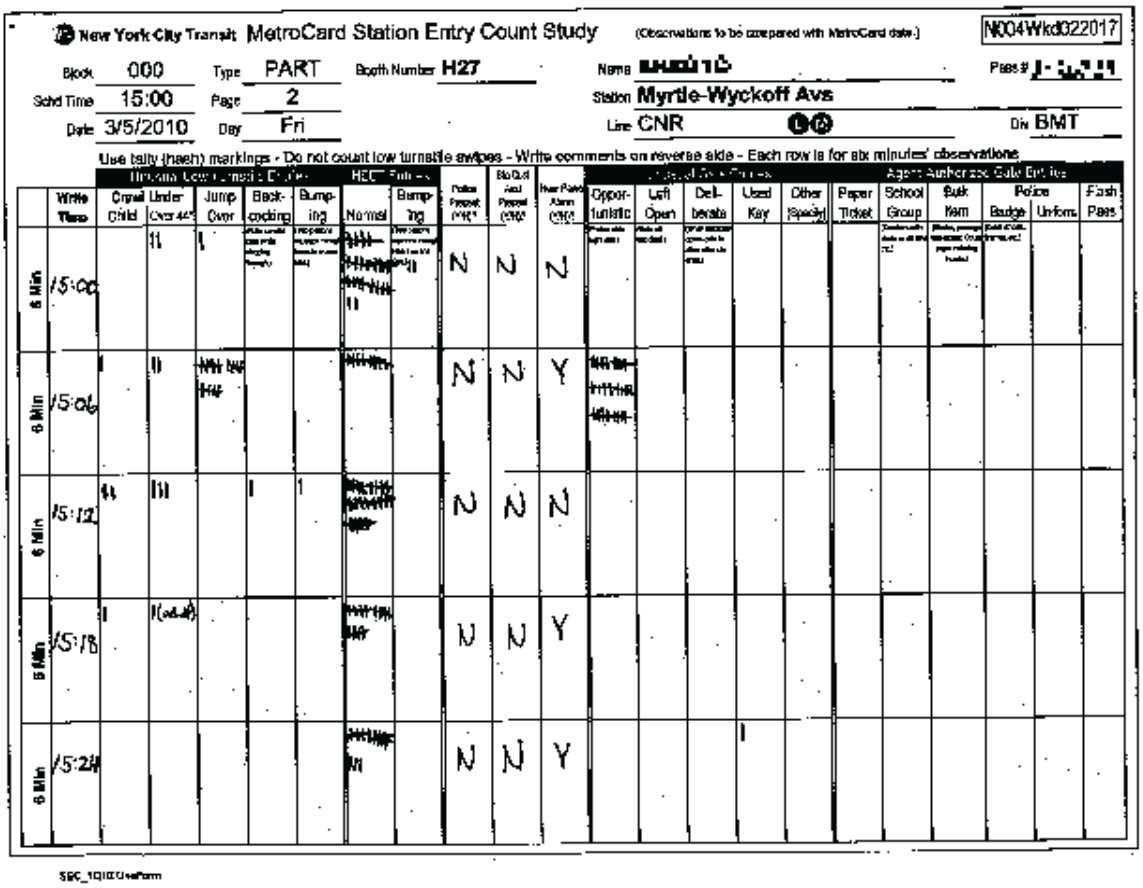
Potential Issues with Observation Methodology

Surveyors do not have authority to stop passengers and examine fare media or identifications, and they must remain discreet. Thus, only observable evasion behaviors are recorded. Several sources of revenue losses cannot be monitored this way. Fare media fraud and electronic evasion are believed to be small but not insignificant. Unlimited MetroCard misuse (e.g., swiping in fellow passengers) occurs, but it is difficult to track through silent observation. Although surveyors' comments occasionally indicate these activities, this anecdotal information does not form part of the survey data set.

The New York City Police Department has arrested professional swipers and key sellers who sell discounted system entries for about $1, or gate keys for between $25 and $100. Organized fare abuse operatives disable MVMs and then sell swipes to customers prevented from purchasing MetroCards. MVM vandalism rates are captured by using the machine-repair staff's fault codes, but associated evasions and revenue losses are difficult to estimate. Nevertheless, vandalism rates serve as a proxy for swipe-selling hotspots.

FARE EVASION TRENDS

The new evasion monitoring program has been effective for over 1 year, collecting 255,436 entry observations in 1,741 assignments totaling 870 h. For this tabulation, questionable entries are ignored. Evasion rate per passenger is observably illegal entries divided by AFC entries, which produces straightforward inflation factors for adjusting AFC ridership statistics. Evasion rates per hour are evader counts that enforcement personnel expect to find during a 1-h sweep.



New York City Transit MetroCard Station Entry Count Study (Observations to be compared with MetroCard data.) N004Wkd022017

Block 000 Type PART Booth Number H27 Name [redacted] Pass # [redacted]

Sched Time 15:00 Page 2 Station Myrtle-Wyckoff Avs

Date 3/5/2010 Day Fri Line CNR Div BMT

Use tally (hash) markings - Do not count low turnstile swipes - Write comments on reverse side - Each row is for six minutes' observations

	Write Time	Crawl Child	Crawl Under Over 44"	Jump Over	Back-cocking	Bump-ing	HEC Turnstiles: Normal	HEC Turnstiles: Bump-ing	Police Report (Y/N)*	Bio Out Report (Y/N)*	Fare Paid/ Alarm (Y/N)*	Opportunistic	Left Open	Deli-berate	Used Key	Other (Specify)	Paper Ticket	School Group	Bulk Item	Police Badge	Police Uniform	Flash Pass
6 Min	15:00		11	1					N	N	N											
6 Min	15:06		1						N	N	Y											
6 Min	15:12	1	111		1	1			N	N	N											
6 Min	15:18	1	1						N	N	Y											
6 Min	15:24								N	N	Y				1							

SBC_1Q10CountForm

(a)

Instructions for Subway Fare Evasion Data Collection

Seven most common methods of illegal entry to the system have been identified. Surveyors should classify each evasion as one of the following categories:

1. **Crawling:** Passengers not accompanied by fare paying adult, or over 44" in height, obtains system access by crawling under low turnstiles (Figure 2(a)).
2. **Bumping:** Two or more passengers enter while turnstile mechanisms rotate once (i.e. 120 degrees or ⅓ of a turn), allowing two entries for one fare (Figure 2(b)).
3. **Vaulting:** Passengers jumping over low turnstiles (Figure 2(c)).
4. **Backcocking:** Passengers pulling back low turnstile mechanism (as if to exit) but steps over or slip between turnstile's lower legs to enter while turnstile is rotated backwards (Figure 2(d)).
5. **Deliberate:** Passenger(s) entering through EXGs or AOGs opened by an accomplice already in the paid area (Figure 2(e) and 2(f)).
6. **Opportunistic:** Passenger(s) entering through already open EXGs or AOGs while others are exiting through same, without deliberate assistance by other passengers (Figure 2(g)).
7. **Left Open:** Passenger(s) entering via closed, but unlocked EXGs or AOGs by opening them from the unpaid side (Figure 2(h)).

Data is also collected on "questionable" entry categories, to understand potential impacts of legacy and unofficial practices (Figure 2(i) and (j)):

1. **School Group:** Large organized group of teachers, chaperones, and children shows or gives up to token clerk authorizing materials (e.g. letter), entering through gate.
2. **Police Uniform:** Passengers enter subway by approaching clerk while wearing full police, fire, court officer, postal, military, and other public service uniform (regardless of whether the uniform is authorized or not).
3. **Police Badge:** Passengers permitted to enter system by approaching clerk and shows and does not give up some form of identification that isn't a transportation employee ID.
4. **Flash Pass:** Passengers permitted to enter by approaching agent and shows and does not give up some form of transportation employee identification (regardless of whether the employee class is authorized to ride).
5. **Key:** Unauthorized passenger(s) entering via locked EXGs or AOGs by opening them with a "P" key, normally issued to certain employees, police, and firepersons.

Data collection efforts must also capture "legal" system entries occurring during the sample period, to obtain the denominator for an evasion rate measurement.

1. **Child:** Passengers accompanied by fare paying adult and under 44" in height, obtains system access by crawling under low turnstiles.
2. **Paper Ticket:** Passengers gives up to token clerk certain authorizing materials (e.g. block ticket), entering system through SET or service gate.
3. **Bulk Item:** Per tariff, passengers pay then rotate turnstile without entering in presence of station agent, who admits the passenger and bulk item through service gate.

Normal system entries by swiping AFC fare media are not collected; the information is downloaded from the MetroCard AFC database. Data is collected in six-minute increments. AFC data (from which normal turnstile entry passenger counts are derived) is recorded to nearest six minutes. Surveyors must synchronize their watch with local AFC Card Reader machine prior to commencing survey.

(b)

FIGURE 3 Evasion data collection by surveyors: (*a*) NYCT fare evasion survey data collection form for Myrtle–Wyckoff station in Eastern Brooklyn shows spike around 15:06, when local high school dismissed students and (*b*) surveyor instructions for classifying evaders.

Hourly Distribution

Evasion rates per passenger by hour (Figure 4*b*) showed counterintuitive trends. Conventional wisdom suggests evasion would peak during late nights when lawbreaking activity is thought to be most prevalent. Peak hours should have lower rates because large passenger volumes (high activity levels) provide more eyes and ears (*59*) than on deserted sidewalks with higher street crime probabilities. Data support this hypothesis somewhat, as rates average about 1.6% during middays (10:00 to 14:59) and 1.3% in evenings (20:00 to 23:59), whereas the rate is 0.9% in peak hours (6:00 to 9:59 and 16:00 to 19:59).

However, the evasion rate spiked to almost 3.0% from 15:00 to 15:59. Investigation revealed students leaving high schools together and evading in large groups cause this peaking, likely by increased social facilitation. Indeed, AFC ridership at stations near schools anecdotally shows unexpected upward surges when police officers are present during afternoon school hours (Lawrence R. Hirsch, New York City TA, unpublished data). Subway incident logs even use the term "school condition" to describe problematic service interferences resulting from concentrations of students. The revenue impact of these incidents is likely minimal, however, because most students who ride the subway to school have free passes for system access.

Most students are allowed three daily trips with student MetroCards; evasions allow those with an exhausted quota to gain extra trips. Because of distinct student evasion patterns, the different juvenile enforcement strategies required, and low potential revenue recovery, evasions from 15:00 to 15:59 are excluded from the remaining analyses to focus on general evasion trends.

System Entry Distribution

Figure 4*a* shows that quieter stations have higher evasion rates per passenger, but lower rates per hour. As stations become busier, per passenger rates trend down whereas per hour rates trend up. Per passenger rates of 5.5% are observed at the quietest locations and slowest times (Figure 4*a*). However, these represent very-low-volume entrance, that is, hours with fewer than 20 legitimate passengers per hour, such as Beach–105 in the Rockaways at 03:00. Despite high per passenger rates, per hour rates are low (<1.0 evader/h), suggesting enforcement at these times and locations is not cost-effective. One possible solution is to simply close fare controls during low-traffic, high-evasion hours. Precedents exist: Dean Street (Franklin Shuttle, between IND Franklin Avenue and BMT Park Place, Brooklyn) was closed in the 1990s because of rampant evasion; more evaders were recorded than revenue passengers.

Conversely, per passenger rates are low at the largest stations and busiest times, averaging around 0.5%. But sheer volumes give rise to high per hour rates hovering around 8.0 evaders/h. Random enforcement at busy locations during peak periods is thus an effective way to apprehend evaders. Indeed, police are often seen at busy stations like Grand Central and Herald Square.

Evasion by Median Income

Median income of adjacent Census tracts was attached to stations, providing results by income (Figure 4*d*). Both evasion rates per passenger and per hour show declines up to a median annual income of about $30,000 (not adjusted for inflation), after which these rates essentially flatline, consistent with conventional wisdom that more evasion activity occurs in lower-income areas.

Seasonality of Fare Evasions

Monthly results demonstrate seasonal effects in evasion rates (Figure 4*c*). Rates in warm summer months can reach 1.7%, dropping to 0.9% during winter months, consistent with the general seasonality of crime. Systemwide evasion rates may also correlate with ridership, as both are influenced by weather conditions.

Revenue Loss Estimation

Although the basic subway fare is $2.25, frequent-rider discounts, concessionary fares, and periodic passes are available. Some evaders are students; others hold valid passes but use gates simply for convenience, and no monetary losses occur. Conversely, if evasion were difficult, regular evaders might divert to multiride fares or purchase passes. Clearly, stolen rides have some value.

Originally, NYCT conservatively assumed evaders would pay an average blended subway fare (including student discounts) of $1.33 if they paid. Losses could be higher if evaders were actually occasional cash riders who otherwise might pay $2.25. However, both time-of-day distribution and anecdotal evidence suggest students are overrepresented among evaders, which would mean that NYCT recoupable losses may be lower. Conversely, free subway–bus MetroCard transfers mean that even if evaders beat the $2.25 subway fare, fares might still be collected when evaders transfer to buses (free if subway fares were paid). If evaders do not successfully skip bus fares, Transit may actually recoup some losses. With the use of a $1.48 adjusted average fare and a 1.0% evasion rate, this translates into annual losses of about $23.6 million.

Methods of Evasion

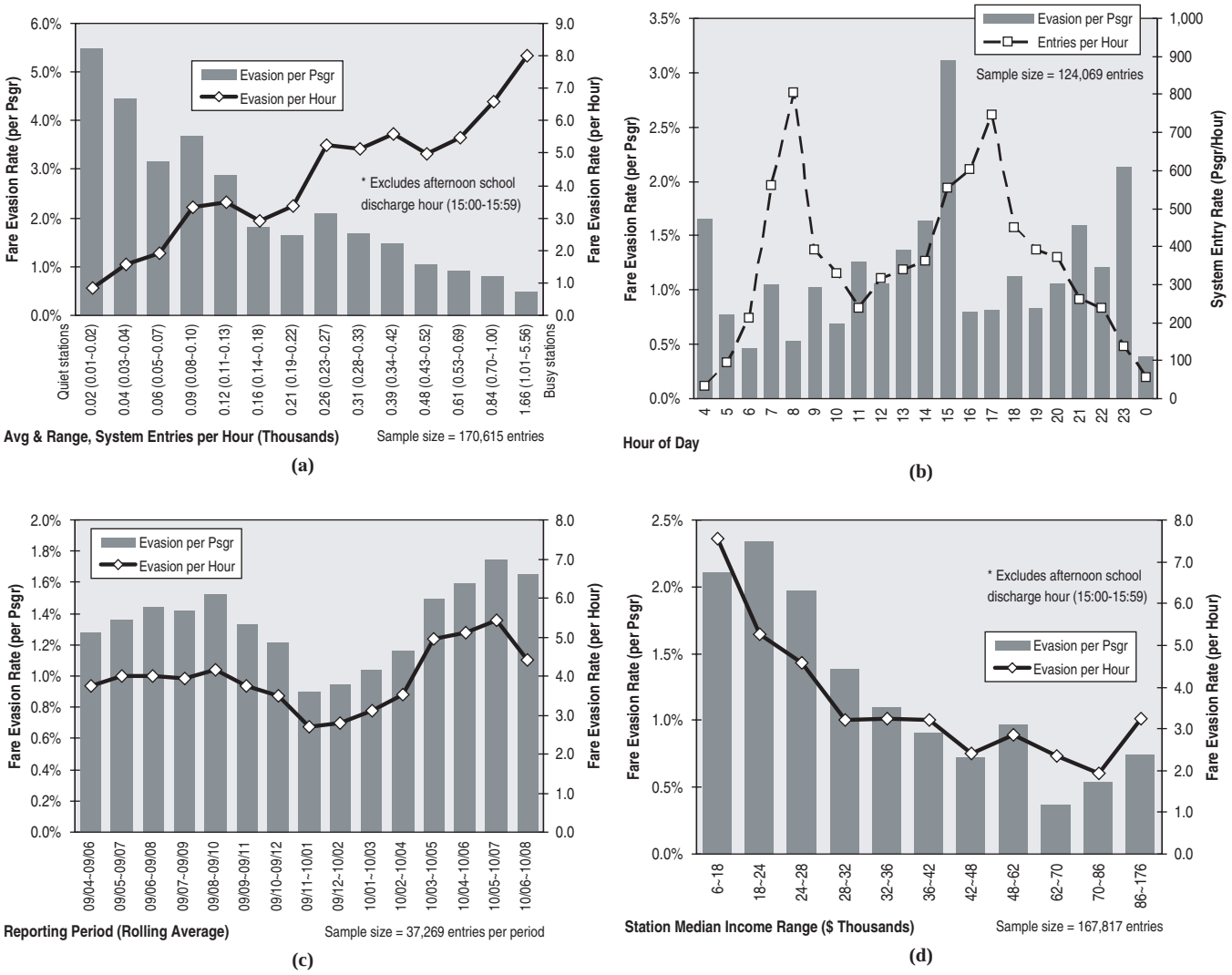
The predominant mode of evasion is children over 44 in. ducking under turnstiles, which accounted for 43% of observably illegal entries. The remaining methods are more or less evenly divided, with gate evasion contributing 24% and other turnstile violations, 32%. For nonstudent evasion enforcement, police should focus equally on gates and turnstiles. When monitoring began, the perception was that gates accounted for most evasions. As gate discipline improved, questionable entries declined (Figure 5).

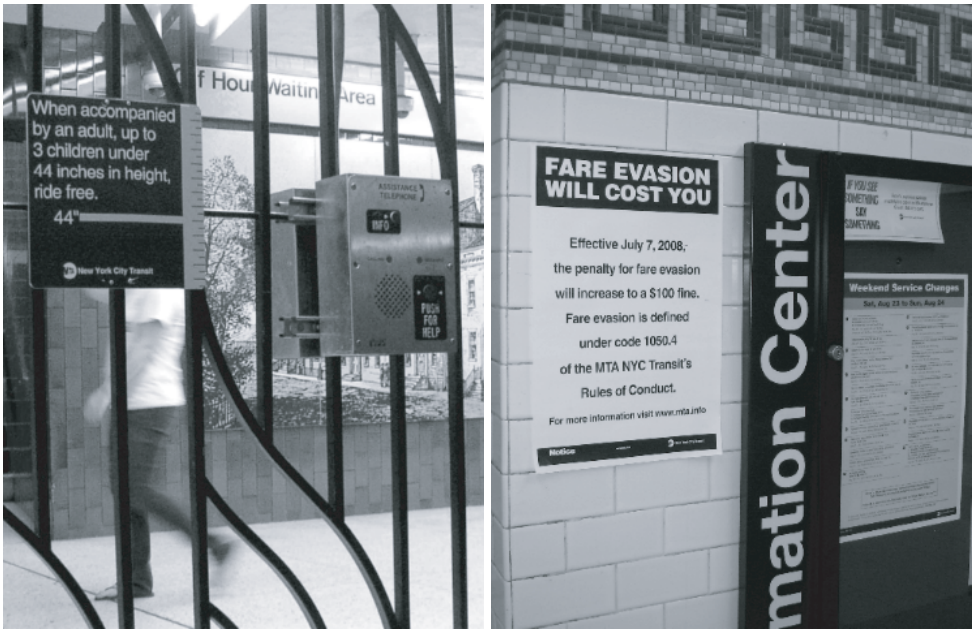
An unexpected finding was that two-thirds of gate entries may actually be legitimate despite their questionable appearance to casual observers; for example, school groups with authorization letters may appear to be entering illegally. In some cases, group entries observed actually matched authorization letter records in retrospective audits.

COMBATING FARE EVASION

Properly Locking Emergency Gates

In pilot studies, surveyors discreetly checked before leaving each location whether gates were properly locked from the unpaid side. Evasion rates were computed by gate-locking status. The unlocked gate evasion rate was 1.5%, but only 0.8% when gates were locked. Unlocked gates also invite more questionable entries: the unlocked rate





(e) (f)

FIGURE 4 NYCT fare evasion data rates for 1 year by (*a*) system entry and (*b*) time of day (hour), (*c*) time-series systemwide evasion rates showing seasonality effects, (*d*) evasion rates by Census 2000 median income of adjacent neighborhoods, and signs to reduce fare evasion that indicate (*e*) children's height guidelines for fare requirements and (*f*) July 2008 fare evasion fine increase to $100.

New York City Transit

DRAFT -- Preliminary Use Only

Station Entry Count Study

Issue Date: 2010/05/05

Monitoring Report for 1st Quarter 2010

	Station Entry Observation Detail	2009Q2 Psgrs	2009Q3 Psgrs	2009Q4 Psgrs	2010Q1 Psgrs	Overall Psgrs	2009Q2 % Total	2009Q3 % Total	2009Q4 % Total	2010Q1 % Total	Overall % Total
ILLEGAL OR QUESTIONABLE	Children Over 44" Entering Under Turnstile	204	155	85	104	548	0.64%	0.63%	0.36%	0.30%	0.48%
	Passengers Jumping Over Turnstile	34	17	37	63	151	0.11%	0.07%	0.16%	0.18%	0.13%
	Passengers Backcocking Turnstile	8	10	9	16	43	0.03%	0.04%	0.04%	0.05%	0.04%
	Passengers Bumping Turnstile	32	21	21	21	95	0.10%	0.08%	0.09%	0.06%	0.08%
	More than One Passenger Entering HEET on One Fare	26	42	31	22	121	0.08%	0.17%	0.13%	0.06%	0.11%
	Opportunistic Gate Entries	30	33	22	51	136	0.09%	0.13%	0.09%	0.15%	0.12%
	Deliberate Fare Evasion Through Service Gate	31	24	25	21	101	0.10%	0.10%	0.11%	0.06%	0.09%
	Passenger Entering while Service Gate is Unlocked	20	29	19	9	77	0.06%	0.12%	0.08%	0.03%	0.07%
	Total - Illegal Entries	***385***	***331***	***249***	***307***	***1,272***	***1.2%***	***1.3%***	***1.1%***	***0.9%***	***1.1%***
	Passengers Entering Through Gate without Authorization	59	49	14	9	131	0.19%	0.20%	0.06%	0.03%	0.11%
	Agent Authorized Entry by Large School Groups	239	0	27	6	272	0.75%	0.00%	0.11%	0.02%	0.24%
	Agent Authorized Entry by Holders of Official Badges	9	5	11	7	32	0.03%	0.02%	0.05%	0.02%	0.03%
	Authorized Entry by Persons Wearing Official Uniform	52	22	21	13	108	0.16%	0.09%	0.09%	0.04%	0.09%
	Agent Authorized Entry by Holders of Employee Passes	119	110	54	71	354	0.38%	0.45%	0.23%	0.20%	0.31%
	Entry by Holders of Gate Key			23	35	58			0.10%	0.10%	0.05%
	Total - Questionable Entries	***478***	***186***	***150***	***141***	***955***	***1.5%***	***0.8%***	***0.6%***	***0.4%***	***0.8%***
	Fare Evasion by Entry Type										
	Turnstile Related	278	203	152	204	837	0.9%	0.8%	0.6%	0.6%	0.7%
	HEET Related	26	42	31	22	121	0.1%	0.2%	0.1%	0.1%	0.1%
	Agent, Gate, or Panic-Bar Related	559	272	216	222	1,269	1.8%	1.1%	0.9%	0.6%	1.1%
	TOTAL - Illegal and Questionable Entries	***863***	***517***	***399***	***448***	***2,227***	***2.7%***	***2.1%***	***1.7%***	***1.3%***	***1.9%***
LEGAL	Children Under 44" Entering Under Turnstile	244	163	85	88	580	0.8%	0.7%	0.4%	0.3%	0.5%
	Authorized Entry by Persons Giving Up Paper Tickets	28	30	19	30	107	0.1%	0.1%	0.1%	0.1%	0.1%
	Authorized Entry by Fare-Paying Persons with Bulk Items	256	258	153	200	867	0.8%	1.0%	0.6%	0.6%	0.8%
	Legal Non-AFC Entries	***528***	***451***	***257***	***318***	***1,554***	***1.7%***	***1.7%***	***1.1%***	***0.9%***	***1.4%***
	Normal Turnstile Entry	28,800	22,581	21,950	32,820	106,151	90.8%	91.4%	92.9%	93.9%	92.3%
	Normal HEET Entry	1,523	1,161	1,013	1,369	5,066	4.8%	4.7%	4.3%	3.9%	4.4%
	Legal AFC Entries	***30,323***	***23,742***	***22,963***	***34,189***	***111,217***	***95.6%***	***96.1%***	***97.2%***	***97.8%***	***96.7%***
	TOTAL - Legal Entries	***30,851***	***24,193***	***23,220***	***34,507***	***112,771***	***97.3%***	***97.9%***	***98.3%***	***98.7%***	***98.1%***
TOTAL	**TOTAL - by Entry Type (All Control Areas, All Hours)**	**Psgrs**	**Psgrs**	**Psgrs**	**Psgrs**	**Psgrs**	**% Total**	**% Total**	**% Total**	**% Total**	**% Total**
	Turnstile	29,322	22,947	22,187	33,112	107,568	92.5%	92.5%	93.9%	94.7%	93.5%
	High Entrance-Exit Turnstile (HEET)	1,549	1,203	1,044	1,391	5,187	4.9%	4.9%	4.4%	4.0%	4.5%
	Service Gate and Agent-Authorized Entries	843	560	388	452	2,243	2.7%	2.7%	1.6%	1.3%	2.0%
	Total Number of Station Entry Observations	***31,714***	***24,710***	***23,619***	***34,955***	***114,998***	***100%***	***100%***	***100%***	***100%***	***100%***

Control Area Observation Detail	Periods	Periods	Periods	Periods	Periods	% Total	% Total	% Total	% Total	% Total
Police Present	109	70	50	83	312	10.6%	8.2%	6.5%	7.6%	8.3%
Station Customer Assistant Present	63	78	30	40	211	6.1%	9.1%	3.9%	3.7%	5.6%
Panic Bar Alarm Sounded	172	125	120	177	594	16.8%	14.6%	15.7%	16.2%	15.9%
Total Number of Six-Minute Periods Observed	***1,026***	***857***	***764***	***1,095***	***3,742***					

FIGURE 5 NYCT keeps track of fare evasion via quarterly flash reports.

was 1.8%, but only 0.9% locked. Keeping gates locked potentially halves gate-related evasions!

As a result of these findings, NYCT reinstructed station supervisors and agents on the importance and revenue impacts of keeping gates locked. Questionable gate entries decreased from 1.5% to 0.4% after this change (Figure 5), but illegal gate entries did not show statistically significant decreases when seasonality effects were accounted for. This measure seems to target mostly casual evasions.

Fare Control Area Configuration

Originally fare control hardware and staff presence were thought to affect evasions. Unstaffed HEETs (with emergency exits), a generally unsupervised environment, might invite rampant evasions. However, pilot studies indicated these locations had similar gate evasions (0.9%) to staffed locations (1.0%). At least in New York, agents do not seem to deter evaders.

Unsupervised HEETs had similar turnstile evasions (1.2%) to staffed locations (1.0%). Unsupervised exit-only locations had lower gate evasions (0.6%) than elsewhere; the rate suggests evasion is a crime of opportunity. Exit-only gates are only opened when trains arrive and passengers open them from the paid side; evaders likely find it more time efficient to evade through entrances. Only the most determined evaders would wait to enter at exit-only locations for others to exit.

Communication of Child Height Restrictions

Passengers may be unaware of height guidelines determining when children must begin to pay, which were posted at booths that many customers no longer use. Prototype signs (Figure 4*e*) are now being tested near turnstiles at the Bowling Green station.

Tackling Organized Fare Abuse Operations

MVM vandalism costs NYCT both in lost revenues and repair expenses. NYCT provides MVM vandalism intelligence to New York City Police Department, which uses hidden portable wireless digital video cameras in sting operations to gather evidence against organized fare abuse rings and to identify their leaders. These professional swipers can be difficult to apprehend because they are very mobile; strategic and determined law enforcement efforts are required to monitor MVM vandalism patterns, prioritizing stations with the highest vandalism rates.

In years past, theft-of-service crimes were often dismissed with time served (several days in Riker's Island), but by working with the Manhattan District Attorney's Office and Midtown Community Court, the fare abuse task force achieved escalating sentences for recidivists. The coordinated efforts resulted in a five-member swiper ring being disbanded and sentences of over 1 year being imposed. Measuring the effects of taking down fare abuse operations is difficult, because even large swiper rings sell very few fares compared with the natural day-to-day fluctuations of the 8.0 million NYC system riders that are caused by weather or special events.

Legal Framework and Enforcement

The most important evasion-fighting tool is arguably comprehensive and functioning legal frameworks to deal with evaders and counterfeiters. NYCT's Rule of Conduct has banned evasions since the 1980s, rules having been established mainly for arresting persons likely to commit other crimes (assault, graffiti) (*60*). With an appropriate legal framework, evasion checks, like traffic stops, can be effective in identifying and arresting criminals wanted on outstanding warrants (*61*).

To round up evaders, fare inspectors continue to use the surge strategy first developed by Transit Police. Renewed enforcement interests led to several high-profile cases. Swiss tourists with allegedly valid passes were ticketed for bumping turnstiles (*62*). One passenger was arrested for exiting, not entering, through an emergency gate (*63*).

A legal framework is more than the prohibition of illegal acts and prescription of fines. Complete regulations should address issues such as arrests versus summonses; arresting and summons-issuing powers; whether undercover enforcement is permitted; the disputes and appeals process (e.g., "my monthly MetroCard isn't working, so I went through gate"); dealing with genuinely confused tourists (e.g., "I flashed my pass, so going through gate is okay?"); and required evidence for conviction (e.g., whether video evidence is admissible). New York allows certain nonpolice employees to issue evasion citations and uses both uniformed and undercover police enforcement.

Contextual security, that is, expressly forbidding nonpayment and offering ways to punish rule breakers, is as potentially important as having secure hardware. In Boston, students used well-known methods (*28, 29*) to defeat the Mifare Classic farecard's proprietary encryption, publicly demonstrating proof-of-concept forgeries (*30*). However, they did not acknowledge the highly illegal nature of using forged cards, which makes cloning not worthwhile for a $1.70 fare. Chips implementing stronger open-standard encryption algorithms have now largely superseded Mifare Classic.

Evasion Detection and Prevention Hardware

Video recording equipment may deter criminal activity, including evasion. Cameras are widely deployed in modern Asian and European transit systems. Like other U.S. agencies, NYCT installed counterterrorism cameras at key stations. PIDs cover fare controls from every conceivable angle with high-fidelity video, positively identifying terror suspects. They also produce clear pictures of entering and exiting passengers, including evaders. Massachusetts Bay Transportation Authority, the Chicago Transit Authority (*20*), and Port Authority Trans-Hudson also use sophisticated camera equipment. The Massachusetts Bay Transportation Authority even apprehended vandals damaging AFC equipment while evading and published the video footage (*19*).

At Port Authority Trans-Hudson (and some NYCT stations), hidden rooms with half-silvered glass or surveillance portals are provided for covert police observation. Perpetrators are apprehended by police who suddenly appear from behind closed doors when illegal acts occur.

Fare Evasion Fines

Transit's $60 penalty was internally set by the Transit Adjudication Bureau with delegated powers (New York State Public Authorities Law, Title 9 New York City Transit Authority, Section 1204, §5[a] and Section 1209-a, §4). In July 2008 NYCT increased fines to $100 (Figure 4*f*), the maximum the Transit Adjudication Bureau can levy without further approvals, to support the conversion to POP fare collection on a Bronx bus line (*64*). In Boston, before CharlieCard AFC implementation and conversion of booth clerks to roving agents, Massachusetts Bay Transportation Authority quietly asked the Massachusetts State Legislature to make evasions a civil offense punishable by progressive fines ($15 first offense; $100 second; $250 third or subsequent offense; Massachusetts General Laws, Title XXII: Corporations, Chapter 159, Section 101). On the Newark City Subway, where POP is in effect, the evasion penalty was initially $75 but increased to $100 in 2008. For evaders on the Metropolitan Atlanta Rapid Transit Authority, evasion fines range from $85 to $235 (*21*), and they "start at $50" on the San Francisco Municipal Railway (*18*).

Economics of Casual Fare Evasion

The New York City Police Department focuses on arrests rather than summonses, because mandatory arrests of wanted criminals are more

critical to general crime reduction. Consequently, the evasions-to-summonses ratio is low. In 2009, 18.5 million estimated evasions occurred. A total of 120,000 summonses were issued, thus routine evaders might expect one summons for every 100 to 200 evasions. Average weekday riders requiring three daily evasions would receive one $100 summons every 6 to 13 weeks. Considering weekly subway passes retail at $27, evaders could save $162 in 6 weeks but pay $100 in fines. In addition, not all summonses are legally feasible to collect.

For occasional cash riders, the evasion economics are quite different. With a 0.7% risk of a $100 summons, the expected price per evasion is only 70 cents, compared with the $2.25 cash fare. This basic street economics might explain observed evasion behaviors. Higher fines or arrests may have better deterrent effects.

Difficulty Evaluating Enforcement and Countermeasure Cost-Effectiveness

A straightforward method for evaluating cost-effectiveness would trade off fare revenue losses, enforcement impacts on evasion rates, fines revenues, and police costs. However, law enforcement economics is complex: uncontrollable factors affect evasions besides enforcement; evasion checks may have other effects, such as preventing crime and confiscating drugs or weapons, whose monetary benefits are difficult to estimate; police costs are subject to complex deployment and overtime rules and cost-allocation issues relating to critical coverage versus off-peak use of available resources; and fines revenues may be offset by court and administration costs.

PUBLIC RELATIONS

Transit agencies' active effort is sometimes required to correct misinformation from special interest groups. In response to impending station agent layoffs, the *New York Daily News* decided to look into the fare abuse issue. Initially, they developed a draft about changes in human presence at stations over the past decade, highlighting agent position reductions. They requested from NYCT evasion data, frequency of emergency assistance requests, and an interview regarding rider perception and safety.

In response, Transit compiled statistics showing significant reductions in serious subway crime, despite station staffing decreases (Figure 6*a*). Far from causing rampant crime and general mayhem, destaffing actually occurred against an improving picture of public safety in New York. Subway crime has decreased 68% since 2000, and the annual average evasion rate remains low (~1.3%).

However, evasion statistics were problematic. NYCT was aware of differences between independent survey data (1.3%) and station agents' 1-day counts (0.2%). To forestall the appearance of instituting methodology changes purely to avoid negative press, Transit officials released data from both the old and new methods (Figure 6*b*) together with explanations for the discrepancies. Simultaneously, NYCT announced future public reporting will use the more accurate independent surveys.

Although expected confusion about methodology adjustments arose, because data showed recent destaffing has not led to rampant evasions (still only 1.3%), and no reasonably accurate estimates exist for historical evasions, the *New York Daily News* chose not to focus on station agent issues. Instead, the story highlighted that accurate measurements revealed more evasion than previously thought (*15*). By keeping communication channels open with the press and supplying accurate and timely data, NYCT reduced a potential public relations disaster to a headline article about evasion measurement methodology changes ("Subway Shocker") (Figure 6*b*). Subsequently, focus shifted to the illegal use of stolen keys (*65*) to unlock gates from the unpaid side.

CONCLUSIONS

NYCT developed a multipronged approach for managing subway fare evasion. AFC was designed with security features to physically prevent abuse, allow silent observations, and facilitate audits. The legal framework gives Transit Police tools to enforce law and order. Data collection and analysis keep an accurate picture of evasion trends and MVM vandalism. A task force–based multidisciplinary approach ensures participation by normally disparate departments within Transit. A comprehensive press strategy ensures NYCT's efforts in clamping down evasion are publicly communicated, both as a caution to evaders and to demonstrate judicious use of resources.

Fare evasion is likely a crime of opportunity. Allowing fare evasion may have implications for the perception of system security far beyond lost revenues. Riders are particularly irked by blatant evasions because of their own basic notions of fairness, and also because abuses can symbolize unaccountability and the idea that "nobody's in charge." An accurate, comprehensive, and transparent fare abuse measurement and enforcement mechanism is a must for transit agencies, whether or not POP fare collection is used.

Curiously, the hacker community is quite willing to share information about fare abuse (even publicize its illegality), and the mainstream press is awash with opinions about evasion and its prevention, but discussions among transit professionals seem taboo. Encouraging an open information exchange could allow agencies to learn about evasion from each other, and even from evaders themselves.

FUTURE WORK

This study raised interesting questions, some beyond the traditional realm of transit research. What are the ancillary security benefits of clamping down on fare evasion? More important, can they be quantitatively measured? Can correspondence between fare evaders and subway criminals be conclusively demonstrated? What are evaders' motivations and trip purposes? How do tariffs or fines discourage evasion? How many fines are actually collected? Does the revenue from fines cover collection costs? What uncontrollable factors (e.g., weather, poverty, special events) affect evasion rates? What countermeasures are most effective? What factors determine optimal enforcement rates? To what degree are casual evasions recurrent or habitual? What other patterns are seen in evasion data and evader demographics? What explains the high evasion rates among students? How do evasions relate to social issues such as homelessness? What about evasions on other modes? What changes in the legal framework could affect evasion rates?

Fare evasion, often thought of as a simple audit matter, is actually a complex phenomenon that transcends transportation operations, fare equipment design, transit tariff, and law enforcement. Far from being a black-and-white matter of either you paid your fare or you did not, each evasion tactic can be linked to specific AFC design features and enforcement strategies. Aside from being academically fascinating, this area deserves further research for its practical implications and

NYCT Subways Major Felony Statistics

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-09 Chg
Annual Ridership (millions)	1,381	1,405	1,413	1,384	1,426	1,449	1,499	1,563	1,624	1,580	14.39%
Subways Major Felonies	4,262	3,756	3,705	3,218	3,286	3,100	2,707	2,359	2,291	2,034	-52.28%
# of Major Felonies per 1,000,000 Riders	3.09	2.67	2.62	2.33	2.30	2.14	1.81	1.51	1.41	1.29	-58.28%
Subways Percent Change from Prior Year		-13.39%	-1.91%	-11.32%	-0.89%	-7.16%	-15.58%	-16.40%	-6.55%	-8.74%	
NYC Population (millions)	8.008	8.062	8.084	8.086	8.104	8.143	8.214	8.275	8.364	TBD	
NYC Major Felonies	252,107	234,229	223,597	212,587	205,804	198,751	189,586	186,685	185,979	TBD	
# of NYC Major Felonies per 1,000,000 Population	31,481	29,053	27,658	26,292	25,395	24,407	23,080	22,561	22,236		
NYC Percent Change from Prior Year		-7.71%	-4.80%	-4.94%	-3.41%	-3.89%	-5.44%	-2.25%	-1.44%		

Major Felonies: Murder, Rape, Robbery, Fel.Assault, Burglary, Grand Larceny *Source: NYPD, NYCT, NYS DCJS, NYS DOH*

Subways Fare Evasion Rates

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-09 Chg
Old Method	Reported Fare Evasion Rate	0.40%	0.32%	0.36%	0.38%	0.38%	0.37%	0.33%	0.32%	0.32%	0.32%	-20.00%
	Absolute Fare Evaders*	209,505	168,176	201,331	213,416	214,141	205,316	186,071	188,328	193,941		
	Revenue Loss from Evasion (millions)	$6.1	$4.6	$5.3	$6.4	$6.8	$7.0	$6.4	$6.6	$7.0		
	Annual Subway Revenue (millions)	$1,528	$1,526	$1,506	$1,667	$1,795	$1,857	$1,947	$2,030	$2,176		
	Fare Evasion Rate - New Methodology**										1.20%	

* No data available for September 2001 fare evasion.

** In response to MTA Audit Subway Fare Evasion Study, a new sampling method was developed to monitor fare evasion independently. Data collection started in April 2009.

Police Activity

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-09 Chg
Fare Evasion Arrests	20,126	15,569	12,306	16,180	16,490	12,985	13,068	16,248	16,315	19,061	-5.29%
Fare Evasion Summonses	98,830	83,038	91,101	95,877	103,139	86,029	89,430	84,955	78,001	68,225	-30.97%
Total	118,956	98,607	103,407	112,057	119,629	99,014	102,498	101,203	94,316	87,286	-26.62%

Transit Adjudication Bureau (TAB) Activity

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2000-09 Chg
Revenues Accrued (All Categories)	$8.4	$9.5	$6.2	$6.3	$7.0	$9.1	$11.8	$11.9	$10.6	$10.1	20.24%
Notice of Violations (All Categories)	223,036	185,676	195,214	170,955	165,743	125,657	131,624	137,971	125,155	115,404	-48.26%

(a)

(b)

FIGURE 6 Open communication channels with the press: (*a*) 10-year trends supplied to *New York Daily News* on major felonies, evasion rates (both methodologies), police activity, and fine collection activity and (*b*) resultant *Daily News* and Peter Donohue coverage on fare abuse issue, including misuse of firemen's keys to gain illegal access to the subway. (Source: *New York Daily News*.)

very real impacts on transit authorities' bottom lines. A multidisciplinary approach bringing together sociological, legal, enforcement, economic, transit management, and psychological expertise will be necessary to answer these questions.

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