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Measuring and Controlling Subway Fare Evasion: Improving Safety and Security at New York City Transit Authority

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ABSTRACT

New York City Transit (NYCT) has a comprehensive framework for assessing, managing, and combating subway fare evasion. The automated fare collection (AFC) system, implemented 1994~97, features lessons learned from field trials of prototypes specifically designed to limit fare abuse. Subway crime has decreased 68% since 2000, and annual average subway evasion rate remains low at approximately 1.3%. Today, the Authority measures fare evasion with independent silent observers using stratified random sampling techniques, classifying passenger entries into 19 categories. Evasion rate peaks at 3pm due to students dismissal, otherwise hovers around 0.9% peak, 1.9% off-peak. Busy times and locations have higher evasions per hour but lower evasions per passenger. More evasions occur in lower-income neighbourhoods. Staff presence apparently doesn't reduce evasions. Results are released to the press on request, promoting transparency and accountability. To combat evasion, 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 "slugs" instead of legitimate tokens to elaborate schemes involving stolen faregate keys, fraudulent electronic fare media, "forgetting" proof-of-payment (POP) receipts, or "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%~6% (*1*). If there's 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*).

Prior research focused on measuring evasion (*4*), relationships between automatic fare collection (AFC) and fare evasion (*5*,*6*,*7*), between evasion and enforcement strategies under POP (*8*,*9*), where evasion rate estimates ranged from 1%~9% (*10*,*11*,*12*). The many-faceted efforts made by New York City Transit (NYCT) recently to identify, detect, and combat subway fare evasion and associated issues is the subject of this paper. Non-paying bus ridership in New York is discussed elsewhere (*14*).

Why Publicly Discuss Fare Evasion?

Discussions of evasion amongst transit professionals have traditionally been controversial. Often considered adjunct to research in law enforcement (*5*), security (*15*), or fare collection (*6*,*7*), published papers aren't widely known amongst transit planners. However, measurement of and strategies to quell evasion are important topics in transit management because:

1. Poorly controlled evasion creates perceptions of an unsafe or insecure transit system amongst some patrons, leading to ridership declines
2. Effective fare enforcement has incidental benefits besides reducing evasion, like chance arrests of wanted criminals
3. Understanding 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, improving farebox recovery
5. Some law-enforcement personnel believe tackling "quality of life" issues like evasion and panhandling creates an orderly environment and may deter more serious crimes

In the transit world, fare abuse studies are sometimes shrouded in utmost secrecy and treated like classified information, when it is widely discussed in popular press (*16–20*), local television news (*21*,*22*), criminal justice literature (*5*,*9*,*23*), economics research (*24*), and internet blogs (*25*); in New York (*14*,*16*,*17*), New Jersey (*2*), Boston (*1*,*20*), Chicago (*21*), Atlanta (*22*), San Francisco (*12*,*19*,*25*), Los Angeles (*3*,*18*), Seattle (*11*), Vancouver (*4*), Edmondton (*9*,*26*), London (*5*), and Paris (*27*). Three agencies (*4*,*11*,*26*) made evasion audit findings public, San Francisco presented a paper (*12*), while Toronto addressed evasion in a fare collection study (*6*), at least one confidential international benchmarking study was published (*8*), and Federal Transit Administration has even requested special studies of non-farebox passengers (*14*) within the context of National Transit Database ridership reporting.

Different observation methodologies were used to estimate evasions: staff interviews (*26*), operator counts (*11*), surveyor counts (*12*,*14*), and third party audits (*4*). Vendor patents (*28*)

provide fare system technical data, potential weaknesses are published in computer security literature (*29–31*), and exploits are widely disseminated on the internet (*29*,*32*,*33*) together with stern warnings and candid discussion of legal frameworks and contextual security making it "not worth it" (*32*).

Evaders can already learn to beat the system by consulting public sources (*34–36*) 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, 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." (*37*)

Rather than attempting unsuccessfully to obscure information regarding evasion and fraud tactics, encouraging its open exchange 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, while private express buses mushroomed (*38*), exacerbating 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" – staffed by a Transit Police officer *at all times*. Comparatively, 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 favour subways over streets […] one in six fare evaders arrested is wanted on an outstanding warrant for another crime. (*23*)

TA's strategy for restoring riders' confidence took a two-pronged approach. In 1981, MTA's first capital program started system's physical restoration to a State-of-Good-Repair. Improving TA's *image* in riders' minds is as important as overcoming deferred maintenance. Prompt removal of graffiti (*39*) and prevention of blatant fare evasion would become central pillars of the strategy to assure customers that the subway is "fast, clean, and safe" (*40*):

> 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. (*41*)

Similarly, fare evasion was taken seriously. The TA began formally measuring evasion in November 1988. When TA's Fare Abuse Task Force (FATF) 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%, didn't 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 FATF was] turned over to Transit Police, headed by Chief William Bratton. (*42*)

To combat the mounting problem, FATF designated 305 "target stations" with most evaders for intensive enforcement and monitoring (*43*). Teams of uniformed and undercover police officers randomly conducted "mini-sweeps", swarming and arresting groups of evaders (*44*). Special "mobile booking centers" in converted citybuses allowed fast-track offender processing (*17*). Fare abuse agents covered turnstiles in shifts and issued citations. Plainclothes surveyors collected data for five hours 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. (*45*)

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 NYC, crime rate decline begun in 1991 under Mayor Dinkins and continued through next two decades under Giuliani and Bloomberg. Some observers credited the "broken windows" approach of law enforcement (*46*) where minor crimes like evasion are routinely prosecuted, and statistical crime-fighting tools, whereas others have indicated different reasons for crime reduction (*47*,*48*). Regardless of causality, evasion checks resulted in many arrests for outstanding warrants or weapons charges, likely contributing somewhat to public safety improvements.

Arrests weren't the only way to combat evasions. The early 1990s TA was examining 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.

Designing the Automated Fare Collection (AFC) System

TA's queuing studies concluded purchasing tokens from clerks wasn't efficient (*49*). Preventing 'slug' use required sophisticated measures like 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 Av-110 St in East Harlem during a "target hardening" trial reduced evasions compared to nearby "control" stations (*23*). 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 18 St-7 Av…] 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. (*34*)

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 was selling tokens, now sell MetroCards. However, AFC eliminated long booth queues, so fewer clerks were needed. Passengers now interact with agents only for requests like mutilated farecards, concessionary fares, or travel directions. Clerks weren't cross-trained 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 FATF (1988-1997) was reconvened in 2009 to review trends and coordinate mitigation strategies between NYCT and New York City Police Department's Transit Bureau (NYPD). Further confusing the issue, agents themselves historically provided evasion counts in their normal course of duty.

Decision to eliminate agents turned out controversial with both riding public and elected officials. Representatives were concerned about constituents' jobs, whereas 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. […] cutbacks will save $6 million each year. […] neighborhood 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. (*50*)

A 2004 compromise converted low volume booths to high-wheels, high volume booths to part-time entrances called "kiosks" (*51*) staffed by Station Customer Assistants (SCAs). Affectionately called "burgundy jackets", SCAs don't sell farecards, instead they walk around solving customers issues, including fare machine usage.

Naturally, both sides put their story out in the press. Those favouring elimination frequently cite a civil suit concerning the 2005 sexual assault at 21 St-Van Alst station, which occurred despite alarm having been raised by the agent. The lawsuit was dismissed (*52*). The agents' contributions are clear to some:

> In 2006, a crazed man wielding two power hacksaws attacked [Michael Steinberg, in 110 St-Cathedral Parkway station.] If it wasn't for a quick-thinking station agent, [he would have died.] "They do more then just sell MetroCards and give directions. They saved my life." (*53*)

The 2009 fiscal crisis necessitated more agent reductions, leaving only one 24-hour booth per station complex (*54*). Planned attrition program was converted to layoffs when fiscal situation deteriorated further in 2010.

Issues with Station Agent Evasion Data

All clerks counted evaders for one day each month, and systemwide evasion rates estimated. However, this data wasn't independently verifiable. Based on the 2008 pilot study (24,175 observed entries), 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 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) simultaneously as counting evaders. While definitive reasons were never conclusively determined, since many evaders are regulars and have fast technique, distracted clerks could easily miss a few evaders. Even though agents aren't supposed to engage evaders and have little power to stop evasions, some may nevertheless see it as performance measurement of how effectively they are "watching" fare controls – introducing subconscious reporting biases. Decreasing agent positions further exacerbated under-counting problems.

NEW MEASURE OF FARE EVASION

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

The two pilots in 2008 determined stratification parameters. Observations correlated most strongly with passenger entry rates (activity levels) and adjacent neighbourhood income levels (*55*). Using these variables, a 40-strata random sample was selected (two income brackets by 20 activity strata). Other variables like 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 locations-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 isn't strictly true because criminal activity (e.g. petty theft) might be subject to coactor effects of social facilitation (see, e.g. Laming (*56*)). Careful sample stratification is believed to provide sufficient coverage representative of the underlying population. Based on these assumptions,

25,000 observations provide evasion estimates significant at 95% ± 0.2% level, although actual confidence levels might be somewhat lower. Pilots found evasion rates of approximately 1%~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 interactions between fare control hardware, fare tariff, and passengers. Evasion occurs when passengers gain access from unpaid to paid side by interacting with fare controls in manners inconsistent with tariff. Transit's tariff is complex, sometimes requiring legitimate revenue passengers to defeat fare controls with behaviors that resemble evasion to casual observers. Additionally, entry procedures aren't always strictly followed, though usually no actual revenue losses takes place. There are, therefore, real debates about what constitutes evasion. Are common behaviors that result in no revenue loss considered "evasion"?

Fare Collection Hardware

NYCT has four basic types of fare control equipment: low turnstiles (including agent-operated special entry turnstiles, SETs), high entrance-exit turnstiles (HEETs), high exit turnstiles (HXTs), and gates (including emergency exit gates (EXG), agent-operated gates (AOG), and Autonomous Farecard Access System (AFAS) 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)) features only HEETs and EXGs. Exit-only locations have only HXTs and EXGs (Figure 1(c) and 1(d)). All control areas must have at least one EXG, as per State emergency regulations (*57*).

Systemwide EXG installations since 2006 (*58*) introduced a weakness into otherwise secure AFC systems. Gates were originally only unlocked via booths buzzers or employees' keys. After London Underground's 2005 terrorism attacks, fire codes required "panic bars", allowing each gate to be opened from paid side, expediting emergency evacuation. While a loud, piercing, and warbling alarm sounds whenever EXGs are opened, general public took to using gates for exiting (substantially reducing queues), especially at unstaffed locations. Panic bars were also installed on Massachusetts Bay Transportation Authority (MBTA) in Boston and on Chicago Transit Authority (CTA) (*21*). This provided an impetus for renewed interests in evasion, because evaders could enter through gates when already opened by exiting passengers (*36*).

Transit Fare Tariff

Per NYCT tariff (*59*), exceptions to normal turnstile operations abound. Children under 44" (turnstile machines' top height) must crawl under when entering with fare-paying adults (not permissible when travelling alone). Those with bulk items (bicycles, strollers, packages) must request station agent witness their swiping farecard, rotating turnstile without entering, then enter through AOG with their items. Passengers with paper half-fare or "block" tickets must relinquish them to agent and enter through SET. School groups traveling with authorization letters may be admitted through AOG.

An added complication is several unofficial system entry methods resulting in no revenue loss but 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 – technically a tariff violation. Children often squeeze through HEETs with paying adults (if under 44", no revenue loss occurred). At token booths, agents often admit passengers through AOG or SET for operational reasons. Police in uniform, construction workers, contractors in safety vests, employees, and concession vendors often enter with keys or 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 observed by NYCT's 4,313 Passenger Identification (PID) cameras. Classification provides intelligence that 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)), ensuring surveyors aren't overwhelmed by high volumes of normal turnstile entries. Hash marks reduce miscounting in busy areas. Training includes accurate categorizations of entries. Information about police/station agent presence, whether gate is locked/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 hand-held 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 same-day and next-day video counts. No significant discrepancies were found, validating 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. Since PIDs aren't available at all stations, video couldn't be used to obtain systemwide counts.

Potential Issues with Observation Methodology

Surveyors don't have authority to stop passengers and examine fare media or identifications, and must remain discreet. Thus, only observable evasion behaviours are recorded. Several sources of revenue losses cannot be monitored this way. Fare media fraud and electronic evasion is believed to be small but not insignificant. Unlimited MetroCard misuse (e.g., "swiping in" fellow passengers) occurs, but is difficult to track through silent observations. While surveyors' comments occasionally indicate these activities, this anecdotal information doesn't form part of survey dataset.

NYPD 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 then sell "swipes" to customers prevented from purchasing MetroCards. MVM vandalism rates are captured using machine repair staff's fault codes, but associated evasions and

revenue losses are difficult to estimate. Nevertheless, vandalism rates serve as proxy for swipe-selling hotspots.

FARE EVASION TRENDS

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

Hourly Distribution

Evasion rates per passenger, by-hour (Figure 4(b)) showed counterintuitive trends. Conventional wisdom suggests evasion peaked 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) provided "more eyes and ears", previously described (*60*) as higher street crime probabilities on deserted sidewalks. Data supports this hypothesis somewhat as rates average about 1.6% in middays (10:00~14:59) and 1.3% in evenings (20:00~23:59), whereas it's 0.9% in peak hours (6:00~9:59 and 16:00~19:59).

However, evasion rate spiked to almost 3.0% during 15:00~15:59. Investigation revealed students leaving high schools together evading in large groups cause this peaking – likely explained by increased social facilitation. Indeed, AFC ridership at stations near schools anecdotally show unexpected upward surges when police officers are present during afternoon school hours (*61*). Subway incident logs even use the term "school condition" to describe problematic service interferences resulting from concentrations of students.

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

System Entry Distribution

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

Conversely, *per-passenger* rates are low at largest stations and busiest times, averaging around 0.5%. But sheer volumes give rise to high *per-hour* rates hovering around 8.0 evaders/hour. Random enforcement at busy locations during rush 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 median annual income of about $30,000 (not adjusted for inflation), then essentially flatlines – 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 general seasonality of crime. Systemwide evasion rates may also correlate with ridership, as both are influenced by weather conditions.

Revenue Loss Estimation

While subway "menu 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, thus no monetary losses occur. Conversely, if evasion were difficult, regular evaders might divert to multi-ride fares or purchase passes. Clearly, stolen rides have some value.

Originally, NYCT conservatively assumed evaders would pay $1.33 blended subway average fare (including student discounts) 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 suggests students are overrepresented amongst evaders, thus NYCT recoupable losses may be lower. Conversely, free subway-bus MetroCard transfers meant even if evaders beat the $2.25 subway fare, fares might still be collected when transferring to buses (free if subway fares were paid). If evaders don't successfully skip bus fares, Transit may actually recoup some losses. Using $1.48 adjusted average fare and 1.0% evasion rate, this translates into annual losses of about $23.6 million.

Methods of Evasion

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

Another unexpected finding was that two-thirds of gate entries may actually be legitimate despite their questionable appearance to casual observers, e.g. school groups with authorization letters.

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 prior to leaving each location whether gates were properly locked from unpaid side. Evasion rates were computed by gate locking status. Gate evasion rate was 1.5% unlocked, and only 0.8% when locked. Interestingly, unlocked gates also invite more "questionable" entries; rate was 1.8% unlocked, but only 0.9% locked. Keeping gates locked potentially halves gate-related evasions!

Following this finding, NYCT reinstructed station supervisors and agents on importance and revenue impacts of keeping gates locked. Questionable gate entries decreased from 1.5% to 0.4% following this change (Figure 5), but illegal gate entries didn't show statistically significant decrease when seasonality effects are accounted for. This measure seems to target mostly casual evasions.

Fare Control Area Configuration

Originally fare control hardware and staff presence was 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 don't seem to deter evaders.

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

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 NYPD, which utilizes hidden portable wireless digital video cameras in "sting" operations to gather evidence against organized fare abuse rings and identify leaders. These "professional swipers" can be difficult to apprehend because they are very mobile and requires strategic and determined law enforcement efforts to monitor MVM vandalism patterns, prioritizing stations with 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, FATF achieved escalating sentences for recidivists. The coordinated efforts resulted in a five-swiper ring being disbanded and sentences of over one year being imposed. Measuring impacts of taking down fare abuse operations is diffuclt, because even large swiper rings 'sell' very few fares compared to natural day-to-day fluctuations of the 8.0 million riders on NYC's system due to reasons like weather or special events.

Legal Framework and Enforcement

Most important evasion fighting tool is arguably comprehensive and functioning legal frameworks to deal with evaders and counterfeiters. NYCT's Rule of Conduct (*62*) has banned evasions since the 1980s, rules having been established mainly for arresting persons likely to commit other crimes (assault, graffiti). With appropriate legal framework, like traffic stops, evasion checks can be effective in identifying and arresting criminals wanted on outstanding warrants (*63*).

To round-up evaders, MTA 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 (*64*). One passenger was arrested for *exiting*, not *entering*, through an emergency gate (*65*).

Legal framework is more than prohibition of illegal acts and prescription of fines. Complete regulations should address issues like: arrests versus summonses; arresting/summons issuing powers; whether undercover enforcement is permitted; disputes/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?"); required evidence for conviction (e.g. whether video evidence are admissible). New York allows certain non-police employees to issue evasion citations, and utilizes both uniformed and undercover police enforcement.

Contextual security – expressly forbidding nonpayment and offering ways to punish rulebreakers – is potentially as important as having secure hardware. In Boston, students used well-known methods (*29*,*30*) to defeat Mifare Classic farecard's proprietary encryption, publicly demonstrating proof-of-concept forgeries (*31*). However, they didn't acknowledge the highly illegal nature of using forged cards, making cloning not worthwhile for $1.70 fares. 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 counter-terrorism cameras at key stations. PIDs covers 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. MBTA, CTA (*21*), and Port Authority Trans-Hudson (PATH) also use sophisticated camera equipment, and MBTA

even apprehended vandals damaging AFC equipment while evading, publishing the video footage (*20*).

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

Fare Evasion Fines

Transit's $60 penalty was internally set by Transit Adjudication Bureau (TAB) with delegated powers (*66*). NYCT increased fines to $100 (Figure 4(f)) in July 2008, the maximum TAB can levy without further approvals, to support conversion to POP fare collection on a Bronx bus line (*67*). In Boston, prior to CharlieCard AFC implementation and conversion of booth clerks to roving agents, MBTA quietly asked Massachusetts State Legislature to make evasions a civil offense (*68*) punishable by progressive fines ($15 first offense; $100 second; $250 third or subsequent). On Newark City Subway, where POP is in effect, evasion penalty was initially $75, but increased to $100 in 2008. On Metropolitan Atlanta Rapid Transit Authority (MARTA), evasion fines range from $85 to $235 (*22*), whereas they "start at $50" on the San Francisco Municipal Railway (*19*).

Economics of Casual Fare Evasion

NYPD focuses on arrests rather than summonses, because mandatory arrests of wanted criminals are more critical to general crime reduction. Consequently, 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 every 100~200 evasions. Average weekday riders requiring three daily evasions would receive one $100 summons every 6 to 13 weeks. Considering weekly subway passes retails at $27, evaders could save $162 in 6 weeks but pay $100 in fines. Additionally, not all summonses are legally feasible to collect.

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

Difficulty Evaluating Enforcement and Countermeasures 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 benefits like preventing crime and confiscating drugs or weapons, whose monetary benefit 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 utilization of available resources; fines revenues may be offset by court and administration costs.

PUBLIC RELATIONS

Transit agencies' active efforts is sometimes required to correct misinformation from special interest groups. Due 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 last 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 the City. Subway crime has decreased 68% since 2000, and annual average evasion rate remains low (~1.3%).

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

While expected confusion about methodology adjustments arose, since data showed recent destaffing hasn't led to rampant evasions (still only 1.3%), and no reasonably accurate estimates exist for historical evasions, Daily News chose not to focus on station agent issues. Instead, the story highlighted that accurate measurements revealed more evasion than previously thought (*16*). 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 (Figure 6(b), "Subway Shocker"). Subsequently, focus shifted to illegal use of stolen keys (*69*) to unlock gates from unpaid side.

CONCLUSIONS

NYCT developed a multi-pronged approach for managing subway fare evasion. AFC was designed with security features to physically prevent abuse, allow silent observations, and facilitate audits. Legal framework gives transit police tools to enforce law and order. Data collection and analysis keeps an accurate picture of evasion trends and MVM vandalism. Taskforce-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 caution to evaders, and demonstrating judicious use of resources.

Fare evasion is likely a crime of opportunity. Allowing it may have implications on system security perceptions far beyond lost revenues. Riders are particularly irked by blatant evasions – out of basic notion of fairness, also because abuses can symbolize unaccountability and "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), while the mainstream press is awash with opinions about evasions and its prevention, whereas discussions amongst transit professionals seem taboo. Encouraging 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 ancillary security benefits of clamping down on fare evasion? More importantly, can they be quantitatively measured? Can correspondence between fare evaders and subway criminals be conclusively demonstrated? What are evaders' motivations? Trip purposes? How do tariffs or fines discourage evasion? How much fines are actually collected? Do they cover collection costs? What are "uncontrollable" factors affecting evasion rates? (e.g. weather, poverty, special events?) What countermeasures are most effective? What factors determine optimal enforcement rates? How much casual evasions are recurrent or habitual? What other patterns are seen in evasion data and evader demographic? What explains high evasion rates amongst students? How do evasions relate to social issues like homelessness? What about evasions on other modes? What changes in legal frameworks could impact 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 didn't, 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 very real impacts on transit authorities' bottom lines. A multidisciplinary approach bringing together sociology, legal, enforcement, economics, transit management, and psychology expertise will be necessary to answer these questions.

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LIST OF FIGURES

Note to Editors: Photos embedded in this document are not publication-resolution. Higher resolution artwork will be supplied separately to TRB.

FIGURE 1 New York City Transit's MetroCard Automated Fare Collection system features a variety of fare control hardware developed in response to the rampant fare evasion problem of the 1980s: (a) The fare controls at Cortelyou Road Station on the Brighton Line (paid side) features three low turnstiles and two emergency exit gates (EXGs); (b) One unstaffed control area at Howard Beach-John F. Kennedy Airport on the Rockaway Line (unpaid side) features two high entrance-exit turnstiles (HEETs) and one EXG; (c) This exit-only fare controls (unpaid side) features one stainless-steel high exit turnstile (HXT) and one EXG; (d) The exit-only control-area (paid side) features an older-style painted HXT and one EXG.

FIGURE 2 New York City Transit's Passenger Identification (PID) Cameras installed for counter-terrorism purposes offers a clear view of different methods of fare evasion practiced by passengers: (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 low turnstile; (d) Passenger "backcocks" the turnstile by pulling it back while entering. PID cameras also covers emergency exit gates, capturing examples of each type of gate-related fare abuse: (e) Child backcocks to enter the station; (f) Moments later, child returns to the emergency exit gate to allow parent to enter with stroller, allowing three passengers to enter without paying a single fare; (g) Commuter entering the system by catching the gate left open by passengers illegally using the gate to exit in a non-emergency situation; (h) Emergency gates are occasionally left ajar or closed but not locked, allowing unpaid passengers to enter the system; (i) A police officer opens the combined service exit/emergency exit for a stroller to exit, a legitimate use of the gate, however, a bystander is waiting outside in the unpaid area; (j) For reasons unknown, the policeperson allows the bystander to enter without paying, resulting in a "questionable" entry.

FIGURE 3 NYCT's fare evasion survey data collection form and surveyor instructions: (a) Completed form from the Myrtle-Wyckoff station in Eastern Brooklyn, the local high school dismissed students at around 15:06, causing the large number of opportunistic evaders and turnstile jumpers. The revenue impacts of this incident is likely minimal, though, because most students who ride the subway to school have free passes for system access; (b) Surveyor instructions illustrate precisely how system entries are classified into one of 19 categories.

FIGURE 4 Analysis of one year's worth of New York City Transit fare evasion observation data, and strategies to reduce evasion: (a) Evasion rates by system entry rate; (b) Evasion rates by time-of-day (hour); (c) Time-series systemwide evasion rates showing seasonality effects; (d) Evasion rates by Census 2000 median income of adjacent neighbourhoods; (e) Prototype signs being tested near turnstiles at the Bowling Green station to indicate height guidelines determining when children must begin to pay fare; (f) Fare evasion fines were increased to $100 in July 2008, and communicated to the public via informational posters.

FIGURE 5 New York City Transit keeps track of fare evasion via quarterly "flash" reports.

FIGURE 6 Transit maintains a good relationship and open channels of communication with mass media, supplying data to minimize averse press where possible: (a) Ten year trends supplied to Daily News on major felonies, evasion rates (both methodologies), police activity, and fine collection activity; (b) The resulting New York Daily News/Peter Donohue coverage on NYCT fare abuse issue, including the misuse of Firemen's keys to illegal gain access to the subway (reprinted with permission).

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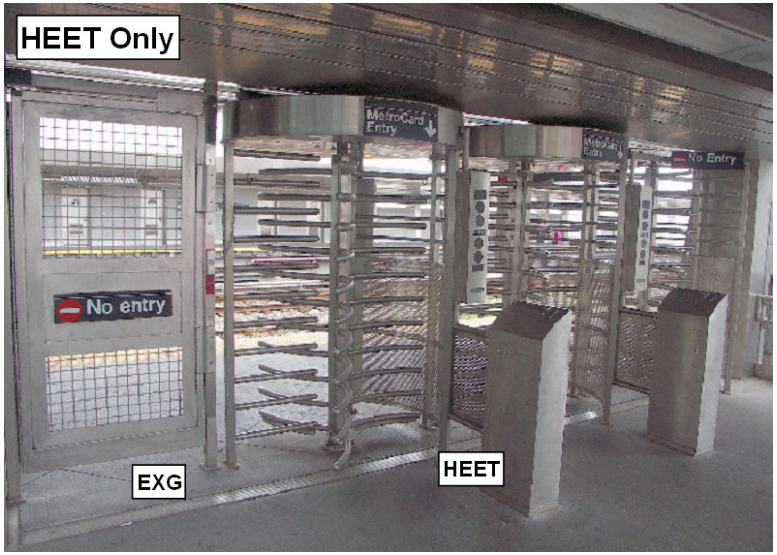
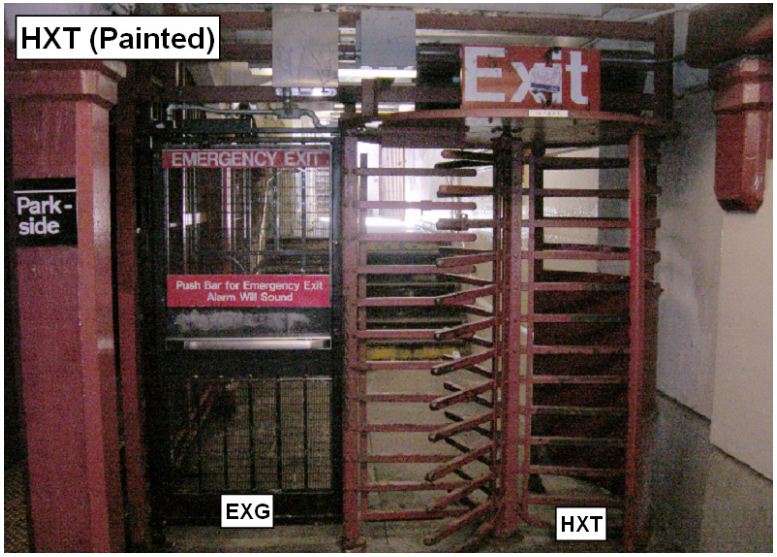
(a)



(b)

(c)



(d)

FIGURE 1 (Not Publication Resolution)

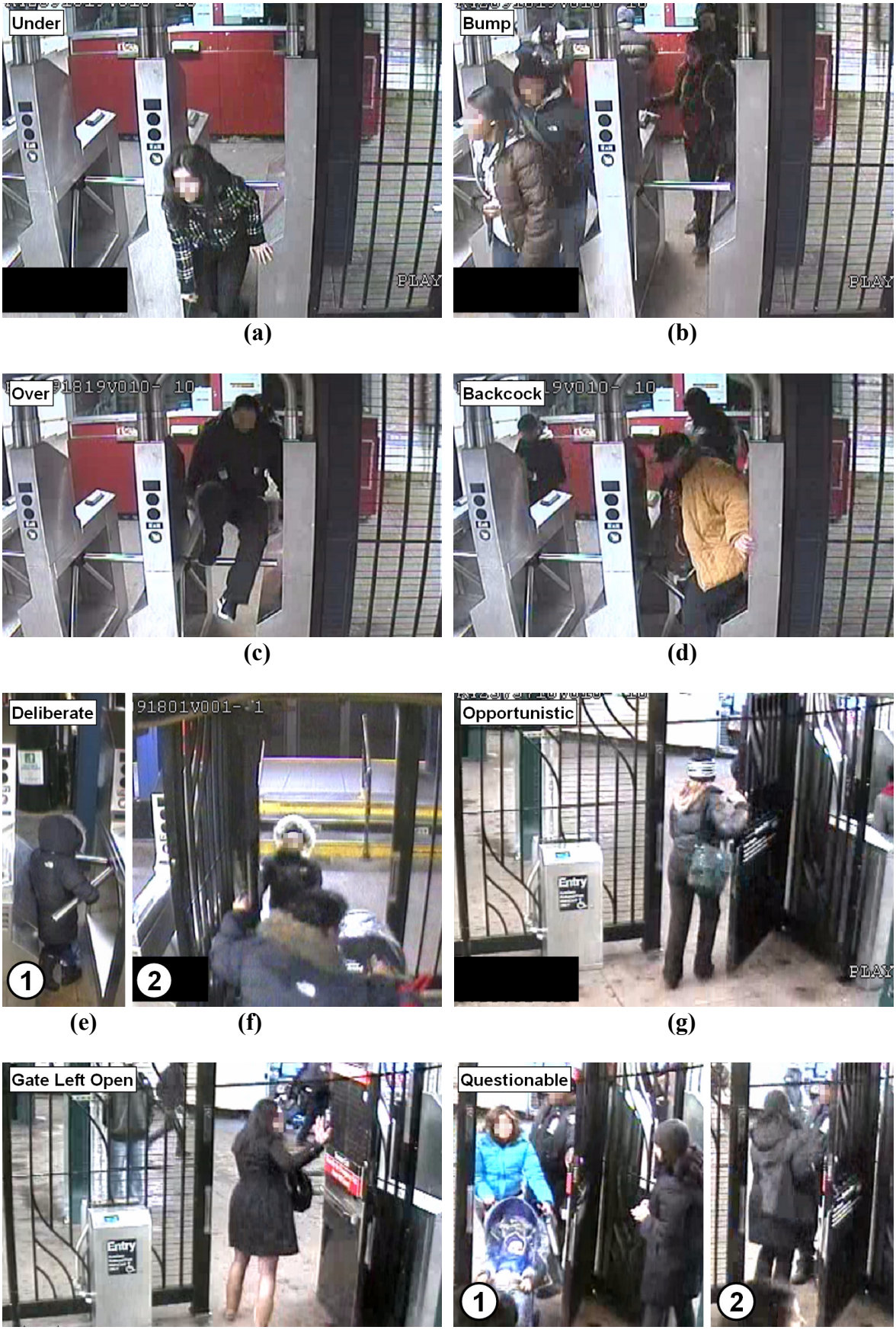
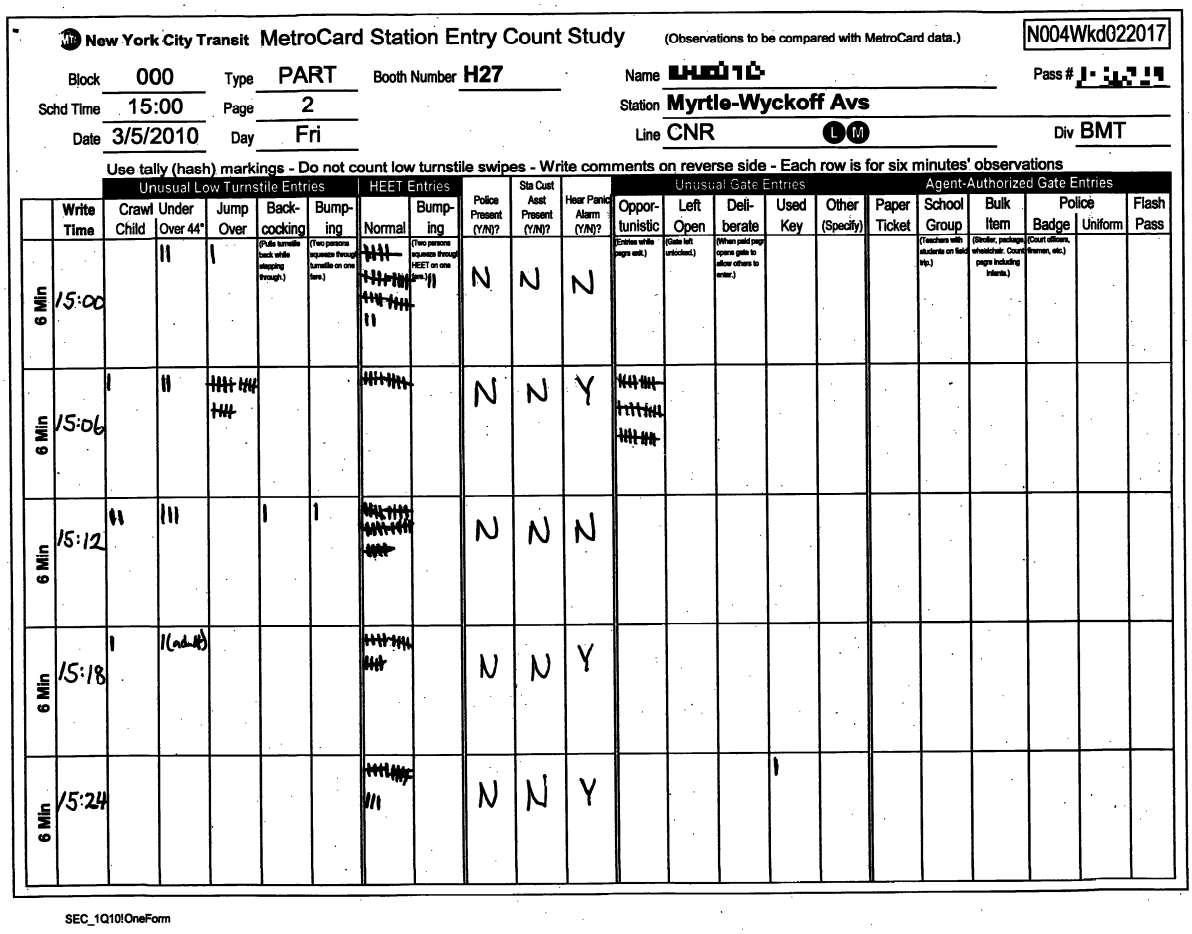


FIGURE 2 (Not Publication Resolution)

(a)



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]

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

Date 3/5/2010 Day Fri Line CNR (L)(M) 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	Unusual Low Turnstile Entries: Crawl Child	Under Over 44"	Jump Over	Back-cocking (Fully turnstile back while stepping through.)	Bump-ing (Two persons squeeze through turnstile on one fare.)	HEET Entries: Normal	Bump-ing (Two persons squeeze through HEET on one fare.)	Police Present (Y/N)?	Sta Cust Asst Present (Y/N)?	Hear Panic Alarm (Y/N)?	Unusual Gate Entries: Oppor-tunistic (Entries while gates exit.)	Left Open (Gate left unlocked.)	Deli-berate (When paid pag opens gate to allow others to enter.)	Used Key	Other (Specify)	Paper Ticket	Agent-Authorized Gate Entries: School Group (Teachers with students on field trip.)	Bulk Item (Stroller, package, wheelchair. Count pages including infants.)	Police Badge (Court officers, firemen, etc.)	Uniform	Flash Pass
6 Min	15:00		II	I								N	N	N										
6 Min	15:06	I	II										N	N	Y												
6 Min	15:12	II	III		I	I				N	N	N											
6 Min	15:18	I	I(and 44")							N	N	Y											
6 Min	15:24									N	N	Y				I							

SEC_1Q10!OneForm

(b)

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)):

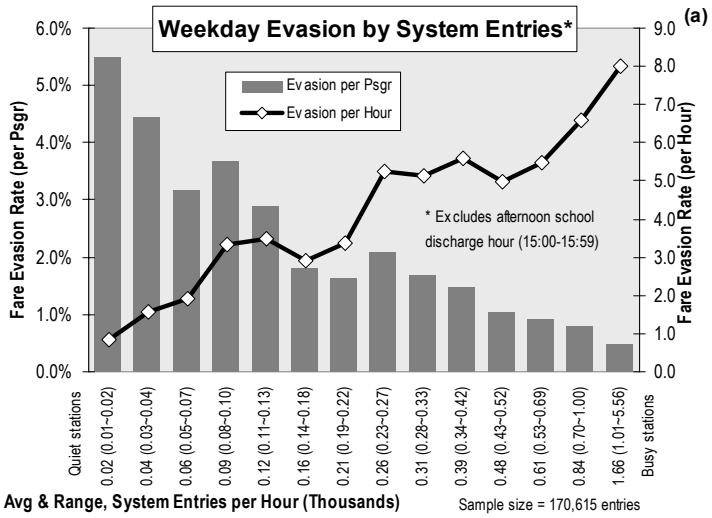
1. **School Group:** Large organized group of teachers, chaperones, and children shows or gives up to token clerk authorizing materials (e.g. letter), entering through gate.
2. **Police Uniform:** Passengers enter subway by approaching clerk while wearing full police, fire, court officer, postal, military, 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.

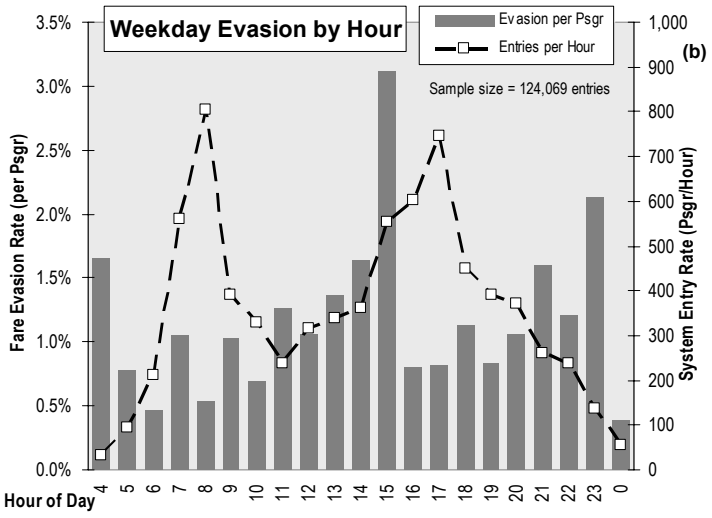
Data collection efforts must also capture "legal" system entries occurring during the sample period, to obtain the denominator for an evasion rate measurement.

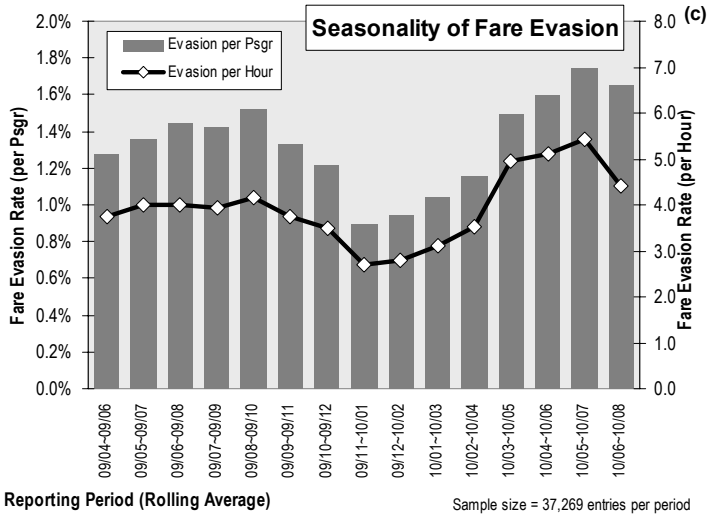
1. **Child:** Passengers accompanied by fare paying adult and under 44" in height, obtains system access by crawling under low turnstiles.
2. **Paper Ticket:** Passengers gives up to token clerk certain authorizing materials (e.g. block ticket), entering system through SET or service gate.
3. **Bulk 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.

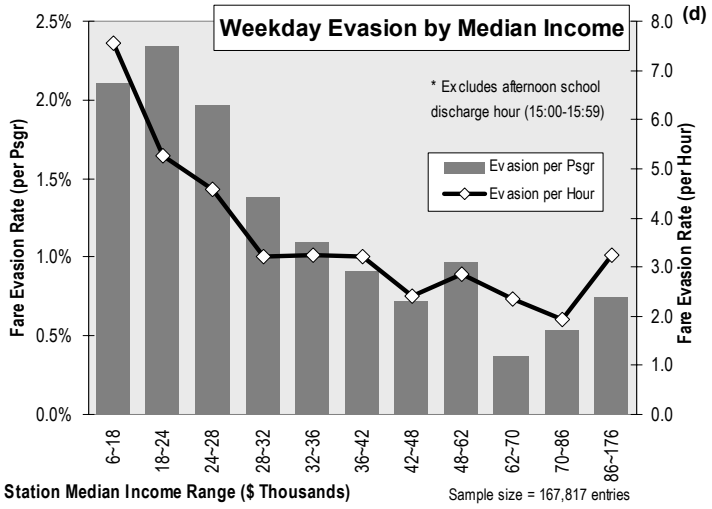
Normal system entries by swiping AFC fare media are not collected; the information is downloaded from the MetroCard AFC database. Data is collected in six-minute increments. AFC data (from which normal turnstile entry passenger counts are derived) is recorded to nearest six minutes. Surveyors must synchronize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

FIGURE 3 (Part (a) Not Publication Resolution)

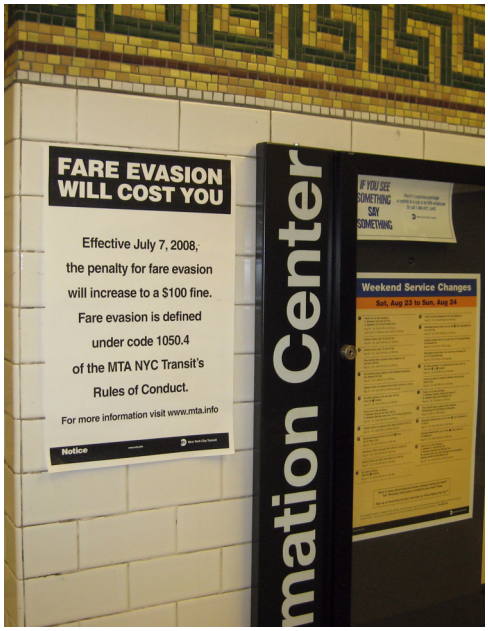








(e)



(f)

FIGURE 4 (Parts (e) and (f) Not Publication Resolution)

New York City Transit

D R A F T -- 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 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 (Part (b) Not Publication Resolution)