

Uncovering San Francisco Muni's Proof-of-Payment Patterns to Help Reduce Fare Evasion

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1 ABSTRACT

2 When transit customers pay fares, they contribute their “fair” share to help fund service. In San
3 Francisco, anecdotal observations had reinforced perceptions that a high percentage of Muni riders were
4 not paying, possibly costing the San Francisco Municipal Transportation Agency (SFMTA) tens of
5 millions of dollars annually in lost revenue. In 2009, the SFMTA, which operates Muni, conducted a
6 Proof-of-Payment Study to answer longstanding questions about fare payment patterns and identify
7 strategies to improve fare enforcement. The resulting survey of 41,239 customers on 1,141 vehicle runs
8 provided enough samples by time period, route and vehicle occupancy to identify fare payment patterns at
9 a disaggregated level. The study found a 9.5-percent minimum systemwide fare evasion rate that varied
10 by route, location, time period, level of enforcement and door of entry, amounting to an estimated \$19
11 million annually in uncaptured revenue based on 2009 fares. Although surveyors observed that there was
12 no “typical” violator, the data showed that fare evasion was more prevalent on certain routes and during
13 the afternoon and evening hours. Besides providing base data to measure future progress, the study
14 enabled the SFMTA to educate its customers about proof-of-payment requirements and deploy its fare
15 enforcement personnel more efficiently and cost-effectively in an effort to improve fare compliance.

1 INTRODUCTION

2
3 Collecting fare revenue is essential to a transit organization's ability to provide service, especially in a
4 tough fiscal environment with limited resources. This is particularly evident in San Francisco, a dense 47
5 square-mile city with approximately 815,000 residents where the heavily-ridden Muni system provides
6 around 700,000 trips on an average weekday. Operated by the San Francisco Municipal Transportation
7 Agency (SFMTA), Muni maintains a diverse transit fleet of light rail vehicles, historic streetcars, buses
8 (electric trolley coaches and motor coaches) and cable cars. A well-functioning Muni network is integral
9 to achieving the goals of the city's adopted "Transit First" Policy.

10 As vital as Muni is to San Francisco's mobility, environment and quality of life, a longstanding
11 perception exists that many people do not pay their fare. This perception has reduced public confidence
12 in the SFMTA and made it harder to identify new funding and implement service initiatives. While the
13 vast majority pays the appropriate fare, those who do not pay frustrate other customers and reduce the
14 financial resources available to operate comprehensive and reliable transit.

15 Like other agencies that have implemented proof-of-payment, the SFMTA wanted to better
16 understand how customers pay to address policy questions relating to fare enforcement, revenues and
17 operations. In 2009, the SFMTA conducted a Proof-of-Payment Study to investigate fare payment
18 patterns, assess their financial and operational impacts, and identify strategies to improve the efficiency
19 and cost-effectiveness of fare enforcement. In an objective and comprehensive analysis, SFMTA
20 employees spent three months surveying customers on nearly every bus and rail route during all times of
21 the day and on different days of the week. The team did not survey cable cars, a unique transportation
22 mode that is the subject of other SFMTA management efforts. Study goals included:

- 23
- 24 • To determine the magnitude of fare evasion through a statistically-significant survey;
- 25 • To quantify fare evasion's financial impact; and
- 26 • To assist in deploying Transit Fare Inspectors effectively
- 27

28 Survey teams observed 41,239 customers on 1,141 vehicle runs, a sample size that provided a
29 snapshot of fare payment patterns at a disaggregated level. The SFMTA found a minimum 9.5-percent
30 systemwide fare evasion rate, defined as the percentage of customers unable to display valid proof-of-
31 payment, which may include a small number of customers who paid cash but were unaware they needed
32 to obtain a transfer/fare receipt as proof-of-payment. The SFMTA estimated that fare evasion, which
33 varied by route, location, time period, level of enforcement and door of entry, lowered revenues by \$19
34 million annually.
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36 STUDY BACKGROUND AND PURPOSE

37 This research may prove valuable to transit providers that employ or are considering a proof-of-payment
38 system. While proof-of-payment may necessitate additional enforcement and revenue collection
39 personnel, it may also reduce dwell times, potentially resulting in higher ridership and/or fewer vehicles
40 to maintain service levels. A proof-of-payment system may also increase the actual or perceived fare
41 evasion, although alternative fare collection systems with operator fare verification and gated station
42 entrances do not necessarily guarantee full fare compliance. Transit agencies may need to weigh the
43 financial impacts of fare evasion relative to the costs and potential ancillary benefits of a proof-of-
44 payment system.

45 In the United States and Canada, random fare inspection typically occurs on "open" light rail or
46 commuter rail lines where customers purchase fare media at vending machines and access barrier-free
47 platforms. In contrast, "closed" rail systems with faregates require tickets or smart cards to enter and/or
48 exit stations and usually do not require fare inspectors to enforce fare payment. Bus proof-of-payment
49 systems are still rare; operators typically check fares as customers enter through the front door. However,

1 proof-of-payment is becoming more common on bus rapid transit (BRT) lines in places such as
2 Cleveland, Eugene, Las Vegas, Los Angeles, New York, Ottawa, suburban Toronto and Vancouver.
3 These systems usually feature wayside ticket vending machines where customers pre-purchase fares and
4 then enter the bus through any door.

5 The SFMTA is unusual among United States transit properties because its proof-of-payment
6 program is effective not just on light rail and streetcars, but on all buses as well. On Muni, Transit Fare
7 Inspectors may issue a \$75 citation to customers without a valid transfer/fare receipt, pass, Clipper®
8 smart card or single-ride limited-use ticket (electronically verified by inspector handheld units), or other
9 form of proof-of-payment. Payment policies vary by location and vehicle mode:

- 10
11 • At underground Muni Metro light rail stations, customers pass through faregates before
12 accessing boarding platforms. SFMTA's old faregates unlocked when customers deposited
13 the coin fare or inserted their passes through a magnetic stripe reader. Since the survey, the
14 SFMTA has replaced these faregates. Customers now load value or pass products onto a
15 Clipper® Card or purchase a limited-use ticket at a ticket vending machine. They then tag
16 the card or ticket on a faregate reader or display a paper transfer/fare receipt to a station agent
17 who will then release the faregate.
- 18 • At light rail surface stops, cash-paying customers must enter through the front door of the
19 first car, deposit their money into the farebox in the operator's cab, and obtain a paper
20 transfer/fare receipt from the operator as proof-of-payment. Customers with valid pre-paid
21 fare media may enter through any door of any car. Clipper® Card and limited-use ticket
22 users must tag a reader adjacent to each set of doors upon entry.
- 23 • On buses and historic streetcars, everyone must enter through the front door unless an
24 authorized SFMTA employee is present to verify proof-of-payment and permit back-door
25 entry. Cash customers deposit their money into the farebox and obtain a transfer/fare receipt
26 from the operator. Other customers display their pass or transfer/fare receipt to the operator
27 or tag their Clipper® Card or limited-use ticket on a reader. Cash customers cannot buy a
28 single-ride ticket off-board since it would be cost-prohibitive to install and maintain ticket
29 vending machines at every stop.

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31 Besides uncovering overall proof-of-payment patterns, SFMTA's study also focused on
32 understanding the impacts of Muni's back-door boarding culture. Back-door boarding on buses occurs
33 frequently, not just when it is permitted officially during the rare times that an authorized SFMTA
34 employee is present to check fares (Figure 1). Despite signage prohibiting back-door entry, some Muni
35 practices may have encouraged it. Operators often open back doors to accelerate loading and maintain
36 schedules. Clipper® smart card readers are also located at the back door. Many customers have grown
37 accustomed to entering through the back door without showing fare media or encountering Transit Fare
38 Inspectors.

39 Notwithstanding revenue impacts, officially permitting back-door boarding systemwide could
40 expedite the fare collection process and enhance Muni's operating performance. Without de facto back-
41 door boarding at certain stops, some routes would experience significant delays. On average, nearly 70
42 customers board a Muni bus (electric trolley coaches and motor coaches) per hour. This boarding rate
43 places Muni alongside New York City Transit with the most unlinked passenger trips per vehicle revenue
44 hour in the United States (1).

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FIGURE 1 Back-Door Boarding.

6 LITERATURE REVIEW

7 In designing the survey, the SFMTA researched previous efforts to measure systemwide fare evasion,
8 both in San Francisco and elsewhere. For a more thorough understanding of proof-of-payment, the
9 SFMTA concluded that its effort would require substantially more data than previous surveys.

10 The SFMTA launched its Proof-of-Payment program on segments of the Muni light rail system
11 between 1993 and 1998. Initially, the San Francisco Police Department (SFPD) enforced fares. Between
12 March 1998 and December 1999, SFPD observations along one line (N Judah) and at two surface stations
13 along another line (M Ocean View) found that less than 1 percent of customers lacked proof-of-payment.
14 After transitioning enforcement from the SFPD to its own Transit Fare Inspectors, the SFMTA estimated
15 a fare evasion rate of 1.5 percent to 2.0 percent (2). Those figures appeared to be significantly less than
16 anecdotal observations.

17 In 2006, a consultant study estimated a systemwide 10.5-percent evasion rate (3). Although this
18 finding was close to that of the 2009 study, it was hampered by a small sample size and non-
19 representative sampling. For example, most samples came from routes comprising just one-quarter of
20 Muni's ridership and no observations took place on weekends.

21 The SFMTA also examined fare evasion assessments elsewhere. In Portland, Oregon, for
22 example, Tri-Met analyzed fare evasion in the Rose Quarter district in conjunction with extending a fare-
23 free zone (4). In addition, the Transportation Research Board published *A Toolkit for Self-Service,*
24 *Barrier-Free Fare Collection* in 2002 as part of the Transit Cooperative Research Program. In this report,
25 several large transit systems in the United States, Canada, and Europe had self-reported fare evasion rates
26 ranging mostly from 1 to 6 percent (5). While this literature assisted the SFMTA with its survey design,
27 staff concluded there were limitations in its applicability. First, proof-of-payment in the studied cities
28 almost exclusively applied to rail lines with off-board fare collection, not buses with on-board farebox
29 equipment. Second, the surveyed transit systems did not use consistent methodologies in their
30 calculations, making it difficult to compare San Francisco and other cities directly.

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2 SURVEY METHODOLOGY

3 Any market research initiative faces the challenge of understanding customer behavior from a limited
4 sample aiming to represent a target population. Regardless of methodology, surveying fare evasion
5 patterns presents additional challenges. Determining customer behavior on a moving, possibly crowded
6 bus or train inherently limits achieving 100-percent accuracy despite the best efforts of fare inspectors or
7 surveyors, especially when the focus subjects may purposely avoid or deceive the survey team.
8 Nonetheless, the results suggest some bounds on the magnitude of fare evasion.

9 Adopting a “blank slate” survey approach, the SFMTA made no prior assumptions about how,
10 where and when fare evasion occurred. Survey teams travelled throughout San Francisco during all times
11 of the day to uncover fare payment patterns. Standard procedure is to check all customers on a vehicle or
12 passing through a checkpoint within a station’s fare-paid zone. Therefore, surveyors did not collect
13 demographic data since it would not add value to the Proof-of-Payment program or alter enforcement
14 procedures.

15 The survey plan achieved a reasonably representative ridership sample by route and time period,
16 subject to logistical and financial constraints. It included observations on all rail lines and bus routes,
17 except for special limited-service buses and those routes the SFMTA was going to discontinue under a
18 planned route restructuring. While the survey plan could not precisely mirror ridership to the stop level
19 by time period due to resource limitations, it employed several strategies to gather representative samples:

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- 21 • Major crosstown and radial routes were surveyed at least ten times and at least once during each
22 weekday time period, with most routes being surveyed at least twenty times.
- 23 • Lower-ridership community routes were surveyed at least once during each weekday time period,
24 with the exception of the evening hours due to resource constraints.
- 25 • On most routes, surveys took place at multiple locations (primarily high-ridership transfer points)
26 to reflect customer turnover. On express buses and other routes with low customer turnover,
27 surveyors boarded near peak-load points to maximize observations.
- 28 • Surveys took place on 45 days throughout the study period, including weekends. To reflect
29 varying ridership patterns, most major routes were surveyed on at least 10 different days.

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31 Each survey team consisted of two uniformed Transit Fare Inspectors and two recorders. Teams
32 employed two methodologies to determine fare payment:

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- 34 • Spot Check – Survey teams waited inconspicuously at a stop until all customers had boarded and
35 alighted. After boarding, one recorder and one Transit Fare Inspector began checking all
36 customers in front while their partners began checking the rear before meeting in the middle.
37 Transit Fare Inspectors asked customers to provide their proof-of-payment and announced their
38 findings to recorders who marked down the information. Usually, at least one team member
39 spoke Spanish or Chinese to assist customers in those languages.
- 40 • Ride Along – “Spot checks” had two limitations: (a) survey teams could not determine whether
41 customers displaying a valid transfer/fare receipt had paid the appropriate fare, and (b) they could
42 not distinguish which customers had entered through the back door. To better understand these
43 issues, for approximately one-third of observations, survey teams would complete a “spot check”
44 and then continue to “ride along” for multiple stops.

45 During a “ride along”, Transit Fare Inspectors remained inconspicuous by sitting or
46 hiding in the accordion section on articulated vehicles. Although vehicle operators were aware of
47 the team’s presence during a “ride along”, they were instructed not to modify normal interactions
48 with customers. To avoid confrontations, operators would sometimes issue a transfer/fare receipt
49 even if the customer did not pay the full fare. If survey team members did not hear the farebox

1 beep, they would record a fare underpayment. The team could also determine whether customers
 2 who entered through the back door had valid fare media. The team watched closely for customer
 3 intent. For example, if someone walked past the operator and sat down, and then saw a Transit
 4 Fare Inspector and went to pay, surveyors would record that the customer had paid nothing.

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 6 In terms of overall results, the two methodologies differed in that “ride alongs” enabled survey
 7 teams to detect underpayments that would have been classified as valid with “spot checks”. Teams
 8 witnessed relatively few underpayments (88), sufficient to know they occur regularly but not enough to
 9 determine an underpayment rate with statistical confidence or to alter the overall fare evasion rate
 10 substantially when integrating the results of the two methodologies. Underpayments remain an unknown
 11 variable and consequently the SFMTA has presented the overall fare evasion rate as a minimum.

12 The “ride alongs” also provided an adequate sample size (857 observations) to estimate a back-
 13 door fare evasion rate. This did not alter the overall results; either methodology would have detected
 14 whether these back-door boarders had valid proof-of-payment but only the “ride alongs” allowed teams to
 15 identify them as back-door boarders per se.

16 SFMTA staff determined that 200 to 1,000 customer observations would be needed to estimate a
 17 systemwide fare evasion rate within a ± 3 percent margin of error (subject to the inherent limitations of the
 18 survey methodology) at a 95-percent confidence level, assuming the actual rate ranged between 5 and 35
 19 percent. However, this sample size would not provide enough detail to understand spatial and temporal
 20 fare payment patterns and inform an enforcement deployment plan. Thus, staff gathered a much larger
 21 representative sample to permit data disaggregation with a high degree of statistical confidence. Survey
 22 teams ultimately sampled 41,239 customers, with sufficient observations to identify trends by route, time
 23 period and vehicle occupancy. Table 1 details the margin of error in each category at a 95 percent
 24 confidence level.

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 27 **TABLE 1 Statistical Margin of Error for Samples Collected**

Fare Analysis Category	Quantity of Samples Collected	Margin of Error (at a 95% confidence level)*
Systemwide	38,672 (“base” survey prior to fare increase) 41,239 (includes supplementary “after” survey following fare increase)	$\pm 0.3\%$
Route	Typically 200 to 1,500+ per local route	Majority of Routes $\pm 2.5\%$ All but 5 routes $\pm 5\%$
Time Period	At least 2,500 per time period (AM Peak, Midday, School, PM Peak, Evening and Weekend)	$\pm 1.3\%$ or better
Back-Door Boarding	857 successful or attempted back-door boardings	$\pm 3.3\%$
Vehicle Occupancy	4,650 to 16,000 by occupancy level (ridership less than 50% of seats, 50-100% of seats, 100-125% of seats, and more than 125% of seats)	$\pm 0.9\%$ or better

* The margin of error is subject to the limitations of collecting fare evasion data and detecting fare underpayments as discussed in the Survey Methodology section.

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 29 **SURVEY FINDINGS**

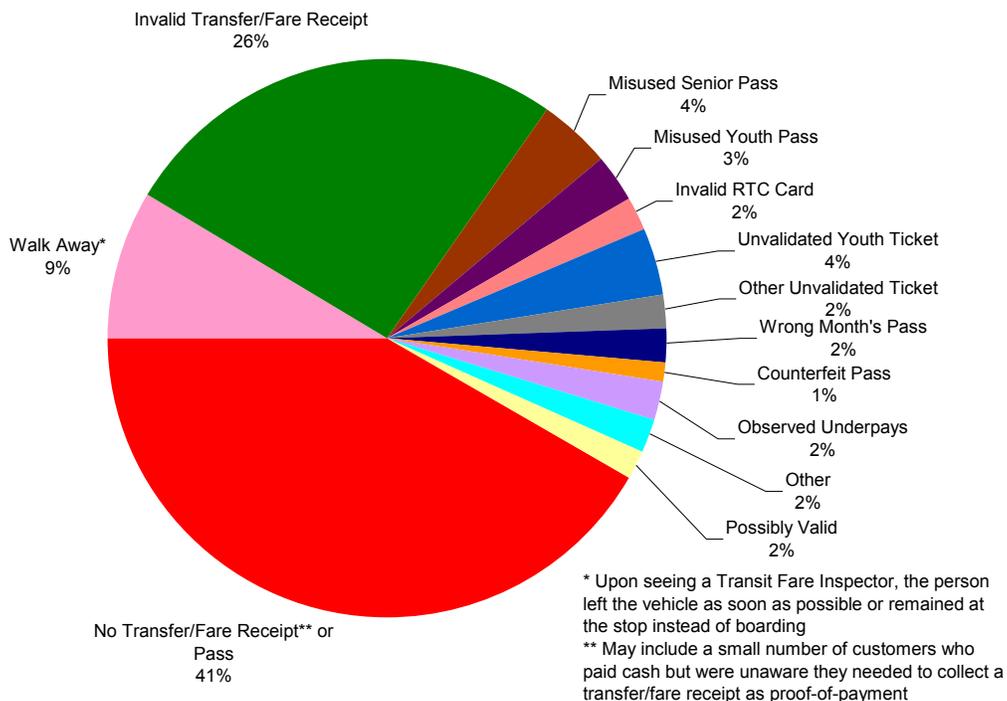
30 Overall, a minimum of 9.5 percent of surveyed riders lacked valid proof-of-payment, but the number is
 31 probably higher due to fare underpayments. This estimate reflects appropriate weighing of raw data by
 32 time period and route, with adjustments so that the samples reflect the proportional ridership distribution
 33 by time period and route. The SFMTA estimates ridership by rotating vehicles equipped with Automatic

1 Passenger Counters on different routes and employing a sampling methodology approved by the Federal
 2 Transit Administration for National Transit Database reporting.

3 Customers employed multiple methods to avoid fare payment (Figure 2). Of the roughly one out
 4 of ten customers without valid proof-of-payment:
 5

- 6 • 50 percent displayed no fare media or presumably had none because they “walked away” (left the
 7 vehicle or did not board after seeing the survey team)
- 8 • 26 percent had expired or otherwise invalid transfer/fare receipts
- 9 • 7 percent were age-ineligible adults with a discount Youth or Senior Pass
- 10 • 2 percent were people with disabilities who used their Regional Transit Connection card
 11 improperly, usually by not purchasing a monthly sticker
- 12 • 1 percent used counterfeit passes
- 13 • 14 percent had invalid proof-of-payment for other reasons

Types of Invalid Proof-of-Payment



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 15 **FIGURE 2 Types of Fare Evasion.**

16 Factors Influencing Fare Evasion

17 Surveyors observed that there was no “typical” fare evader. Fare issues could arise anywhere anytime.
 18 Nevertheless, fare evasion varied greatly by route and location, time period, level of enforcement and
 19 door of entry (Table 2).
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3**TABLE 2 Disaggregated Survey Results**

Fare Analysis Category		Customer Observations	Vehicle Runs Observed	Fare Evasion Rate (a)	Margin of Error (b)
Systemwide (c)	All Routes and Times (prior to fare increase)	38,672(c)	1,089	9.5% (d)	±0.3%
Route	1 California (TC)	893	29	4.5%	±1.3%
(Top 10 Bus	5 Fulton (TC)	740	23	9.7%	±2.1%
Corridors and	6 Parnassus/71 Haight-Noriega (TC/MC)	1,760	60	9.0%	±1.3%
All Rail Lines)	8X Bayshore Express (formerly 9X) (MC)	1,882	37	14.0%	±1.5%
(c)	14 Mission/14L Mission Limited (TC/MC)	1,760	44	19.9%	±1.8%
	22 Fillmore (TC)	1,074	31	9.7%	±1.7%
	29 Sunset (MC)	750	25	9.2%	±2.0%
	30 Stockton (TC)	1,316	32	8.4%	±1.5%
	38 Geary/38L Geary Limited (MC)	2,739	61	9.5%	±1.1%
	49 Van Ness-Mission (TC)	1,258	33	12.2%	±1.8%
	F Market & Wharves (HS)	1,546	35	12.0%	±1.6%
	J Church (LR)	734	17	5.6%	±1.6%
	K Ingleside (LR)	870	26	3.8%	±1.2%
	L Taraval (LR)	1,023	34	2.4%	±0.9%
	M Ocean View (LR)	1,216	29	3.8%	±1.0%
	N Judah (LR)	1,469	34	2.5%	±0.8%
	T Third (LR)	666	18	15.2%	±2.7%
Time Period (c)	Weekday Morning Peak (7 am.-9 am)	9,056	250	6.2%	±0.5%
	Weekday Midday (9 am-2 pm)	7,655	230	9.5%	±0.7%
	Weekday School (2 pm-4 pm)	7,170	206	9.8%	±0.7%
	Weekday Afternoon Peak (4 pm-7 pm)	9,249	252	10.5%	±0.6%
	Weekday Evening (7 pm-10 pm)	2,923	85	14.5%	±1.3%
	Weekend (All Day)	2,619	66	12.3%	±1.3%
Level of	Heavy (Muni Metro light rail)	6,024	158	4.7%	±0.5%
Enforcement (c)	Light (buses and historic streetcars)	32,648	931	10.5%	±0.3%
Back-Door	Observed Attempted and Successful Back-Door Boarding Entries	857	207	55.3%	±3.3%
Vehicle	Ridership less than 50% of seats	5,008	317	9.2%	±0.8%
Occupancy (c)	Ridership 50-100% of seats	15,939	477	9.3%	±0.5%
	Ridership 100-125% of seats	13,064	235	9.5%	±0.5%
	Ridership more than 125% of seats	4,661	59	10.5%	±0.9%
Fare	Before (selected routes and times of day)	7,557	173	12.1%	±0.7%
Increase	After (same routes and times of day)	2,567	52	12.6%	±1.3%

(HS) = Historic Streetcar, (LR) = Light Rail, (MC) = Motor Coach, (TC) = Electric Trolley Coach

(a) "Fare evasion rate" represents customers without valid proof-of-payment. It does not necessarily account for all cases of fare evasion (for example, undetected underpaying customers who still received a valid transfer/fare receipt). It may also include a small number of customers who paid their fare but were unaware they needed to obtain a transfer/fare receipt as proof-of-payment.

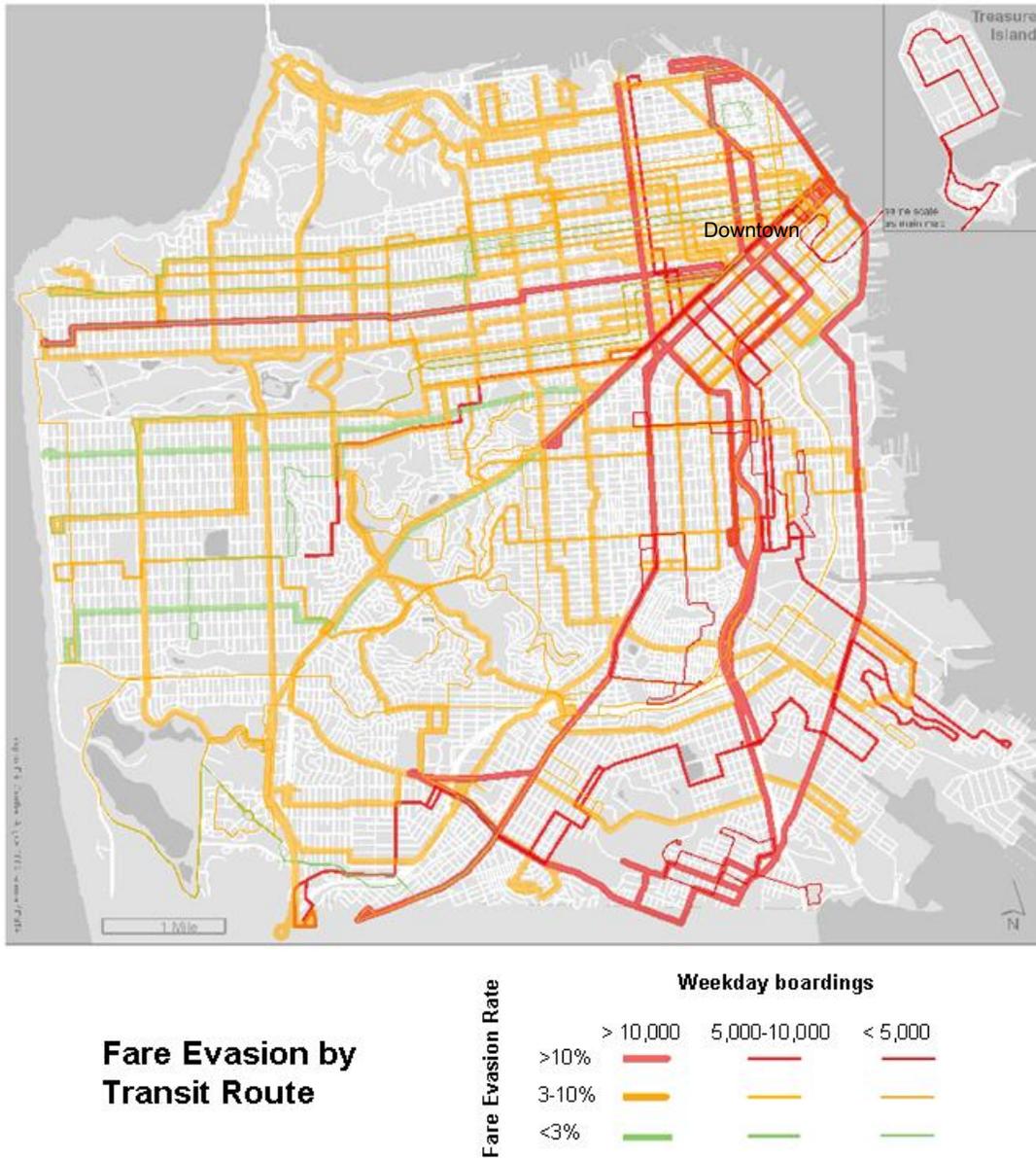
(b) Margin of error at a 95% confidence level.

(c) Consists of "base" survey data taken before the July 1, 2009 fare increase (38,672 customer observations) and excludes supplementary "after" data (2,567 customer observations).

(d) The 9.5% systemwide fare evasion rate is a minimum estimate that reflects weighing by time period and route.

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- Route and Location – Fare evasion occurs everywhere, but is concentrated in Downtown San Francisco and the city’s eastern half. Figure 3 illustrates Muni routes shaded by their estimated fare evasion rate, with line thickness reflecting average weekday ridership. Figure 4 shows the observed rate associated with survey boarding locations. The circle shading indicates the evasion rate while the circle size indicates the number of customers surveyed without proof-of-payment.



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FIGURE 3 Map of Fare Evasion Rates by Route.

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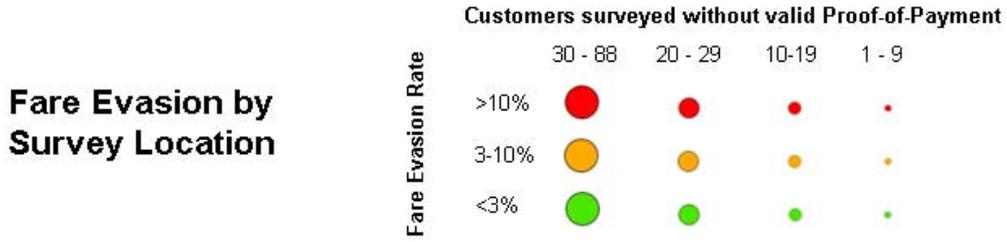
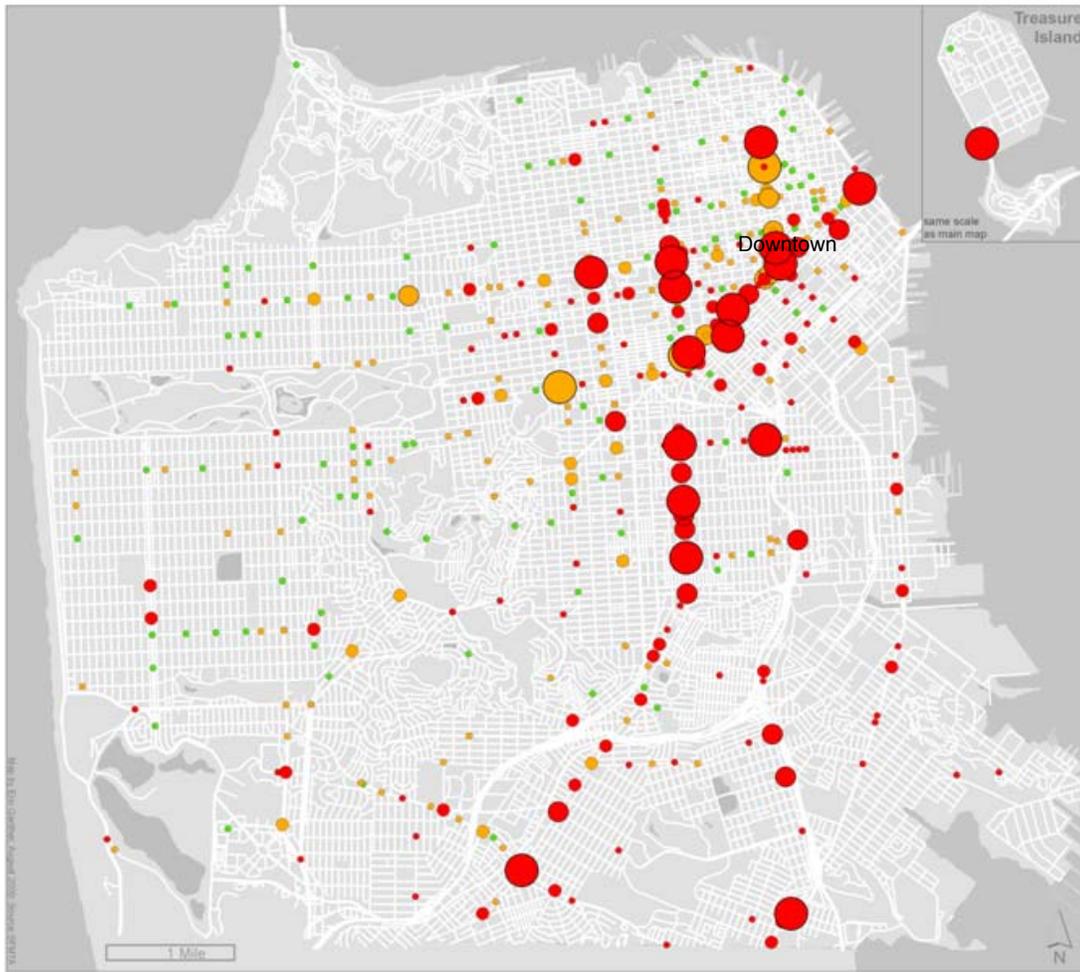


FIGURE 4 Map of Fare Evasion Observations by Survey Location.

- Time Period – Fare evasion increased as the day progressed, from 6 percent in the morning to 14 percent in the evening. Survey teams observed that morning peak ridership tends to be commuter-oriented with higher monthly pass usage. Later, a greater percentage of customers either paid nothing or presented expired transfers/fare receipts.
- Level of Enforcement – On Muni buses and historic streetcars, where Transit Fare Inspectors rarely appeared, the evasion rate was approximately 10.5 percent. Bus and streetcar operators checked fares but may have hesitated to confront fare evaders out of concern for their own safety and security. In contrast, the evasion rate averaged less than 5 percent on the light rail system where Transit Fare Inspectors have enforced proof-of-payment for over a decade. Faregates at

1 subway stations possibly may have deterred fare evasion on the light rail system, but the old
 2 emergency exit swing gates in use during the survey were unlocked and may have also enabled
 3 people to pass through unstaffed entrances without encountering SFMTA employees.

- 4 • Back-Door Boarding – Of the 857 people that survey teams observed either successfully boarding
 5 or attempting to board the back door of buses, the fare evasion rate was 55 percent – over five
 6 times higher than the systemwide average. Although back-door boarding appears to facilitate fare
 7 evasion, an immediate shift to exclusive front-door boarding could slow travel times, particularly
 8 on some of Muni’s busiest routes that average over 100 boardings per vehicle hour.

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 10 Other factors did not appear to impact fare payment patterns significantly.

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 12 • Vehicle Occupancy – The fare evasion rate on heavily-crowded vehicles was only about one
 13 percentage point higher than on less-crowded vehicles. Nevertheless, on average the absolute
 14 number of customers without proof-of-payment was higher on heavily-crowded vehicles simply
 15 because they had heavier ridership, possibly creating the perception that the fare evasion rate was
 16 correlated with vehicle crowding.
- 17 • Fare Increase – During the survey, the SFMTA raised cash fares from \$1.50 to \$2.00 for adults
 18 and from \$0.50 to \$0.75 for seniors, people with disabilities and youths, and increased
 19 corresponding monthly pass prices. Fare evasion rates for comparable routes and times before
 20 and after the fare increase were within 0.5 percentage points of each other (12.1 percent with a
 21 margin of error of ± 0.7 percent before versus 12.6 percent after). Given that the number of
 22 customer observations after the fare increase was approximately one-third of those before (and
 23 therefore statistically less precise), it appears that the fare increase probably had little to no
 24 impact on fare payment patterns.

25 26 **Uncaptured Revenue Estimates**

27 Based on the survey, the SFMTA estimated that it could increase fare revenue by \$19.2 million annually
 28 in the unlikely scenario of 100-percent fare compliance, or about \$2 million for each percentage point
 29 reduction in the fare evasion rate. About \$15 million of the uncaptured revenue stemmed from customers
 30 lacking any fare media or having expired or otherwise invalid transfers/fare receipts. Fare underpayment
 31 was estimated to cost at least \$2 million while the misuse of Youth and Senior Passes by age-ineligible
 32 adults lowered revenues by \$1.3 million. Other fare violations, such as counterfeit passes, passes from
 33 the wrong month, or misused visitor passes, accounted for less than \$1 million in uncaptured revenues.
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35 **FARE ENFORCEMENT CHANGES**

36 Prior to the study, fare enforcement’s focus on light rail – comprising one-quarter of system ridership –
 37 meant that most Muni customers rarely encountered fare inspectors. Expanding enforcement to buses
 38 and historic streetcars and maintaining the inspection rate would have required roughly 300 percent more
 39 inspectors. Although the SFMTA had planned a 30 percent increase (from 46 to 60 full-time inspectors)
 40 for Fiscal Year 2009-2010, funding shortfalls precluded even this level of additional staffing.

41 The study enabled the SFMTA to develop inspector deployment schedules that balanced two
 42 goals within the limited resources available:

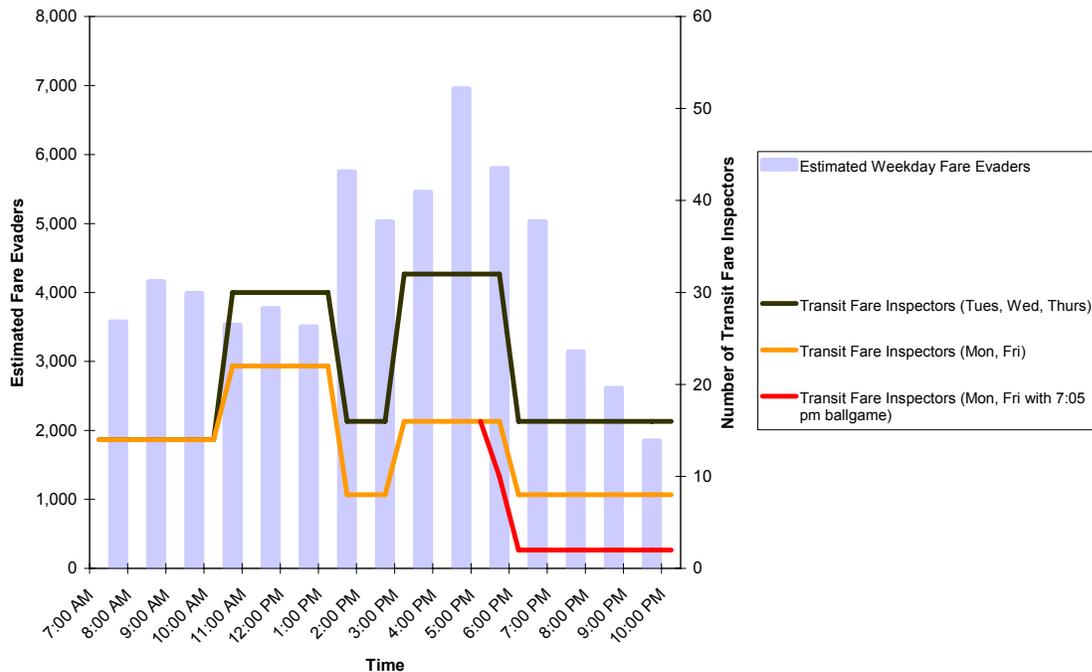
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 44 • Ensuring that all customers expect that a fare inspection might occur anywhere anytime
- 45 • Increasing fare compliance on routes and at times with substantial fare evasion issues

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 47 The study revealed that fare inspection schedules did not correspond with when fare evasion was
 48 most likely to occur (Figure 5). Generally, the estimated number of fare evaders on weekdays peaked

1 from 1 pm to 7 pm, with significant occurrences in the evening. In contrast, staffing was oriented towards
 2 the morning, particularly on Mondays and Fridays when half the inspectors had a regular day off. During
 3 evening Giants baseball games requiring up to six inspectors, there might be just two others covering the
 4 remainder of the system.

5 Using the study results, the SFMTA moved shifts one to three hours later to reallocate more
 6 resources towards the afternoon and evening. For example:

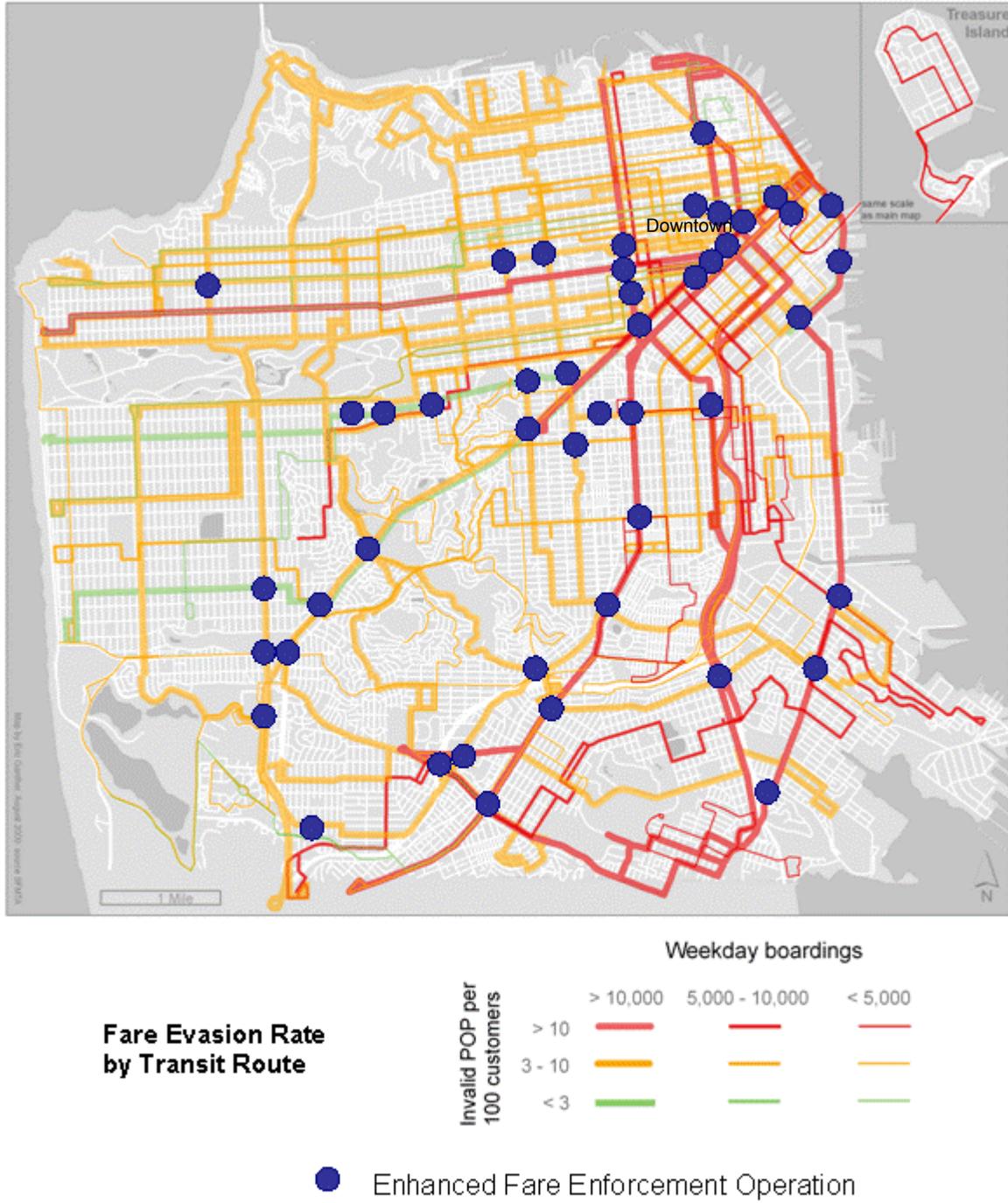
- 7
- 8 • The Monday-Friday day shift was moved to end at 3:30 pm instead of 2:00 pm
- 9 • The Tuesday-Saturday day shift was moved to end at 5:00 pm instead of 2:00 pm
- 10 • The Sunday-Thursday mid-shift was moved to end at 7:30 pm instead of 6:30 pm
- 11 • The Tuesday-Saturday mid-shift was moved to end at 8:30 pm instead of 6:30 pm
- 12



13 **FIGURE 5 Weekday Fare Inspector Staffing During the Survey vs. Estimated Fare Evaders by**
 14 **Time of Day.**

17 In addition to deploying two-person fare inspection teams to bus routes with identified fare
 18 evasion issues, the SFMTA initiated “Enhanced Fare Enforcement” operations at major stops. Up to six
 19 inspectors check on-board and alighting customers while a vehicle waits at a stop, typically in under a
 20 minute. Fare inspection teams have issued as many as 50 citations per hour. These operations have taken
 21 place not only where there is above-average fare evasion, but also in other locations so that all customers
 22 can expect a fare inspection (Figure 6). The SFMTA has conducted outreach in English, Spanish and
 23 Chinese (Figure 7) to increase public awareness of the purpose of its fare enforcement program and to
 24 educate customers that they must carry valid proof-of-payment at all times. Multilingual automated bus
 25 announcements also notify customers that they must always possess proof-of-payment.
 26
 27
 28
 29
 30

1



2
3

FIGURE 6 Transit Fare Inspector “Enhanced Fare Enforcement” Operations.



1
2 **FIGURE 7 Multilingual Outreach to Discourage Fare Evasion.**
3

4 Currently, the SFMTA is contemplating a pilot program to permit back-door boarding officially
5 along four bus corridors. These corridors have a combined weekday ridership of approximately 150,000
6 with fare evasion rates ranging from 10 to 20 percent. The SFMTA is also evaluating whether to hire
7 more Transit Fare Inspectors to boost enforcement coverage on these routes. While additional staff would
8 increase operating costs, greater enforcement may also increase fare revenue. The SFMTA is also
9 estimating the potential operating cost savings that back-door boarding could produce by reducing the
10 number of vehicles required to maintain service headways.
11

12 **IMPLICATIONS FOR OTHER TRANSIT SYSTEMS**

13 While all transit systems have unique characteristics, they also encounter common fare compliance issues.
14 A Proof-of-Payment Study adapted to localized needs may help systems address questions such as:

- 15 • Do perceptions of fare evasion match reality?
- 16 • Because it costs money to collect money, how much should be invested in fare enforcement
17 and equipment to reduce fare evasion rates to “acceptable” levels?
- 18 • Should a rail system have proof-of-payment, faregates with station agents, or both?
- 19 • Should buses convert to proof-of-payment? If so, are off-board ticket vending machines
20 required? Alternatively, can customers purchase tickets on-board to reduce vending machine
21 capital, operating and maintenance costs?
- 22 • Is there an “optimal” enforcement level where additional staff costs do not exceed the
23 expected fare revenue gains from greater fare inspection and the potential operating cost
24 savings from expedited boarding?

- 1 • What is an appropriate fine for failure to display valid proof-of-payment?
- 2 • How are fare enforcement policies sensitive to a transit system’s demographically-diverse
- 3 customer base?
- 4 • What additional staffing might be required to ensure “equitable” enforcement that extends to
- 5 all locations, including places with low fare evasion?
- 6

7 SFMTA’s study found that each percentage point reduction in the fare evasion rate equates to
8 approximately \$2 million in additional revenue based on 2009 fare rates. After accounting for citation
9 revenue, the net Proof-of-Payment labor budget for fiscal year 2009-2010 totaled about \$3 million, or less
10 than 2 percent of the \$188 million in fare revenue collected. These figures suggest that the Proof-of-
11 Payment program would “pay” for itself if the presence of Transit Fare Inspectors reduced the
12 systemwide fare evasion rate by just 2 percentage points.

13 Beyond these financial criteria, a transit system may wish to consider the non-monetary value of
14 proof-of-payment. The perception or reality that some people ride for free can make it difficult for an
15 organization to gain political support, secure new funding or implement fare changes. Finally, proof-of-
16 payment may also bring operational benefits. Sixty percent of Muni bus customers use passes and
17 officially allowing them to board through the back door may reduce dwell times substantially. The
18 SFMTA has estimated that increasing average Muni bus speeds from 8 to 8.5 miles per hour would
19 reduce average passenger costs per trip by 5 percent or conversely would equate to adding approximately
20 30 peak buses.

21

22 CONCLUSION

23 Like other transit providers, SFMTA’s recent operating budget pressures have impacted service and fares.
24 A lean fiscal environment has made it all the more imperative to collect fares from those not paying their
25 “fair” share. SFMTA’s Proof-of-Payment Study continues to provide a quantitative and analytical basis
26 for policy decisions relating to inspector deployment, boarding procedures and other issues. The SFMTA
27 intends to conduct supplementary surveys every one to two years to measure progress towards improving
28 fare compliance.

29 Prior to the study, many people might have been surprised to learn that 9 out of 10 people
30 possessed valid proof-of-payment when riding Muni. With few exceptions, at least 8 out of 10 people on
31 average had valid proof-of-payment even for the most problematic routes and times of day. Though fare
32 evasion remains a significant issue, especially considering the estimated \$19 million in annual uncaptured
33 fare revenue, the study curbed speculation that the magnitude of the problem was far greater.

34 For some, the study results might still appear to contradict their anecdotal observations. This
35 divergence between perception and reality underscores that fare evasion, particularly blatant forms such
36 as entering through the back door without paying, is highly visible and can shape public impressions of a
37 transit system and its management. In contrast, creating the expectation that one might encounter a
38 Transit Fare Inspector anywhere anytime can lower perceived and actual fare evasion and increase public
39 respect for the system. Perhaps most importantly, the study affirmed that investing in a fare inspection
40 program and gathering research data to deploy enforcement resources strategically can yield significant
41 benefits and help build a culture of fare compliance.

42

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3

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