

Will Consumers Voluntarily Undertake More
Proenvironmental Actions When It is Easier?
Evidence from Metrocard Usages in New York
City

Meiping Sun

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Abstract

Using a large subway transaction dataset with deposits and rides information in the New York City Metropolitan Transportation Authority (MTA) system, this paper examines the efficacy of various policy mechanisms to increase reuse of existing metrocards. Unlike findings in prior studies using self-reported survey data, commuters did not voluntarily reuse existing free transit cards more when cross-type refill options became available. In contrast, the surcharge fee on new card purchases reduced the overall demand for new metrocards by over 52 percent and prompted commuters to substitute to refill existing metrocards. These results suggest that accompanying better facilities with economic incentives can be much better effective in promoting proenvironmental actions than the implementation of better facilities alone.

1 Introduction

Based on the empirical literature, individual behaviours that benefit the environment are influenced by multiple factors such as personal values of environmental quality (Hopper and Nielsen, 1991; Hornik et al., 1995; Vinning and Ebreo, 1990), social norms that encourage sustainable actions (Bruvoll and Nyborg, 2004; Frey, 1994; Rabin, 1998), the opportunity cost of time spent on proenvironmental activities (Hong et al., 1993; Halvorsen, 2008; Jakus et al., 1996), and economic incentives (Frey, 1997; Tøgersen, 1994).

Economic incentives often loom particularly large, including those that result from environmental policies. Less well understood are the respective roles of facilities provided. Do people voluntarily undertake proenvironmental actions more out of their personal valuations of the environment that might be characterized as warm glow effects when better facilities are implemented? Many studies have shown that different types of facilities provided matter for proenvironmental behaviours (Halvorsen, 2010; Hong et al., 1993; Jenkins, et al., 2000). However, prior studies were based on self-reported survey data which could potentially introduce selection bias or endogeneity problem to the estimations. For instance, residents in neighborhood with access of curbside recycling may be inclined to report more recycling activities in questionnaire due to pressure of social norms or other influences, but not actually recycle more.

With a large card-level subway transaction dataset in the New York City Metropolitan Transportation Authority (MTA) system, this paper contributes to empirical evidence on individual proenvironmental actions that, unlike findings in prior studies, commuters did not voluntarily undertake more proenvironmental actions (reuse existing free transit cards more) when better facilities are implemented (cards can be refilled with both time-based and value-based options). In contrast, the number of cards sold dropped significantly right after \$1 surcharge fee was imposed on new transit card purchases.

Section two gives a brief review of existing literature that has investigated the determinants of proenvironmental actions. In the third and fourth sections, I describe the unique data set being used and the analytical framework. The fifth and sixth sections present results of my estimation and additional validation tests and, finally, I conclude by discussing these results, how they relate to past findings, and their implications for future policy.

2 Literature

For policy makers to achieve their aim of increased sustainable activities and to secure the most efficient design of the chosen policy instruments, it is important to understand the mechanisms behind voluntary contributions to sustainable actions and how they are affected by the introduction of economic incentives.

Many studies have shown that different types of facilities provided matter for proenvironmental behaviours (Halvorsen, 2010; Hong et al., 1993; Jenkins et al., 2000). For instance, Halvorsen (2010) found that increasing the supply of recycling services has a significant effect on household recycling, and that door-to-door collection and

drop-off centres are the two most effective methods in this respect. Jenkins et al. (2000) found that access to curbside recycling has a significant and substantial positive effect on the percentage recycled of all five materials (newspaper, glass bottles, plastic bottles, aluminum, and yard waste) and that the level of this effect varies across different materials.

Several papers have examined how voluntary recycling contributions are affected by the opportunity cost of time spent on recycling activities. Jakus et al. (1996) used generation models to estimate the demand for recycling by households. Their empirical models indicate that paper recycling by households are sensitive to the own cost of recycling activities. Waste managers may encourage greater levels of recycling by providing information on ways to enhance time efficiency. Hong et al. (1993) modeled participation in recycling as an ordered probit choice using a large sample of households from Portland, Oregon metropolitan area. With two-stage least squares estimation of demand for solid waste collection, their results implied that increases in disposal fees encourage recycling while demand for solid waste collection services is not reduced substantially.

Social norms have been shown to be a considerable determinant of all voluntary contributions, including household recycling activities. Bruvoll and Nyborg (2004) have found, using survey data, that recycling efforts of many individuals are motivated by a preference to conform to moral norms. However, they warned that increasing voluntary contributions through appeals to consumer responsibility may come at a social cost since appeals work through imposing a heavier (perceived) responsibility on consumers. This represents a welfare loss, which is not necessarily outweighed by warm glow benefits. Brekke et al. (2003) predicted that, besides its effects on relative prices and budget or time constraints, public policy indirectly influences voluntary contributions to public goods through the policy's effect on the morally ideal contribution, which is consistent with survey data on recycling behavior and voluntary community work.

If household behaviour is motivated by moral norms, introducing economic incentives may crowd out the intrinsically motivated behaviour (Frey, 1994 and 1997; Tøgersen, 1994). Frey (1994) suggested that consumers may react to an external motivation applied by authorities by reducing their effort to fulfill a certain duty. In an empirical study discussing the motivations for household recycling as well as the effects of economic incentives, Tøgersen (1994) found evidence of re-framing and crowding out of moral norms when economic incentives are introduced in the form of differentiated garbage fees.

In an effort to shed light on how all these factors interact, Halvorsen (2008) developed a method for analysing the effects on household recycling of many factors simultaneously, explicitly modelling the effects of norms and the opportunity cost of time spent on recycling. This study was carried out on a sample of Norwegian households. The study found that norms, the supply of recycling services and the alternative cost of time significantly influenced household recycling. There were also indications of crowding-out effects, as households tend to reduce their recycling efforts when recycling is perceived as mandatory. Unfortunately, the data included little information about renovation fees, and it was thus not possible to test for the crowding-out effects found in Tøgersen (1994).

3 Data

The MetroCard is used as a stored ride fare card for the New York City Subway rapid transit system; New York City Transit buses, including routes operated by Atlantic Express under contract to the Metropolitan Transportation Authority (MTA); MTA Bus, and Nassau Inter-County Express systems; the PATH subway system; the Roosevelt Island Tram; AirTrain JFK; and Westchester County’s Bee-Line Bus System. It is a thin plastic card on which a rider electronically loads fares. It was introduced to enhance the technology of the transit system and eliminate the burden of carrying and collecting tokens. The MTA discontinued the use of tokens in the subway on May 3, 2003, and on buses on December 31, 2003.

Various types of metrocards are available for purchase. There are two types of value-based cards. Single-Ride Ticket, a paper card with a magnetic strip on the front and with the date and time of purchase stamped on the back, is for one subway or local bus ride with one free bus to bus transfer. Single-Ride tickets expire two hours from the time of purchase. Pay-Per-Ride (PPR) MetroCard is a thin plastic card on which the customer can electronically load fares in multiples of 5 cents. When a PPR metrocard is swiped at a turnstile, base fare is deducted from the card balance. When a commuter loads fare to a PPR MetroCard, bonus free ride (a certain percent of the purchase amount) is given for purchases of threshold amount or more. For instance, from June 28, 2009 to December 29, 2010, the bonus value for PPR metrocards was 15% of the purchase amount for purchases of \$8 or more.

There are two types of time-based cards. A 7-Day unlimited-ride card is for unlimited subway and local bus rides until midnight on the seventh day following the first usage. A 30-day unlimited-ride card is for unlimited subway and local bus rides until midnight on the thirtieth day following the first usage.

Table 1: History of MTA fare hikes and changes in card types

Date	Jun 28, 2009	Dec 30, 2010	Feb 20, 2013	March 3, 2013	March 22, 2015
Base fare (\$)	2.25	2.25	2.25	2.5	2.75
7-day unlimited (\$)	27	29	29	30	31
30-day unlimited (\$)	89	104	104	112	116.50
Single-ride (\$) tickets	2.25	2.50	2.50	2.75	3.00
Surcharge on new metrocard purchase	No	No	No	Yes	Yes
Both time and Value can be added	No	No	Yes	Yes	Yes
Bonus for PPR, %(cutoff)	15%(\$8)	7%(\$10)	7%(\$10)	5%(\$5)	11%(\$5.50)

The two main policy changes of interest for this paper are: implementation of better facilities since February 2013 and imposition of \$1 surcharge fee on new metrocard

purchases since March 2013. Before February 20th, 2013, there were only same-type-refill options available: PPR metrocards could only be refilled with value-based deposits for PPR trips; 30-day unlimited-ride cards could only be refilled with 30-day unlimited-ride option; and 7-day unlimited-ride cards could only be refilled with 7-day unlimited-ride option. From February 20th, 2013 on, one metrocard can be refilled with any time-based or value-based options, irrespective of whether it was initially purchased as a PPR or an unlimited-ride metrocard. A new metrocard itself used to be cost-free. But a \$1 surcharge fee, tacked on when someone buys a new metrocard, went into effect on March 3rd, 2013. Table 1 shows the recent history of MTA fare hikes and policy changes.

The first part of this paper compares the effectiveness of added refill options versus surcharge fee in encouraging refills of existing metrocards. I analyze all transaction-level metrocard deposit data from January 1st, 2013 to May 1st, 2013 provided by New York City Subway Rapid transit system.

Each observation corresponds to a metrocard deposit transaction and includes information on amount of money added to the card, location of station, date and time, type of deposit, method of payment, and balance of the metrocard right before transaction. In addition, the data includes information on whether the transaction was performed at a booth station or at a vending machine. This data allows me to calculate daily sales of different types of metrocards as well as new metrocard sales as a percentage of total in-system transactions. Therefore, I am able to compare demand before and after the implementation of additional refill options. I am also able to compare demand before and after the \$1 surcharge was imposed.

The rides data includes the total number of MetroCard swipes made each week by customers entering each station of the New York City Subway, PATH, AirTrain JFK and the Roosevelt Island Tram from June 2010 to December 2013, broken out for various types of MetroCards. I use rides dataset to investigate whether the differences in behaviour I observe in added refill options versus surcharge fee suggest that customers reused their existing metrocards more with respect to surcharge or that they simply decreased usage of subway system due to higher surcharge and/or fare hikes.

4 Model

The base fare of a ride is c_1 and fixed cost of each deposit (i.e., cost of waiting in line to add money to the card, etc) is c_0 . r_i is a known, nonnegative constant, representing the marginal utility, or benefit of each ride for commuter i . The punishment (or tax) on purchasing new card is T . L is the current balance of the metrocard.

Commuters have idiosyncratic preferences for reusing metrocards and incur a utility cost for trying to keep the same card, a_i , which can be a positive cost (for instance, a psychological cost for remembering to take the metrocard) or a negative cost (for instance, a warm glow from helping the environment).

When there is no surcharge on new metrocard purchases, commuters with positive cost a_i have no incentive to execute efforts to keep the metrocard when balance drops to zero. Only commuters with warm glow for environment $a_i < 0$ will execute efforts to keep the same metrocard. After the surcharge T was imposed on new card purchases,

commuters with $a_i < T$ will actively seek to keep the same metrocard even when the balance of the card drops to zero, while commuters with $a_i > T$ may or may not.

5 Empirical Results

5.1 Descriptive Statistics

Table 2: Descriptive statistics

Variable	Jan 1st to Feb 19th, 2013	Feb 20th to March 2nd, 2013	March 3rd to April 30th, 2013
Daily New sales, n(%)			
Pay-per-ride	166596 (74.8)	179202 (75.4)	70912 (75.2)
7-day unlimited	37379 (16.8)	38319 (16.1)	15483 (16.4)
30-day unlimited	18823 (8.4)	20102 (8.5)	7902 (8.4)
Daily New PPR sales, n(%)	166596	179202	70912
No refill	106404 (63.9)	110692 (61.7)	38338 (48.7)
Refills ≤ 30 days	34901 (21.0)	39873 (22.3)	24769 (31.5)
Refills > 30 days	25285 (15.2)	28637 (16.0)	15592 (19.8)
Daily New 7-day unlimited sales, n(%)	37379	38319	15483
No refill	34202 (92.8)	35287 (92.1)	11302 (63.2)
Refills ≤ 30 days	1287 (3.5)	5406 (3.4)	3815 (21.3)
Refills > 30 days	1377 (3.7)	1726 (4.5)	2771 (15.5)
Daily New 30-day unlimited sales, n(%)	18823	20102	7902
No refill	13843 (76.3)	15056 (74.9)	5641 (57.0)
Refills ≤ 30 days	554 (3.1)	1182 (5.9)	2491 (25.2)
Refills > 30 days	3744 (20.6)	3864 (19.2)	1764 (17.8)

Table reports mean values of each variable

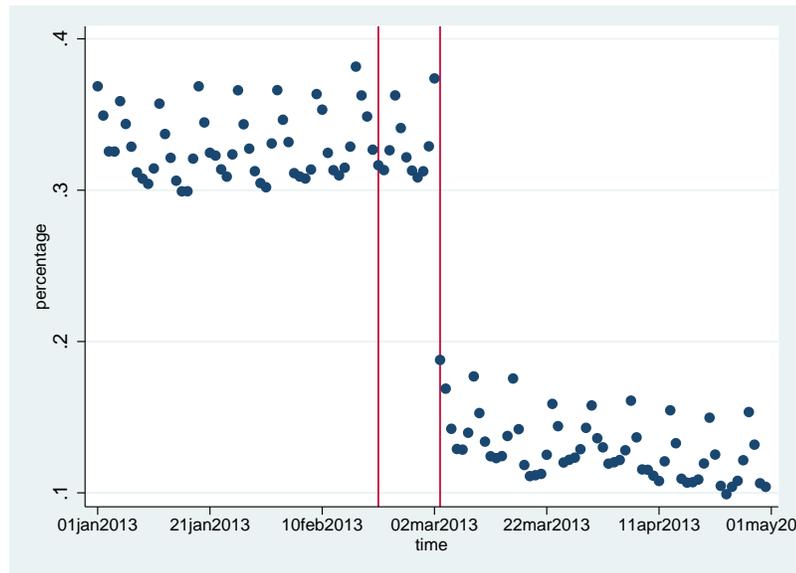
From January 1st, 2013 to April 30th, 2013, a total of 73275848 metrocard deposit transactions were observed. Table 2 contains the mean values of daily new card sales in the sample by different types of metrocards and time periods. Before the implementation of additional refill options on February 20th, there were on average 166596 new Pay-per-ride metrocards sold daily, which represented about 74.8 percent of total new metrocard sales. Among metrocards initially sold as PPR cards, over 63 percent cards had no refill activities at all, 21 percent with refill activities only within 30 days after initial purchase date, while merely 15.2 percent of PPR metrocards had refill activities after 30 days of original purchase date. After the implementation of additional refill options on February 20th, number of new PPR metrocard sold daily slightly increased to 179202 on average, which represented about 75.4 percent of total new metrocard sales. After the imposition of surcharge fee on March 3rd, number of new PPR metro-

card sold daily quickly dropped to 70912 on average, which was less than half of the initial daily sales. Similar patterns were observed for 7-day unlimited-ride and 30-day unlimited-ride metrocards.

5.2 Demand for New Metrocards after implementation of additional refill options versus surcharge fee

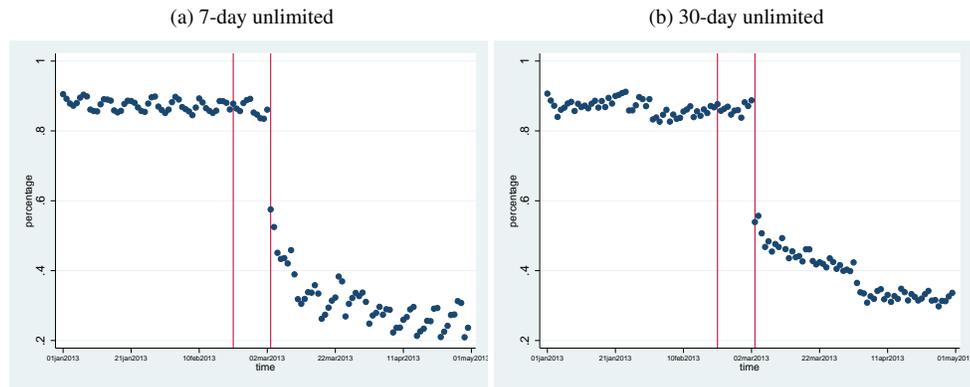
New PPR metrocard sales as a percentage of total in-system PPR sales did not change after cards could be refilled with both time and value. However, new PPR sales as a percentage of total in-system PPR sales dropped from 35 to 17 right after \$1 surcharge was imposed (Figure 1). Similarly, percentage of new 7-Day unlimited-ride card sales remained the same after cards could be refilled with both time and value, but dropped from 85 to 58 right after \$1 surcharge was imposed (Figure 2a). Percentage of new 30-day unlimited-ride card sales stayed around 86 after cards could be refilled with both time and value, but dropped from 85 to 56 instantly after \$1 surcharge was imposed (Figure 2b).

Figure 1: Daily New PPR metrocard sales as a percentage of total in-system PPR deposit transactions from January 1st, 2013 to April 30th, 2013



One possible reason the added refill options were not effective at changing commuter behavior is that customers were not aware of the existence of better facilities with which cards can be refilled with both time and value. The \$1 surcharge fee was highly visible in several dimensions. First, all major newspapers in New York City such as New York Times and Daily News had reports that informed residents of the impending surcharge fee on new metrocard purchases. Second, subway stations posted announcements by booth stations and vending machines about the surcharge fee. Third,

Figure 2: Daily New Unlimited-Ride metrocard sales as a percentage of total in-system Unlimited-Ride Card deposit transactions from January 1st, 2013 to April 30th, 2013



customers were notified on vending machine screen about \$1 surcharge fee when they purchased new metrocards at vending machines. While subway stations advertised the implementation of better facilities through announcements posted around booth and on the screen of vending machines, the lack of additional marketing may have generated a difference in awareness of the two policies.

To investigate possible discrepancies in awareness, I compared metrocard transactions occurred in subway station booths versus vending machines. When a commuter purchases a new metrocard or refills an existing metrocard at a subway station booth, the MTA employee who processes the transaction may or may not notify the person about newly implemented policies. However, when an individual purchases a new metrocard or refills an existing metrocard at a vending machine, the screen will always notify the person about newly implemented facilities or service fees.

Figure 3 plots the percent of new pay-per-ride metrocard sales at subway booth stations versus at vending machines. In each chart, the first vertical line signals the first day when additional refill options became available. The second vertical line marks the day when surcharge fee was first imposed. The figure shows that customers buying at booth stations purchased new pay-per-ride metrocards about 40 percent of the time while customers buying at vending machines purchased new pay-per-ride metrocards about 30 percent of the time before the availability of cards that could be refilled with both time and value. New pay-per-ride metrocard sales as a percentage of total in-system PPR deposit transactions did not change at either booth stations or at vending machines after the implementation of better facilities. In contrast, new PPR sales as a percentage of total in-system PPR deposit transactions dropped to 18 percent in the first week after \$1 surcharge was imposed. This estimate decreased to 11.3 percent by the first week in April and remained at or around 11 percent for the rest of study period.

I replicate this analysis for unlimited-ride cards in figure 4. Figure 4a shows that customers buying at booth stations purchased new 7-day unlimited-ride metrocards over 95 percent of the time while customers buying at vending machines purchased

new 7-day unlimited-ride metrocards about 80 percent of the time before the implementation of better facilities. New 7-day unlimited-ride metrocard sales as a percentage of total in-system 7-day unlimited-ride sales remained the same in vending machines, but began to decrease slowly for purchases at booth stations after cards could be refilled with both time and value. Contrarily, new 7-day unlimited-ride card sales as a percentage of total in-system 7-Day unlimited-Ride card sales dropped immediately to 60 percent for purchases at vending machines and 50 percent for purchases at booth stations upon the implementation of \$1 surcharge fee. By the last week in April, only 25 percent of 7-day unlimited-ride card sales at vending machines were new card sales.

Results for the percent of customers buying 30-day unlimited-ride metrocards are presented in figure 4b and tell a qualitatively similar story. Customers buying at vending machines purchased new 30-day unlimited-ride metrocards about 85 percent of the time while customers buying metrocards at booth stations purchased new 30-day unlimited-ride metrocards over 97 percent of the time before the implementation of better facilities. New 30-day unlimited-ride metrocard sales as a percentage of total in-system 30-day unlimited-ride transactions remained the same for sales at both booth stations and vending machines after cards can be refilled with both time and value. In contrast, new 30-day unlimited-ride card sales as a percentage of total in-system 30-Day unlimited-Ride card transactions dropped immediately to 50 percent for sales at booth stations and 60 percent for sales at vending machines upon the implementation of \$1 surcharge fee. By the last week in April, only 20 percent of 30-day unlimited-ride card sales at booth stations were new card sales.

Therefore while differences in awareness may affect the observed impact of surcharge fee versus availability of more refill options, its influence is, to the utmost, trivial.

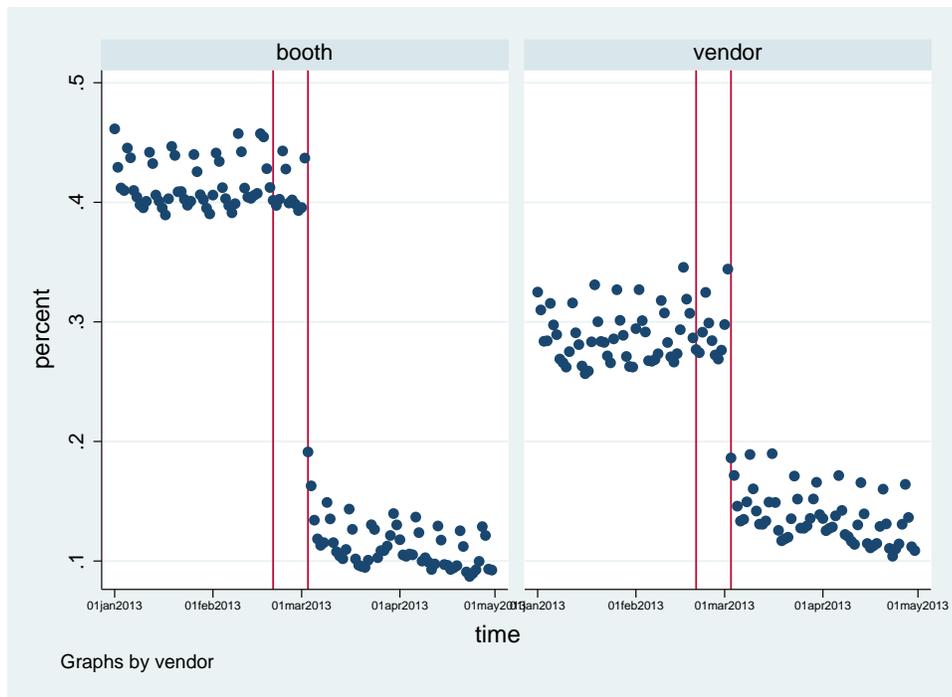
5.3 The Effect of implementation of more refill options versus surcharge fee: A Difference-in-Differences Analysis

Controlling for station-level covariates, I then use a regression framework to evaluate the effects of added refill options and surcharge fee on percent of new metrocard sales. The empirical model follows a difference-in-differences strategy and takes the following forms:

$$Y = \theta_0 + \theta_1 \text{Post-facilities} * \text{Vendor} + \theta_2 \text{Post-surcharge} * \text{Vendor} \\ + \theta_3 \text{Post-facilities} + \theta_4 \text{Post-surcharge} + \theta_5 \text{Vendor} + \lambda X + \epsilon,$$

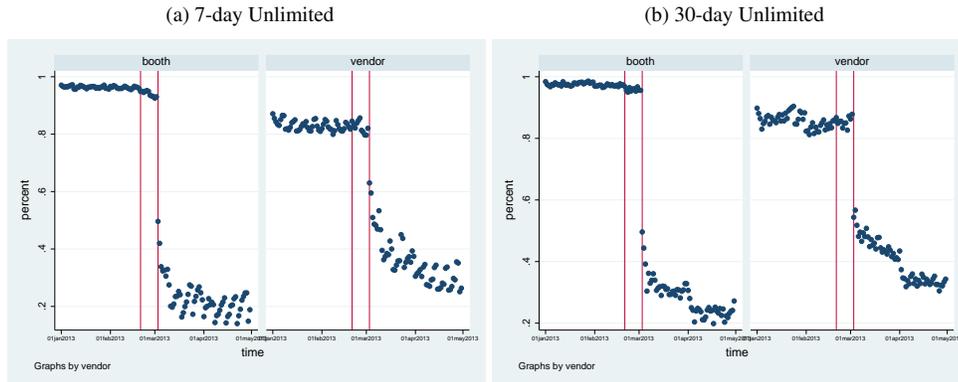
where Y is percent of new metrocard sales on daily basis at station-level, Post-facilities and Post-surcharge are indicators for observations after the implementation of additional refill options and imposition of surcharge fee, respectively. Vendor is an indicator for customers buying at vending machines, X is a set of controls. The coefficients of interest are θ_3 and θ_4 , coefficients of Post-facilities and Post-surcharge , which measure the effect of better facilities and surcharge fee, respectively, on changes in percent of new metrocard sales.

Figure 3: Daily New PPR metrocard sales as a percentage of total in-system PPR deposit transactions from January 1st, 2013 to April 30th, 2013: Booth versus Vending Machine



Note: the first vertical line signalled the first day when additional refill options became available. The second vertical line marked the day when surcharge fee was first imposed

Figure 4: Daily New Unlimited-Ride metrocard sales as a percentage of total in-system unlimited-ride metrocard deposit transactions from January 1st, 2013 to April 30th, 2013: Booth versus Vending Machine



Note: the first vertical line signalled the first day when additional refill options became available. The second vertical line marked the day when surcharge fee was first imposed

Table 3: Effect of Better Facilities versus Surcharge Fee on percent of new pay-per-ride metrocard sales

	Better Facilities		Surcharge Fee	
	(1)	(2)	(3)	(4)
Post*Vendor	0.009*** (0.00)	0.009*** (0.00)	0.117*** (0.00)	0.117*** (0.00)
Post	-0.009*** (0.00)	-0.009*** (0.00)	-0.281*** (0.00)	-0.281*** (0.00)
Vendor	-0.112*** (0.00)	-0.124*** (0.00)	-0.112*** (0.00)	-0.124*** (0.00)
Month Fixed Effects (FE)	Yes	Yes	Yes	Yes
Day of the week FE	Yes	Yes	Yes	Yes
Station FE	No	Yes	No	Yes
R^2	0.74	0.74	0.74	0.74
N	87204	87204	87204	87204

Outcome variable: percent of new card sales on daily basis at station-level

Note: Robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 presents results for the effects of better facilities and surcharge fee on changes in percent of new pay-per-ride metrocard sales, using different control variables in each specification. The models in column 1 and 3 control for day of week and month of year. The results show that implementation of more refill options only caused a negligible decrease of 0.9 percentage in the proportion of new metrocard purchases while the surcharge fee caused a significant decrease of 28.4 percentage in the proportion of new metrocard purchases. To account for the possibility of differences in location or customer-size of the station as well as neighbourhood demographics, my preferred specification in columns 2 and 4 included station-level fixed effects. As with the other controls, the addition of station-level fixed effects has little impact on the estimated effects of better facilities and surcharge fee.

Table 4: Effect of additional refill options on percent of new card sales for different types of metrocards

	Pay-per-ride	7-day unlimited	30-day unlimited
Post*Vendor	0.009*** (0.00)	0.017*** (0.00)	0.006 (0.00)
Post	-0.009*** (0.00)	-0.014*** (0.00)	-0.003 (0.00)
Vendor	-0.124*** (0.00)	-0.141*** (0.00)	-0.112*** (0.00)
Month Fixed Effects (FE)	Yes	Yes	Yes
Day of the week FE	Yes	Yes	Yes
Station FE	Yes	Yes	Yes
R^2	0.74	0.85	0.78
N	87204	82648	71271

Outcome variable: percent of new card sales on daily basis at station-level

Note: Robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Using this preferred specification, Table 4 includes measures of changes in proportion of new card sales for 7-day and 30-day unlimited-ride cards as well as pay-per-ride cards in response to implementation of additional refill options. The added refill options only led to a negligible increase of 1.4 percentage point in percent of new 7-day unlimited-ride metrocard sales and 0.4 percentage point in proportion of new 30-day unlimited-ride metrocard sales.

Table 5 repeats the analysis for changes in proportion of new metrocard sales among different types of metrocards in response to surcharge fee. The imposition of the surcharge fee led to a decrease in proportion of new 7-day unlimited-ride metrocard sales by 64.0 percentage points, and a decrease in proportion of new 30-day unlimited-ride metrocard sales by 50.1 percentage points.

Table 5: Effect of Surcharge fee on percent of new card sales for different types of metrocards

	pay-per-ride	7-day unlimited	30-day unlimited
Post*Vendor	0.117*** (0.00)	0.213*** (0.00)	0.095*** (0.00)
Post	-0.281*** (0.00)	-0.633*** (0.00)	-0.498*** (0.00)
vendor	-0.124*** (0.00)	-0.141*** (0.00)	-0.112*** (0.00)
Month Fixed Effects (FE)	Yes	Yes	Yes
Day of the week FE	Yes	Yes	Yes
Station FE	Yes	Yes	Yes
R^2	0.74	0.85	0.78
N	87204	82648	71271

Outcome variable: percent of new card sales on daily basis at station-level

Note: Robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Validation Tests

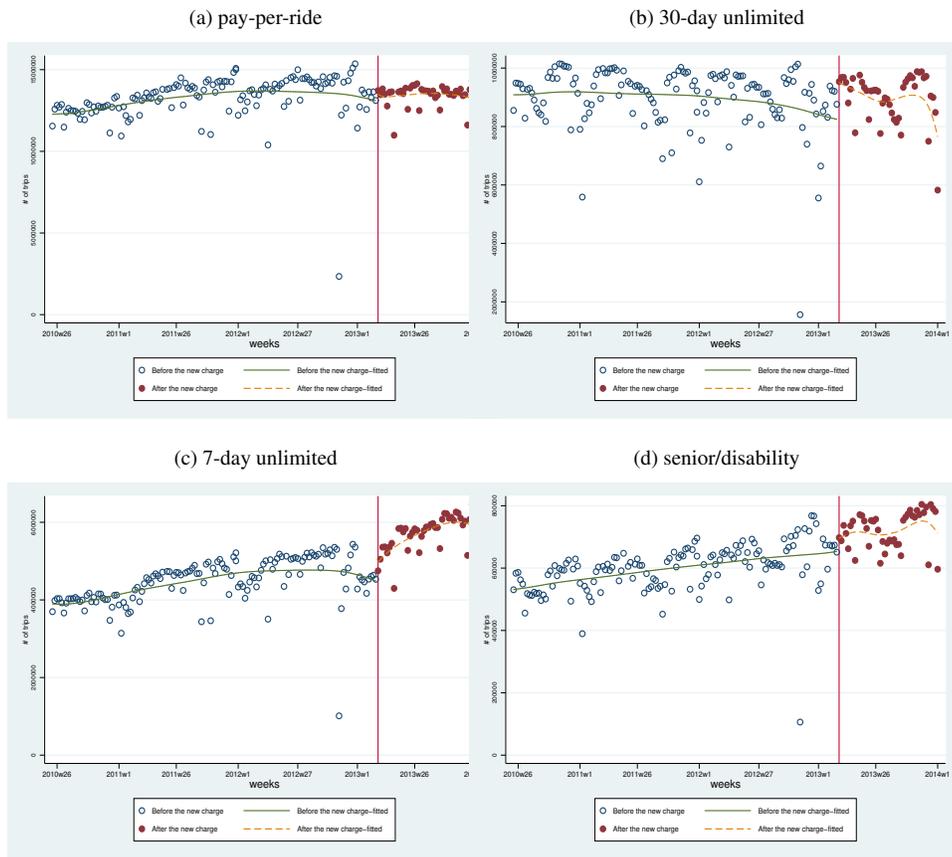
6.1 No jumps (or discontinuity) in ridership before versus after availability of additional refill options or imposition of surcharge fee

One concern with interpreting changes in behavior as a response to the added refill options or surcharge fee is that there may be fluctuations in subway ridership that could conflate the effect of better facilities or surcharge fee. Figure 5 shows the total number of MetroCard swipes made each week by customers entering the New York City Subway, PATH, AirTrain JFK and the Roosevelt Island Tram, broken out for various types of MetroCards. While the figure signals a substantial growth trend in ridership using unlimited-ride cards, it does not show a jump or discontinuity in ridership before versus after implementation of added refill options or surcharge fee. This suggests that differences in percent of new metrocard sales are unlikely to be caused by rides variations.

6.2 Demand for cross-type metrocard options by commuters

Another concern with interpreting changes in behavior as a response to the added refill options or surcharge fee is that there may be minimal demand for cross-type refills by commuters. For instance, if only few commuters purchase 7-day unlimited-ride cards

Figure 5: Number of trips taken weekly for different types of metrocards from Jan2012 to Dec2013



and pay-per-ride cards across time, there is negligible need for better facilities to add both unlimited-ride and pay-per-ride options to the same metrocard.

Since the surcharge fee became effective only two weeks after the implementation of cross-type refill options, I limit the examination of demand for cross-type refills to 7-day unlimited-ride and pay-per-ride options. Figure 6 shows percent of metrocards with versus without cross-type 7-day unlimited-ride and pay-per-ride refills. In figure 6a, there was almost no metrocards with cross-type refills before March 3rd, 2013, even the cross-type refills were already available. In contrast, about 10.7 percent metrocards with activities after March 3rd, 2013 had cross-type refills (figure 6b). This suggests that there is genuine demand for cross-type metrocard usages.

7 Conclusion

This paper investigates the impacts of implementation of better facilities versus surcharge fee on new transit card purchases in New York City. Unlike findings in prior studies regarding different types of facilities provided, commuters did not voluntarily reuse existing free transit cards more when additional refill options became available (cards can be refilled with both time and value). Conversely, the surcharge fee on new card purchases reduced the overall demand for new metrocards by over half and prompted commuters to substitute to refill existing metrocards; this is particularly notable given the relatively small size of the surcharge fee. I show that differences in awareness of the two policies and fluctuations in rides of subway trains are unlikely to account for my results.

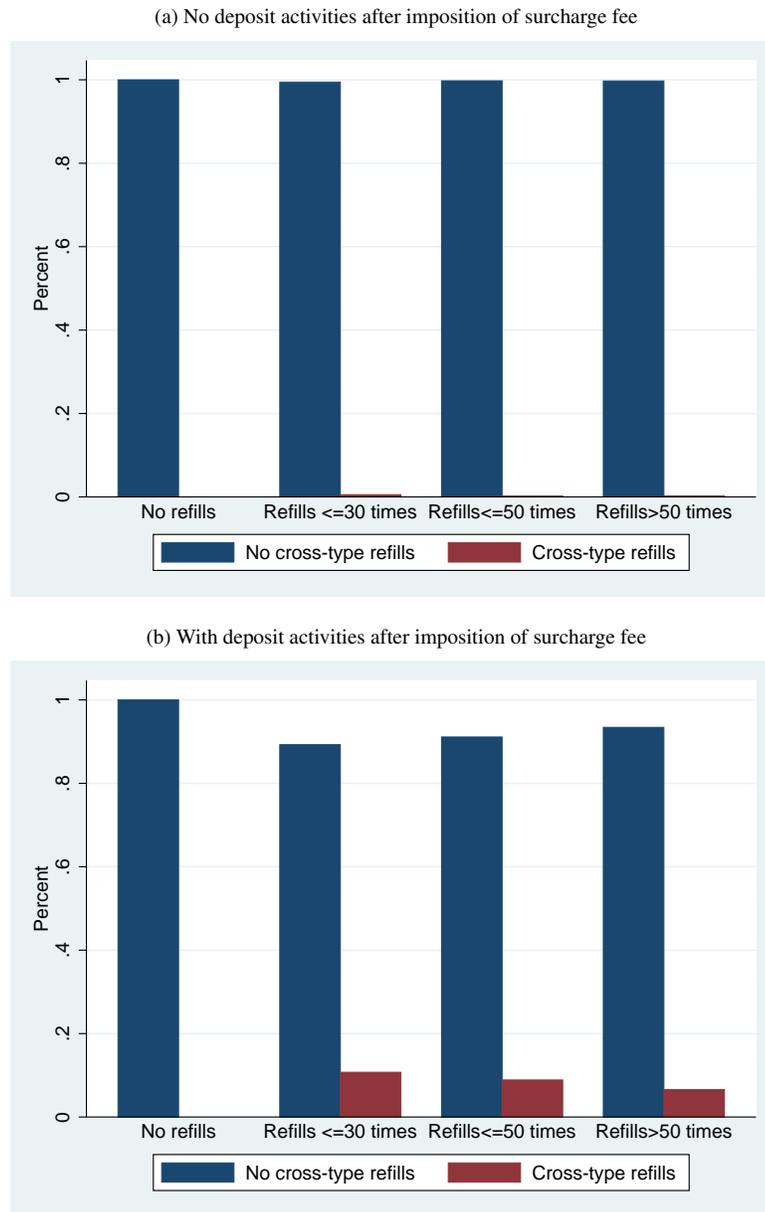
As the surcharge fee became effective only two weeks after the implementation of additional refill options, this paper cannot identify the long-term effects of availability of additional refill options. However, as similar change in behaviour was observed between consumers buying from booth and consumers buying from vending machines, there is little reason to believe that the added refill options alone will alter consumer behaviour significantly in a longer time period.

Many communities solely increase supply of curbside recycling to encourage residents to recycle more. However, the results of this study suggest that the implementation of better facilities, without providing sufficient economic incentive, might not be as effective in boosting recycling activities as suggested by prior studies using self-reported survey data. Therefore, coupling such recycling policies with volume-based unit charge on trash drop-offs might much better promote recycling actions in the neighborhood.

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Figure 6: Percent of cards with versus without cross-type 7-day unlimited and Pay-per-refills



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