# Access to Taxicabs for Unbanked Households: An Exploratory Analysis in New York City

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## Abstract

*Taxicabs are critical complements to public transit systems. In New York City, ubiquitous yellow cabs are as iconic as the city's subway system, and the city recently added green taxicabs to improve taxi service in areas outside of the Central Business Districts and airports. In this paper, we used multiple datasets to explore taxicab fare payments by neighborhood and examine how paid taxicab fares are associated with use of conventional banking services. There are clear spatial dimensions of the propensity of riders to pay cash, and we found that both immigrant status and being "unbanked" are strong predictors of cash transactions. These results have implications for local regulations of the for-hire vehicle industry, particularly in the context of the rapid growth of services that require credit cards to use. At the very least, existing and new providers of transit services must consider access to mainstream financial products as part of their equity analyses.*

**Key words:** *Taxicabs, unbanked, immigrant populations, New York City*

## Introduction

Taxicabs represent an important transit service in urban areas, and the industry is undergoing rapid change. In recent years, new technologies developed by private firms have piqued substantial interest in growing the taxi industry from niche markets that complement transit systems to full-fledged alternatives auto ownership. Much of the current scholarly and popular interest in taxicabs focuses primarily on making taxicabs easier to use through smartphone-based e-hail applications and credit card payments. Although these technological innovations, have made taxi services—both

conventionally regulated taxicabs and upstart firms—easier to use for many travelers, these same innovations may make it harder for certain people to access taxis. In many US cities, large portions of low-income households do not have access to mainstream bank accounts or credit cards, which are required for smartphone apps. These unbanked or underbanked households are effectively excluded from new services, fare discounts for transit passes, and other transportation services that require access to credit cards.

A review of the literature suggests that transportation access is rarely addressed as an issue for underbanked households. Within the transportation literature, in contrast, ability to pay is generally considered a function of income or wages. Yet, in the case of the underbanked, ability to pay also includes access to fare payment media. In some studies, scholars have examined how the adoption of smart cards for transit fares may be affected by income, immigrant status, and other factors (Yoh et al. 2006). Within transit payments, low-income riders tend to not take advantage of volume discounts or unlimited fares, which likely is caused by their precarious financial straits. But all of these examinations assume that users are at least *able* to access transit services or other transportation facilities. In the case of private taxi and transit services, lack of a formal bank account and credit card (or branded pre-paid debit card) prohibit the use of these services, at least in the United States.

For this research, we use the definition of "unbanked" and "underbanked" of the US Federal Reserve (Gross et al. 2012). An unbanked household is one in which the head of household is without a checking, savings, or money market account, as is their spouse or partner. Underbanked people, in contrast, do have a checking, savings, or money market account but also use alternative financial services such as payday lending, title loans, or similar.

There are many reasons the unbanked and underbanked may opt out of or limit use of formal banking products. First, they might not have employment with regular paychecks. People who work odd jobs for cash may not need an account for savings. Second, they may have a regular job with a steady paycheck, but the fees charged for bank accounts with a debit card are too high for their income, or they receive most of their wages in cash tips. These people are likely to use check-cashing stores or pre-paid debit cards, and paying check cashing fees actually may be cheaper than using an ATM throughout the week. Third, immigrants—both legally in the country and illegally—are less likely to have formal bank accounts than native-born people. Together, low-income and immigrant status are associated with most of the unbanked and underbanked populations.

New York City has a higher share of unbanked households than the national average (Ratcliffe et al. 2015). In a 2012 report, the City's Department of Consumer Affairs estimated that more than 10% of the adult population was without a bank account (New York City Department of Consumer Affairs 2012). The share of unbanked varies widely across the city, however, with nearly 30% of the population of the Bronx—the poorest borough—unbanked, whereas wealthier Staten Island has less than 2% unbanked. Moreover, nearly half of all unbanked live in just 10 neighborhoods, all

clustered in the poorest parts of the city, and happen to be places that traditionally have been underserved by taxicabs.

In the past few years, the City has launched a series of programs with the cooperation of financial institutions to increase access to mainstream services (New York City Department of Consumer Affairs 2008). These programs have had modest success for encouraging saving, even among very low-income people, and modest success moving people into mainstream accounts (New York City Department of Consumer Affairs 2013). Under Mayor de Blasio's administration, the City has created a municipal identification card that does not require citizenship to acquire. This new ID card is hoped to assist at least some of the unbanked population to open new accounts. Yet, for all the City's efforts, the evidence is mixed on the overall effectiveness of such "lifeline" services for promoting shifts into formal banking (Doyle et al. 1998).

Overall, the concern presented herein is that a particular aspect of poverty—whether or not a household has access to a formal bank account and, thus, potential access to credit cards—is critically important for access to a variety of transportation options. To the best of our knowledge, access to bank accounts and credit cards has been addressed in the literature only marginally, and not in the context of taxi services. This exploratory analysis used taxi data from New York City to identify spatial factors associated with the likelihood of being unbanked and cash fares for taxi trips.

## Unbanked and Underbanked in New York City

Many households go between banked and unbanked depending on their circumstance. In general, there are a few factors strongly associated with being unbanked. The largest predictor of becoming unbanked is a steep decline in household income, followed by race and ethnicity factors, marital status, and housing characteristics (Rhine and Greene 2013). Most of these factors are found concentrated in particular neighborhoods, which suggests that households on the edge of poverty in certain communities will move in and out of the banking system as they can afford to.

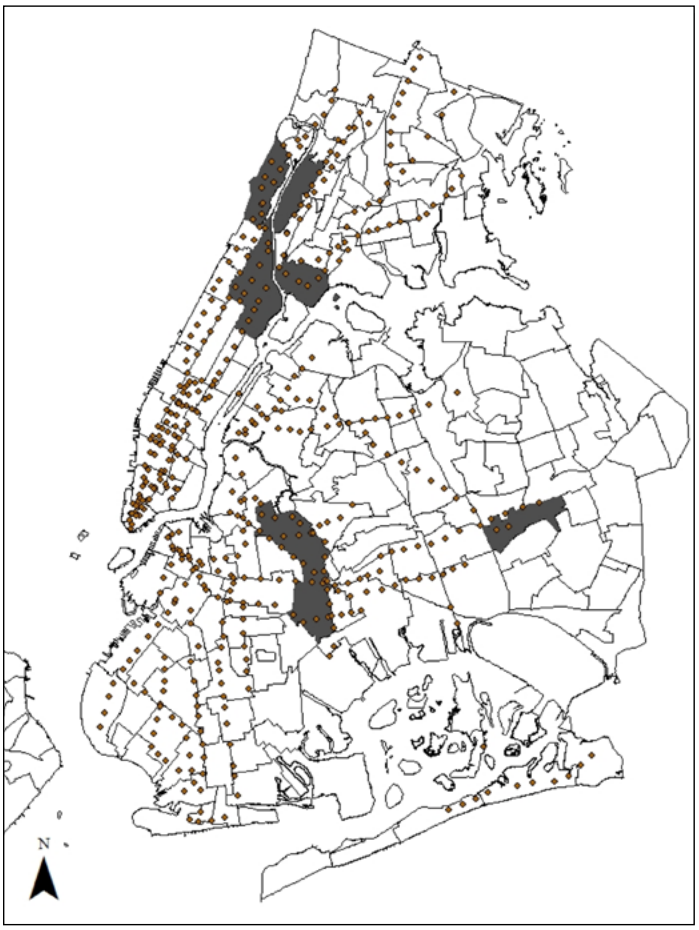
The extent of underbanking recently has been recognized around the world, but both the diagnoses and remedies depend greatly on local context. A few generalized statements about underbanked households can be made. They are more likely to be poor, both by income and wealth, than households with bank accounts. In the literature, the primary concerns about the unbanked are usually about the high costs of being poor, especially as it relates to the cost of money. Check-cashing services can be more expensive than a savings account, for instance, as can be getting a money order to pay all bills. Recently, there has been some interest in pre-paid debit cards as a financial tool for low income families, but there are few examples of how these may work for transportation in the United States.

In New York City, studies show that physical proximity to conventional bank branches is unrelated to the likelihood of being unbanked (Ratcliffe et al. 2015). Throughout the city, retail bank branches are ubiquitous, although new bank branches are viewed as a sign of gentrification. Whereas not the focus of this paper, the neighborhoods with high

levels of unbanked households have mixed experience with gentrification, however it is defined.

Figure 1 shows the neighborhoods with the highest share of unbanked households along with subway stations throughout the city. This map is intended to show the spatial concentration of unbanked and underbanked households, which is why it is presented simply. There are approximately three main clusters of unbanked communities: northern Manhattan and the south Bronx, east-central Brooklyn, and Jamaica, Queens. The neighborhoods in Manhattan and the Bronx are the poorest neighborhoods in these boroughs, but they also have fairly good transit access by subway. Table 1 shows the actual share of unbanked households by neighborhood. Overall, the top 10 neighborhoods for share of unbanked and underbanked households represent about 450,000 unbanked people, or over half of all unbanked in the city.

**FIGURE 1.**
Most unbanked neighborhoods in New York City




*Data Source: New York City Department of Consumer Affairs (2012)*

**TABLE 1.**
Largest Share of Unbanked Households by Neighborhood

| Name | Borough | Unbanked |
|---|---|---|
| Mott Haven/ Melrose | Bronx | 56% |
| Morris Heights/University Heights | Bronx | 53% |
| Highbridge/Concourse | Bronx | 51% |
| Ocean Hill/Brownsville | Brooklyn | 47% |
| Bushwick | Brooklyn | 47% |
| Washington Heights/Inwood | Manhattan | 46% |
| West Harlem | Manhattan | 38% |
| East Harlem | Manhattan | 37% |
| Central Harlem | Manhattan | 36% |
| Jamaica | Queens | 24% |

*Source: New York City Department of Consumer Affairs (2012)*

## The High Cost of Transportation

Poverty is a major urban policy concern. For much of the post-war period in the US, poverty was largely an inner-city phenomenon within metropolitan areas. One reason for concentrated poverty in the urban core was the availability of public transportation (Glaeser et al. 2008). Although poor, these households at least had access to transit networks that may allow for economic mobility, although our knowledge of how transportation affects poverty is limited (Sanchez et al. 2004, Sanchez 2008). In recent years, in part due to the Great Recession, poverty has suburbanized (Kneebone 2010), which has led to new concerns about the role of transit in suburban locations to prevent economic isolation for those who cannot afford to drive.

Poor households face a number of ways that reinforce how expensive it is to be poor. Inner-city neighborhoods pay higher retail prices (Talukdar 2008), for instance, or pay higher transit fares because they cannot take advantage of discounts. WNYC, a news radio station in New York, used data from the Metropolitan Transportation Authority (MTA) to demonstrate where riders purchase 7-day transit passes for $30 or unlimited transit passes for $112 per month (Schuerman 2015). The MTA data show that the 7-day passes are used more frequently than the unlimited passes, at 2.3 rides per day vs. 1.9. This means that the average fare paid is somewhat less for the typical 7-day pass holder—the higher usage means that these riders would receive substantial discounts simply by switching to a monthly unlimited pass. It is not known precisely why transit riders purchase 7-day passes when unlimited passes ultimately would save them money, but the most likely explanation is that the travelers simply do not have $112 to commit to transit trips at the beginning of each month. What these riders can do is buy a shorter pass when they are able and, if not, they do not travel or find other alternatives. This is a subtle example of how costs of living increase as income drops.

## Discrimination in Taxi Markets

Taxi markets are well-known for pockets of discrimination, especially with regard to people of color (Ambinder 1996; Anderson 2004). A key purpose of regulations is to ensure equitable access to taxicabs, which has led most cities to adopt a dispatch model of taxi service. In a dispatch model, all taxi rides are prearranged through a phone call or e-hail, in which the passenger calls a central dispatch hub and then waits for an assigned cab to arrive. The dispatch model is in contrast with the street hail model, in which all passengers are required to hail a cab on the street by raising their hand from the curb.

Dispatched taxicabs are favored because this model avoids two specific types of discrimination. First, by requiring all trips to be arranged through a central operator, taxi drivers must accept all trips within their licensed area. This prevents drivers from cruising only certain areas of a city, such as the Central Business District and airport, which offer more lucrative trips. It also provides a record of requests for rides made, regardless of their location, allowing regulators to ensure that no neighborhoods are systematically discriminated against. Second, dispatch services are nominally race-blind, such that the drivers are unable to target fares based on skin color. Although these protections do promote equal access to taxicabs across cities, in practice there are still major hurdles, and drivers do find ways to avoid certain neighborhoods.

In contrast to dispatch taxicabs, taxi drivers operating in a street-hail system often engage in more blatant discrimination where they simply will not stop their empty taxi for a person of color (Belcher and Brown 2012; Shuford 1999). This discrimination is very difficult to prove, however, as drivers claim they often did not see the person attempting to hail their services. Moreover, with street-hail services, drivers tend to avoid completely certain neighborhoods in which they feel unsafe or view as financially undesirable.

New e-hail technologies and services, such as Uber, Lyft, Juno and others, claim to avoid these known processes of discrimination. Being able to summon a taxi from your phone offers the convenience of a street hail with potentially race blind assurances that a taxi will accept the trip. However, as discussed in this paper, access to bank accounts is very much related to racial and immigration characteristics, which represents a new, albeit unintended, type of discrimination.

## The Flexible Transit Market in New York

The New York City region is the nation's largest transit market, with approximately one-third of all US transit riders, and the city is one of the few in the US that has seen consistent ridership growth over the past 15 years (APTA 2015). Beyond the well-known fixed-route services, New York also boasts many modes of flexible transit such as taxis, jitneys, and other types of for-hire services. These services are regulated by the Taxi and Limousine Commission (TLC), a City agency is run by a Commissioner appointed by the Mayor. The TLC's primary responsibilities include licensing 50,000+ taxis, liveries, and commuter vans and about 100,000 drivers (TLC n.d.).

For-hire vehicles are a collection of distinct services; the most well-known, and part of the focus of this paper, are yellow medallion taxicabs. In the city are approximately 13,500 yellow taxis with medallions physically stamped onto their hoods[1] that confer the exclusive right to pick up street-hail taxi fares in any part of the city. The service patterns of these taxis have been criticized for focusing on LaGuardia and JFK airports along with Manhattan's central business districts rather than serving the city as a whole, a criticism not unwarranted, as airport travelers and short trips in the dense business districts have long been viewed as the most lucrative. Partially because of this, for years it was rare to see a yellow taxi on the streets of the outer boroughs (Brooklyn, Queens, Staten Island, the Bronx) or in communities of color. But this does not mean that these areas were not served; rather, they were served by a mix of informal and formal taxi services.

Neighborhoods outside of the Manhattan core have long relied on informal networks of community cars, livery vehicles, commuter vans, dollar vans, and other for-hire services. Each of these services tends to serve a particular niche, such as service between the city's three distinct Chinatowns in Manhattan and Queens (Tsai 2010). Formalizing these services has been difficult for a number of reasons (King and Goldwyn 2014), one of which is that these services are used mostly by immigrants and low-income riders who always pay with cash.

In 2012, the City announced a program to increase the number of taxicabs outside the Manhattan core into traditionally-underserved neighborhoods. These new taxis, known as green cabs (because of their distinctive color) or borough cabs, cannot pick up passengers at the airports or in Manhattan south of 110th Street on the west side of Central Park or 96th Street on the east and are available as either a street hail or pre-arranged ride. The full effect of the green cab program is not yet known for overall taxi access or ridership as the program is still new, but preliminary data can be used to assess how trips made in green cabs differ from those made in yellow cabs.[2]

The licensed taxicabs described above differ from livery licenses required for e-hailing services such as Uber, Lyft, and Via as well as longstanding livery companies that now have their own smart-phone applications, such as Carmel. These services are licensed by the TLC and must adhere to transparent regulations about insurance and safety but under livery guidelines that allow for more variation in vehicles and service standards. These licenses are unlimited in number and allow for trips anywhere within the city. However, these livery licenses require pre-arranging all trips (no street hails), which is satisfied through the smart-phone application.

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[1] An approximate number is used, as the true number of medallions has been affected by the growth of Uber and Lyft services. Some medallions have come out of service, but it is unknown exactly how many. For the purposes of this analysis, an approximate number of medallions is acceptable, as we are analyzing trips, for which we have all data.

[2] Green cabs were introduced at the same time Uber, Lyft and other competitors entered the market. Since the growth of smartphone-enabled services, demand for green cabs has declined, and the City has not sold all available licenses.

## Data and Methods

The data used in this analysis are from a recent TLC policy change. In 2004, the TLC initiated a program that required all taxicabs to use technology that allowed for credit card processing and also collected data about trip characteristics (King, Peters et al. 2012). This program, known as TPEP, was introduced in 2008. This research uses one month of geolocated trip data collected in October 2014 for all yellow and green taxicabs in New York City and provided by request from the TLC.[3] The dataset includes trip origin, destination, time, number of passengers, fare paid, tolls paid, method of payment, tips (if paid by credit card) and other information. From the observed origins and destinations, distance traveled can be estimated but is not included in these analyses. These taxi data were combined with neighborhood level socio-economic data for analysis.

Table 2 shows the total trips by green and yellow taxis for the entire city during the study period. Yellow taxis make about 10 times the number of paid trips as green taxis. This is for many reasons, but primarily, the yellow taxis are used much more intensively and there are simply thousands more of them. Each yellow taxi typically is used for two 12-hour shifts daily, and medallion owners are eager to keep drivers in the cabs to make sure they collect rents of their assets. Green taxis, however, typically are owned by someone who drives part-time and leases the taxi for the balance of the week; thus, green taxis are used for more flexible shifts.

**TABLE 2.**
Characteristics for All Trips, October 2014

| | Green Taxi Trips | Yellow Taxi Trips |
|---|---|---|
| Total Trips | 1,491,266 | 14,232,488 |
| Cash Trips | 820,747 | 5,684,248 |
| Share of Trips Paid Cash | 55% | 40% |

*Source: New York City Taxi and Limousine Commission (n.d.)*

The characteristics of trips by green and yellow are quite different. Most obviously, green taxis are prohibited from picking up passengers in many areas of the city, even though there may be high taxi demand relative to supply. More importantly, however, the data reveal that trip characteristics vary by location. A total of 55% of all green taxis trips—serving only outer boroughs by law—are cash fares. For yellow taxis, the likelihood of a cash fare is related to distance and whether the trip is an airport trip (these calculations are not shown).

Overall, there are observable differences for cash payments by taxi type, location, trip origin, and trip destination. It is impossible to know which characteristics differ between a typical yellow cab passenger and a typical green cab passenger, but something leads green cab passengers to use cash far more often than yellow cab passengers. The results shown on Figures 2 through 5 suggest that there is a spatial factor in play.

[3] After the start of this research, the TLC has made all taxi GPS data available through its website; this was not the case when the research began.

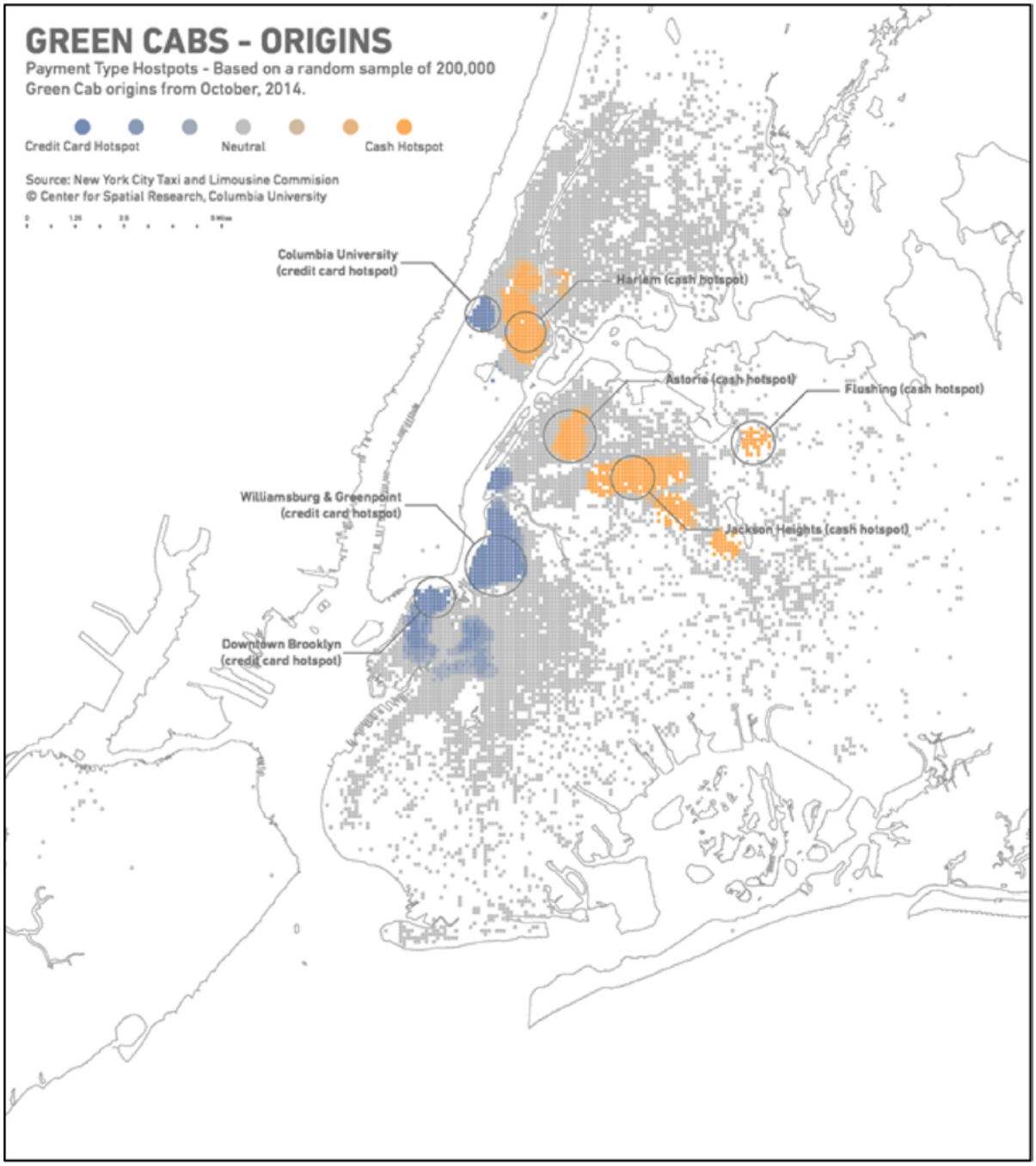


**FIGURE 2.** Cash and credit payment types for green cabs by origin

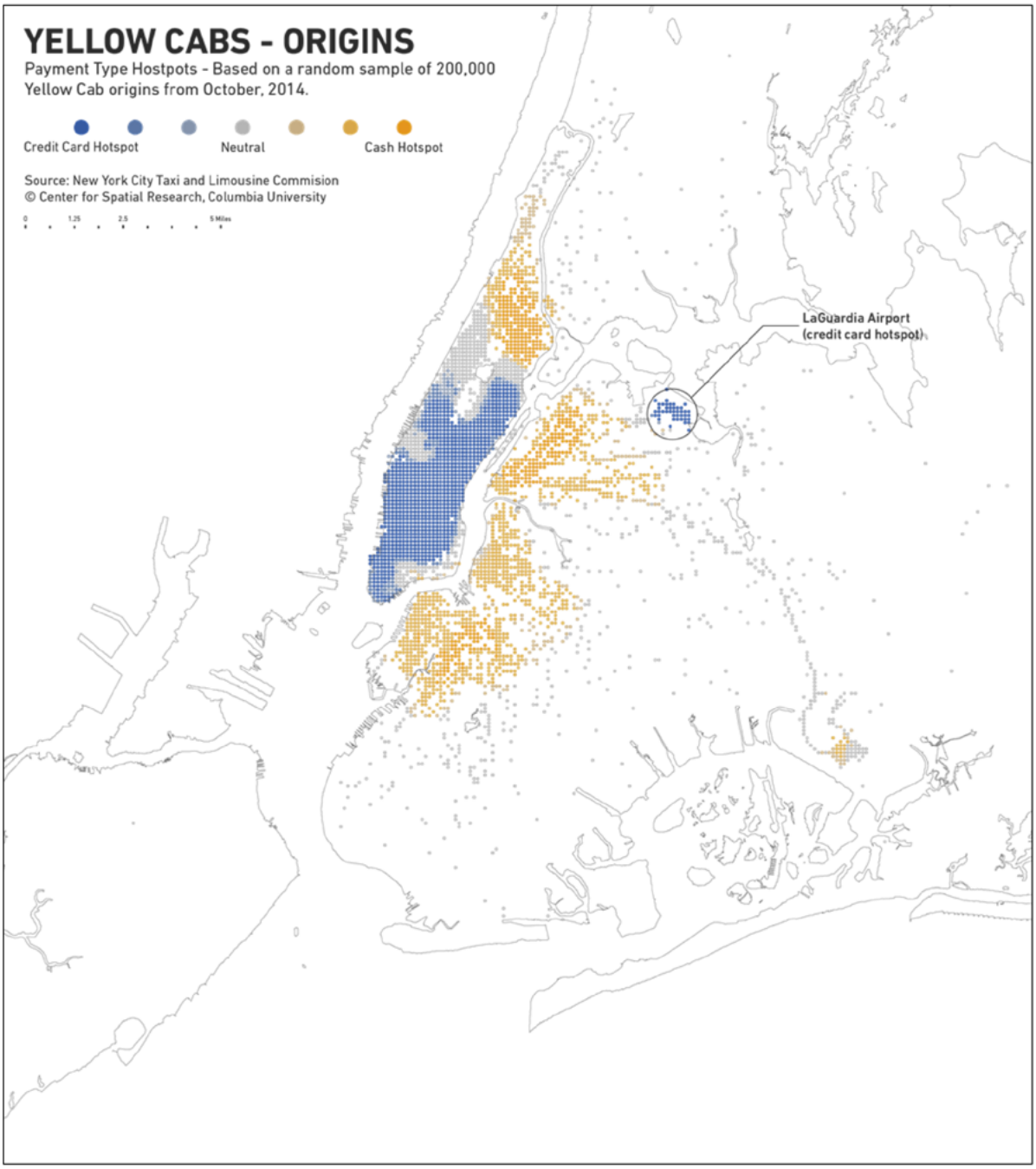


**FIGURE 3.** Cash and credit payment types for yellow cabs by origin

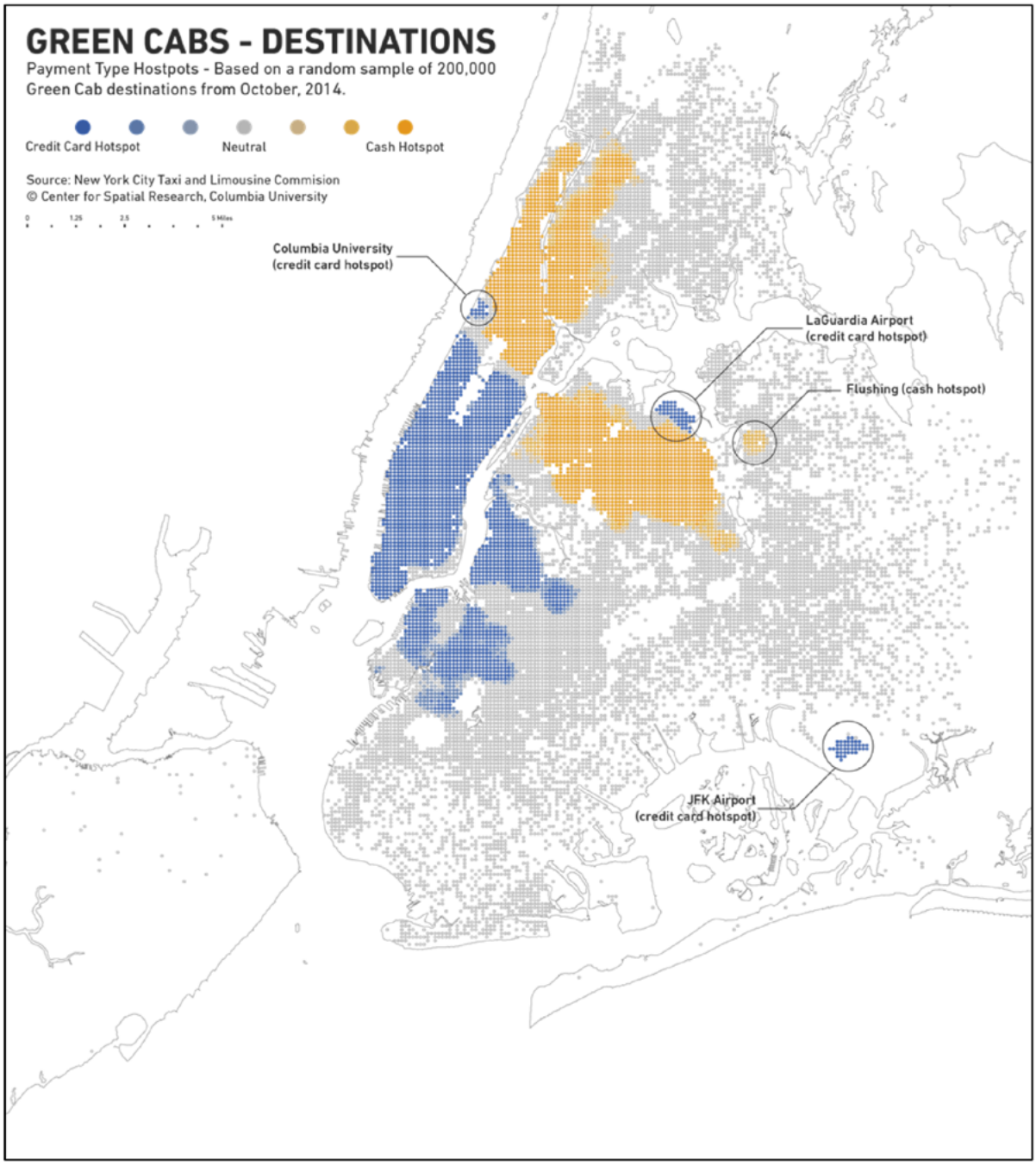


**FIGURE 4.** Cash and credit payment types for green cabs by destination

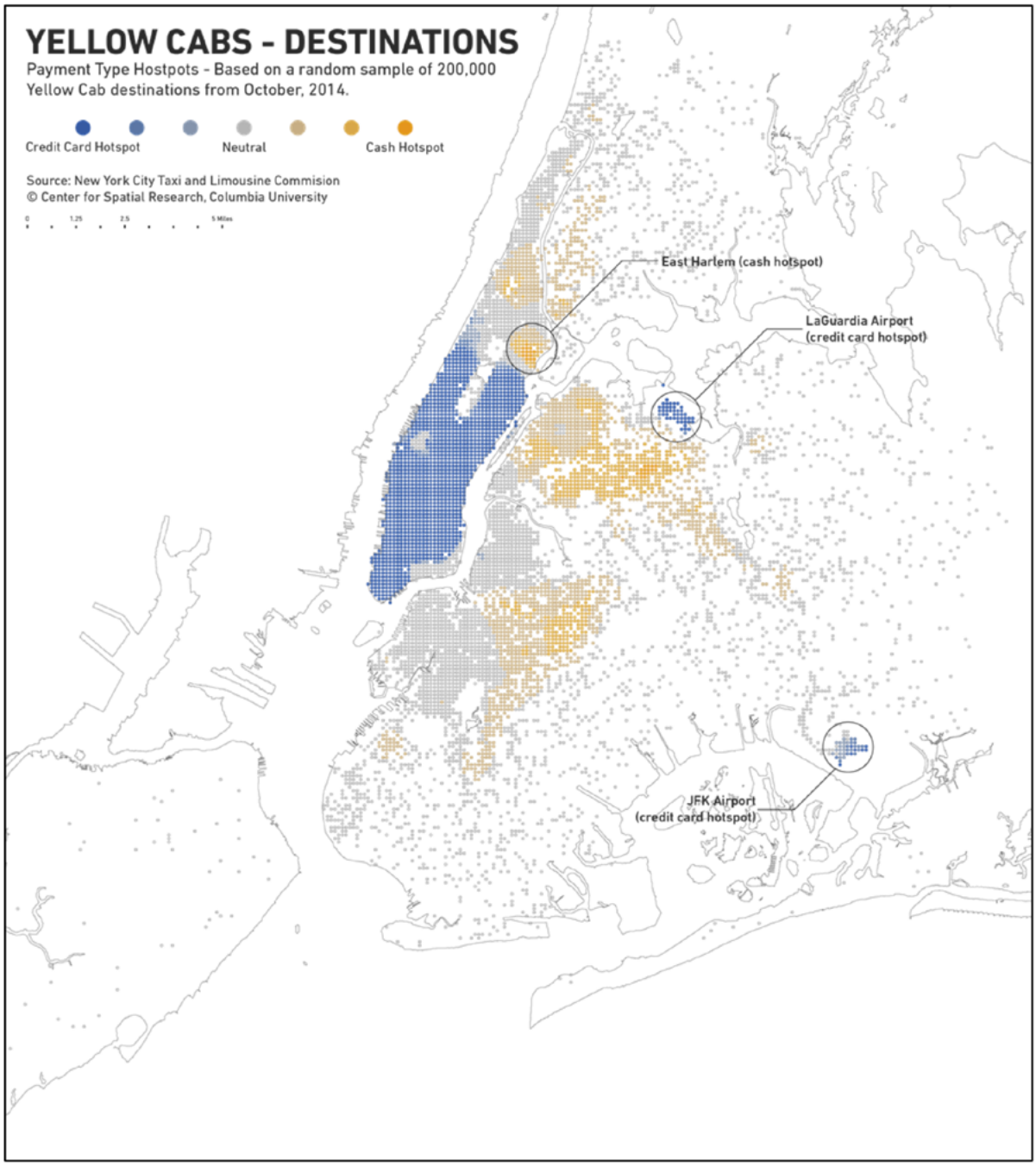


**FIGURE 5.** Cash and credit payment types for yellow cabs by destination

In Figures 2 through 5, the relative frequency of payment types by origin and destination for yellow and green taxicabs. All maps show stark lines that demarcate where riders predominately use cash (shown in yellow) and where they use credit (shown in blue). With the exception of a credit card hotspot surrounding Columbia University in Morningside Heights (a blue area circled in Figure 3) Manhattan payment types divide cleanly along income lines, where wealthy neighborhoods flanking Central Park (the empty white rectangle in the middle of the map surrounded by blue to the south and yellow to the north) on the Upper West Side and Upper East Side pay for taxi trips mostly with credit cards, and poorer neighborhoods to the north in Spanish and Central Harlem are dominated by cash. One interesting aspect is that the socio-demographic characteristics of neighborhoods seemingly play a large role in determining payment type. It is likely that the cash or credit choice is a function of access to a bank account, for which these spatial data are a good proxy. Another takeaway is that much of the city still does not produce many taxi trips, and there is not enough data to present primary payment types.

## Statistical Analysis

In this section, statistical analyses of the associations between socio-demographic characteristics and the share of cash fares for taxicabs are presented. The taxi trip data are limited in that they provide origins and destinations along with fare characteristics, but these data are associated with a known vehicle rather than a known passenger. As such, a series of assumptions can be made about a typical rider based on neighborhood factors. The regression analyses shown below used all trip data for the week of October 6–12, 2014, which is assumed to be a typical week in terms of good weather, no holidays, and no major school or employment breaks (n=3,217,092 for yellow taxi trips, n=330,024 for green taxi trips). These data are assumed to represent a close approximation of the average trip and, thus, the average trip-taker. Taxi trips were aggregated spatially to the neighborhood level, which were the smallest geographies with available demographic data, and then analyzed by trip origins and destinations for cash payments. Origins and destinations were treated separately, primarily because people leaving an area and returning to an area by taxicab may represent different groups of people.

Table 3 shows the summary statistics for dependent and independent variables considered for the regression models. These are shares of cash fares by origin (Ocash) and destination (Dcash) by neighborhood for all yellow and green taxi trips and are not mutually exclusive. Trips that begin and end in the same neighborhood were counted as both Ocash and Dcash. For most of the outer borough neighborhoods, the total number of intra-neighborhood trips was small and does not affect the overall results. For 2013, the percent of households in poverty headed by a foreign-born family member and unbanked are included. The unemployment rate in 2013 also was considered but ultimately was dropped from the analysis after post-test diagnostics.

**TABLE 3.**
Summary Statistics by Neighborhood

| Variable | Mean | Standard Deviation | Minimum (%) | Maximum (%) |
|---|---|---|---|---|
| Ocash (Dependent) | 0.42 | 0.07 | 0.35 | 0.81 |
| Dcash (Dependent) | 0.42 | 0.07 | 0.35 | 0.76 |
| Poor2013 | 0.18 | 0.10 | 0.03 | 0.40 |
| Foreignborn2013 | 0.38 | 0.12 | 0.17 | 0.64 |
| Unemployment2013 | 0.10 | 0.04 | 0.03 | 0.18 |
| Unbanked2013 | 0.13 | 0.08 | 0.03 | 0.31 |

Tables 4 and 5 show the regression results. The data are organized by neighborhood, and the dependent variable is either the share of cash trip by origin or cash trips by destination. Post-test diagnostics were used to evaluate multicollinearity, and the resulting models represent the best fit for the data. Ordinary least squares (OLS) was used along with generalized linear models (GLM), which accounts for the dependent variable not being normally distributed.

In all cases, the strongest predictors of cash fares are the share of foreign-born and the share of unbanked. These effects are largest for taxi trip destinations and are large and positive coefficients that are highly statistically significant; the share of households in poverty is not statistically significant. In both the OLS and GLM models, the direction of effects and approximate magnitudes are similar, suggesting that both models adequately represent the relationships among variables. The $R^2$ for the OLS models suggest that close to half of the variation of cash fares is explained by destination, which is a fairly high level of explanatory power for the model. It is likely that the reason poverty has an insignificant effect is that it is not a perfect predictor of banking status or immigrant status.

**TABLE 4.**
Regression Results for Cash Trips by Origin by Neighborhood

| | OLS | GLM |
|---|---|---|
| Poor 2013 | -0.431 | -1.814 |
| | (.339) | (1.644) |
| Foreignborn2013 | 0.668 | 2.808 |
| | (.133) | (.461) |
| Unbanked2013 | 1.087 | 4.56 |
| | (.439) | (2.139) |
| Constant | 0.2732 | -0.955 |
| | (.061) | (.209) |
| F | 10.31 | |
| $R^2$ | 0.39 | |
| n | 52 | 52 |

**TABLE 5.**
Regression Results for Cash Trips by Destination by Neighborhood

| | OLS | GLM |
|---|---|---|
| Poor 2013 | -0.548 | -2.258 |
| | (.261) | (1.220) |
| Foreignborn2013 | 0.587 | 2.415 |
| | (.102) | (.359) |
| Unbanked2013 | 1.390 | 5.727 |
| | (.337) | (1.602) |
| Constant | 0.241 | -1.065 |
| | (.047) | (.144) |
| F | 17.52 | |
| $R^2$ | 0.52 | |
| n | 52 | 52 |

## Discussion

Taxicabs and for-hire transportation services are premium services that complement fixed-route transit and supply critical accessibility to people who do not or cannot drive. Ensuring that these services are available to all who need them is a desirable policy goal. What the data in this research shows is that, in some cases, access to bank accounts and credit cards may affect access to certain types of taxi services. There are strong correlations between neighborhoods with high shares of unbanked households and taxi trips, especially green cabs, paid with cash.

These results underscore an important aspect of emerging taxicab technologies, which is that many supporters of expanding the taxicab supply base their support on the potential of new services to reach previously underserved markets. As potential can be refuted only through experience, existing firms in the taxi market look comparatively bad, as they have a history that can be checked. It is a common claim that smartphone-enabled taxi services will not employ the same geographic discrimination as conventional taxis because the drivers will respond to the service request. This may prove true at some point in the future, but many of the communities that need taxi services have high shares of unbanked households, who, by definition, cannot participate in a business that requires a credit card for access.

A scholarly example of this is a recent study by the BOTEC Analysis Corporation, in which researchers were sent into various neighborhoods to check response times and total trip costs for taxicabs and Uber drivers (Smart, Rowe et al. 2015). The study is methodologically sound, and the authors found quite conclusively that Uber cars arrive faster and cost quite a bit less, on average. But in the Los Angeles neighborhoods not well-served by taxis, households have very high rates of being unbanked (Khashadourian and Tom 2007). These households are in neighborhoods in which carpooling acts as taxi service and is far more prevalent than taxis (Liu and Painter 2011), and Uber cars are likely slower and more expensive than the taxi service actually used. It is possible that credit card-based taxi services simply are out of reach for many of these communities.

*Washington Post* writers collected data from Uber's API and found that it offers faster service—measured by wait times after requests—to whiter and wealthier neighborhoods (Stark and Diakopoulos 2016). Such a claim is, by itself, not evidence of discrimination—and we want to be clear that is not part of our argument here—but taxicabs have long been subject to regulations, in part, to ensure access to service without regard to neighborhood, income, or race. Whereas a systematic review of tech-enabled taxi services is beyond the scope of this paper, the studies cited above are suggestive that there may be spatial differences in taxi access even with app-enabled hailing.

The green taxicabs in New York City also may have helped solve one problem—taxi access—but introduced another—decline of community cars. Community cars used to prowl the streets honking at prospective passengers, then a fare was negotiated for each trip. Although this practice was illegal, it was common. Through informal interviews with drivers and passengers of green cabs, some indicated they preferred the old system

of negotiated fares—the green taxis have the same fare schedule as the yellow taxis—because drivers would give breaks to certain people, while other paid higher fares. The poorest riders, who previously could have negotiated a trip for whatever cash they were willing to pay, now have to pay the meter fare, which often is higher. As these are not data collected systematically through interviews, the claims should be treated as speculation, but as anecdotes they are insightful observations about how at least a few very poor riders made use of taxi-type services with cash.

One shortcoming of the taxi GPS data used is there is no specific information about the passenger. We can only assume that high rates of unbanked households are related to high rates of cash payments. Although we feel this assumption is sound, the lack of passenger data limits its robustness and other analyses of taxi vehicle activities. It cannot be said for certain that a high share of unbanked households predict demand for cash payments for taxis, and this certainly requires additional surveys and passenger data. We also cannot evaluate these data for potential discrimination against passengers based on personal, locational, or payment characteristics. There may be unobserved discrimination that affects the results shown.

With the green cabs in New York, it is not clear that unbanked people are underserved by taxicabs. However, this does not mean that taxi regulations and transportation policy should not seek to protect vulnerable households. As the taxi industry goes through structural changes brought about by the rise of e-hailing applications, the City must consider ways to ensure access to all, not just those with a bank account.

## Conclusions

This research presented an exploratory analysis of how taxi services in New York City exhibit market segmentation by fares payment methods. Overall, green cabs, which were designed to serve outer boroughs and underserved areas, disproportionately have cash fares. The yellow and green taxi markets exhibit some aspects of market segmentation in that yellow cab trips in unbanked areas are more like yellow cab trips elsewhere and green cab trips are more like community cars and likely serve different riders. The use of cash to pay for taxi trips is strongly associated with neighborhoods that have high shares of unbanked and immigrant households. Airports and central business district taxi trips are more likely to use credit cards, and these riders likely have different socio-economic characteristics than outer borough riders. Some potential implications from these findings are discussed above, but the key points are worth reiterating. Discrimination in the taxi market is a long-standing concern. Taxi drivers are infamous for avoiding certain types of people and certain neighborhoods, which is a key argument in favor of public regulation against discrimination. Such discrimination should not be tolerated. A concern based on the analysis in this paper is that limiting taxi services to those with a credit card also leaves many households unserved and may act as a new type of discrimination. Households on the edge of poverty go between having and not having bank accounts, and not having access to mainstream financial services may become a new type of discrimination without thoughtful policies.

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