# San Francisco City CarShare:
# Second-Year Travel Demand and Car Ownership Impacts

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**ABSTRACT**

Two years into the introduction of carsharing in San Francisco, nearly 30 percent of members have gotten rid of one or more cars and two-thirds stated they opted not to purchase another car. By City CarShare's second anniversary, 6.5 percent of members' trips and 10 percent of their vehicle miles traveled were in carshare vehicles. Matched-pair comparisons with a statistical control group suggest that, over time, members have reduced their total vehicular travel. Because carshare vehicles tended to be small and fuel-efficient, per capita gasoline consumption and greenhouse gas emissions among members also appeared to go down. Suppressed travel likely reflected a combination of influences: reduced car ownership, more judicious and selective use of cars for particular trip purposes, and multiple-occupant car-share trips. Carsharing, however, has also enhanced mobility, allowing members to conveniently reach more destinations in and around San Francisco and to do so more quickly. Because it widens mobility choices and offers a resourceful form of automobility, carsharing is a welcomed addition to the urban transportation sector in cities like San Francisco.

## 1. INTRODUCTION

A study of the first-year impacts of San Francisco's City CarShare program uncovered evidence of travel inducement (*1*). Examining changes in travel several weeks before and up to nine months after the introduction of carsharing, members appeared to be making more car trips than expected relative to a control group. This was not unanticipated given the make-up of early adopters. The majority of those first signing up for the program owned no cars; many were self-professed environmentalists and bicycle enthusiasts.

Might increases in vehicular travel among City CarShare's membership hold two-plus years into the program? Our hunch is this is less likely so as the program matures and membership becomes more mainstream. This paper addresses the question of travel inducement versus suppression two years into the program, and more broadly tracks trends and changes in travel behavior of San Francisco's carshare program over the intermediate term. As in the study of first-year impacts, a matched pair comparison of travel patterns of members and a statistical control group of non-members is used in this pursuit. Second-year findings are presented with regard to: (1) trends and background description of travel, membership, and car ownership; (2) evaluation of travel-demand impacts; and (3) predictive models of mode choice, travel consumption, and car ownership. The interested reader is referred to earlier reports (*1-3*) for details on the research methodology and first-year findings and a more recent report (*4*) for in-depth discussions on the second-year findings.

## 2. CITY CARSHARE TRENDS AND USAGE

City CarShare, a non-profit corporation established to promote carsharing in the San Francisco Bay Area, was launched in the city of San Francisco in early-March 2001. Figure 1 shows that City CarShare has gained steady popularity -- a year and a half into the program, the monthly number of reservations had reached 2350, up from several hundred during the program's first few months of existence. (In this paper, a "reservation" is counted as a formal lease, of unlimited duration, by a City CarShare member, marked by a member picking up and returning a car to a POD, or point-of-departure; multiple trips can be, and usually are, made as part of a reservation.) By September 2002, over 1800 individuals had formally joined the program (representing around a quarter of one percent of San Francisco's population), and over 67,000 miles per month were being logged on City CarShare vehicles (most of which were Volkswagen Beetles). There were 48 carshare vehicles distributed amongst the 17 PODs in the fall of 2002, with each vehicle used, on average, 33 miles per day. A year and a half into the program, members averaged 28.6 miles per reservation. The typical reservation was 5 ½ hours in length and cost $32. Linking City CarShare reservation logs to surveyed background data revealed that males and Asian-Americans were, compared to overall membership profiles, the most frequent users of City CarShare vehicles.

During the first year and a half of the program, the typical City CarShare member could best be described as an occasional user. Figure 2 shows that slightly over a third of

members reserved and used a vehicle just once a month. The second most frequent level of usage was once a week, associated with a little over a quarter of members. More than 15 percent of members leased a vehicle once every three months or less.

Relatively infrequent use translated into relatively modest annual expenditures for City CarShare membership and usage: 56.3 percent of members spent less than $1000 per year during the first year and a half of the program. Around 30 percent of members spent between $1000 and $2000 per year to share cars and less than 2 percent spent $5000 or more.

The first year evaluation of City CarShare found that, while there was evidence of travel inducement, most trips were made outside of peak hours, suggesting the program was having a fairly modest impact on rush-hour traffic conditions. Figure 3 suggests this pattern has largely continued, with vehicles typically being taken out during midday and returned sometime between 6 p.m. and midnight. Any correspondence of carshare usage with rush hour generally occurs during the afternoon-evening peak. Saturday is City CarShare's most popular day, accounting for 16.7 percent of reservations, followed by Friday (15 percent).

## 3. CITY CARSHARE TRAVEL CHARACTERISTICS

To augment City CarShare's reservation logs, a survey was conducted of usage among all 48 vehicles that were located at the 17 POD parking lots in San Francisco between mid-September and mid-October 2002. All members leasing vehicles over this period were asked to fill out a self-administered survey about their car-share usage. Members completed the one-page clipboard survey upon returning cars to PODs. In all, 351 responses were received. Survey respondents tended to be City CarShare's most frequent customers – around half used City CarShare vehicles for half or more of times they were making the particular trip for which they were reporting. This section discusses these in-vehicle survey findings.

### Trip Purposes and Destinations

For around three out of ten reservations, the main purpose for leasing a City CarShare vehicle was to shop. Journeys to work constituted only around one out of ten car-share leases. Reservations for which "other" was the dominant purpose tended to be the longest: on average, 43.7 miles and 6.1 hours were logged during the lease. (Next longest were, in order, reservations for going to and from work, social/recreation trips, and for shopping/personal business.) Additionally, in-vehicle surveys revealed that 68.9 percent of reservations were to a single destination. Spatially, surveyed carshare trips were fairly scattered throughout the city; fewer than one out of ten were to downtown San Francisco where public transit and walking are often superior options to any form of car travel (Figure 4).

## Trip Occupancies and Modes

Among the CarShare trips surveyed, the average vehicle occupancy was 1.59 persons (including the driver), comparable to the 1.63 average for the U.S. as a whole in 2001 (*5*). Fewer than 10 percent of City CarShare trips had children as passengers.

City CarShare users were asked what modes they previously took for the particular trip(s) they were making, prior to joining the program. Around half took public transit or else walked or biked. Also, 15.6 percent said they previously carpooled/ vanpooled or did not make the trip. These findings suggest that 68.9 percent of City CarShare trips added new motorized vehicles to the streets of San Francisco. The remaining shares were motorized-vehicle substitutions: 17.9 percent of trips were previously made by driving and 13.2 percent were via taxi, rental car, or borrowing someone else's vehicle.

City CarShare users were also asked how they reached PODs: 68 percent walked, 18 percent took public transit, and 9 percent biked.

## Comparative Costs

Using in-vehicle survey data, it was possible to compare costs between using City CarShare vehicles and taking two other for-hire carriers: taxi or rental car. Based on compiled data on the total duration (in and out of vehicles) and miles of car-share leases, we compared what the costs would be if a taxicab or rental car were used instead. (Taxicab costs were based on San Francisco's rates for flagdrops, mileage, and idling time; car-rental estimates were based on the lowest rate in San Francisco quoted by Expedia.com, assuming unlimited mileage, a compact vehicle comparable to City CarShare's Volkswagen Beetle, insurance coverage, and outlays for regular unleaded gasoline and sales tax.) Scenarios for lease durations of one, four, seven, and ten hours were examined. (For City CarShare and rental car leases, trip durations equal the sum of in-vehicle travel time plus time spent at destinations, based on averages from in-vehicle surveys; for taxi trips, durations are only for times in vehicles but not times at destinations.)

Figure 5 summarizes the simulation results. For one-hour leases, City CarShare (at a $3.50 per hour lease fee plus $0.37 per mile) is consistently cheaper than taxi or rental car over all distance ranges. Given the amount of time averaged at destinations, taxis are generally cheaper for round trips of 5 miles or less that occur over a four hour period; when more miles are logged over this period, City CarShare costs less than taxi. For a lease of 10 hours, taxis are generally cheapest when round trips are 16 miles or less, followed by carshare (for the 16 to 24 mile range) and rental car (for the 24-plus mile range). In general, carsharing is the cheaper alternative for intermediate-distance trips and intermediate time lengths; it loses its advantage to rental car, however, as the duration of a lease lengthens.

Of the City CarShare leases that were surveyed, carsharing was cheaper than

taking taxi or rental car in 84 percent of cases. For leases that would have been cheaper via taxi or rental car, 88 percent of surveyed car-sharers said that regardless they use City CarShare vehicles half or more of the time for the dominant purpose of their trip. Clearly, City CarShare has gained a loyal following despite such cost differentials.

## 4. CARSHARE MEMBERS: MARKET SHARES, BACKGROUNDS, AND CAR OWNERSHIP TRENDS

The remaining sections of this article draw upon the results of the fourth of a series of surveys conducted of City CarShare members and a statistical control group. Besides compiling personal, household, and car-ownership background information, the four surveys also solicited detailed travel-diary information for all trips (not just by car-sharing as was the case with the in-vehicle survey). Complete travel-diary information enabled the travel-behavior impacts of the City CarShare program to be gauged.

The first set of background and travel-diary surveys were conducted several weeks before City CarShare's March 2001 inaugural. Those who signed up to immediately join the program ("members") and those hoping to one-day become members (hereafter called "non-members" and functioning as a control group) were surveyed. (These non-members were ideal controls because they displayed comparable levels of motivation, having taken the time to sign up for the program, but had not formally joined due to factors like there not being a POD in their neighborhood.) Similar surveys were then conducted of both members and non-members three and nine months into the program. The fourth set of surveys, carried out in early-to-mid March 2003, provided insights into travel-demand and car ownership impacts two years into the program. In all, 462 members and 54 non-members responded to the fourth survey (with response rates being 25.5% and 34.0%, respectively). (See *1-3* for sample information for the first three surveys.) Survey mailbacks and financial incentives were used to increase response rates. Individual trip records obtained from the fourth survey totaled 2031 (for members) and 242 (for non-members).

### Market Shares

By the end of the second year, carsharing made up 6.5 percent of members' total trips. This is up from 2.2 percent three months into the program but down from 8.1 percent at the nine-month mark (suggesting the novelty of carsharing might have worn off over time). Adjusting for trip length, carsharing made up 10.1 percent of total vehicle miles traveled (VMT) by members at the end of year-two – again up from the 3-month mark but down from what was recorded nine months into the program. In March 2003, 45 percent of all trips by members were by foot or bicycle, the most popular forms of conveyance.

**Comparative Trip Purposes**

Travel-diary data revealed that at the two-year mark, City CarShare was used most (relative to other modal options) for individual affairs: personal business, shopping, and medical appointments. Journeys to work made up 20.6 percent of members' total trips but, as previously noted, just 10.7 percent of carshare trips.

**Member Profiles**

City CarShare's first wave of members were found to be fairly unrepresentative of the Bay Area's and even San Francisco's population, drawn disproportionately from professional-class residents who do not own cars and who live either alone or in non-traditional households. By the end of the second year, City CarShare's membership, while still unique in its composition, was slightly more representative of the city's population as a whole.

In March 2003, the median age of City CarShare members was 36 years, the same as for the city of San Francisco in 2000 [from the census (*6*)]. Still, City CarShare tended to draw a fairly young clientele – 43.2 percent of members were between the ages of 25 and 34, compared to just 27.8 percent of the city's population (among those 20 years and older). Also, 57.1 percent of surveyed members were women and 81.2 percent were white (compared to 49.2 percent and 49.6 percent of San Francisco residents in 2000, respectively). Members' median annual personal income was $57,000 and over 90 percent worked in professional fields, both figures being above the city's average.

In terms of household types, City CarShare attracted a comparatively large share of individuals who lived with one or more unrelated adults – 36.3 percent of members surveyed in March 2003 versus 17.4 percent of San Francisco households in 2000. Around 42 percent of members lived alone, slightly above the citywide average. Overall, the members' mean household size was 1.9 persons compared to 2.3 for the city as a whole.

**Car Ownership Patterns and Trends**

By City CarShare's second anniversary, some members might be expected to have sold personal cars. The convenience of having a fleet of vehicles available on demand, proponents contend, will prompt some carsharers to get rid of second cars and perhaps forego car ownership altogether. This section reveals the degree to which this has been the case based on second-year survey findings.

In March 2003, 56.7 percent of members were from zero-car households and 33.7 percent were from one-car households. Thus, around nine out of 10 members were from 0-1 car households, above the 83.3 percent share during the program's first year and well above the year-2000 average of 70.6 percent for all San Francisco households. What cars members did own tended to be fairly old – on average, their primary vehicle was 9 years old and had an odometer reading of 73,000 miles. The typical member's car was a 4-

cylinder medium-size sedan, like a Honda Accord (the most common car owned by members).

The March 2003 survey queried members and non-members about changes in the number of motor vehicles (including motorcycles, recreational vehicles, trucks, and mopeds) in their households. Table 1 shows that a significantly higher share of members reduced car ownership than non-members: 29.1 versus 8.0 percent (producing an Analysis of Variance F statistic of 5.53, significant at the 5 percent probability level). Furthermore, 67.5 percent of members said they forewent the purchase of a motor vehicle during City CarShare's first two years compared to 39.2 percent of non-members (F statistic and probability of 3.69 and 0.059, respectively). Thus, 73.3 percent of members reduced car ownership and/or opted not to purchase a vehicle between March 2001 and March 2003, compared to 42.9 percent of non-members (F statistic and probability of 4.18 and 0.052, respectively). Collectively, these statistics are compelling: two years into the program, participation in carsharing prompted many members to reduce their levels of car ownership.

### Other Attributes

In March 2003, sixty percent of surveyed members owned a bicycle and 65 percent had a Muni Fast pass, suggesting that a majority of members had non-automobile alternatives for many for their trips. (These shares were similar in the program's first year.) One-third of surveyed members lived with another person who was a City CarShare member, also similar to earlier surveys.

## 5. EVALUATION

This section addresses the question of whether City CarShare, on balance, induced or reduced travel among its members during its first two years of operation. All trips made by each surveyed person are included in the analyses. (Each person was asked to complete a 24-hour travel diary for one of two days of their choosing; the two days were randomly selected over a two-week survey period.) Sample sizes were large enough only to examine trends for weekday travel – for days that corresponded to respondents' workdays as well as non-work days. Changes in mean trip distance, travel time, VMT, and several additional indicators of travel consumption are examined below between the period of February 2001 (several weeks prior to City CarShare's inauguration, called Survey #1) and March 2003 (representing the program's second anniversary, called Survey #4). Table 2 summarizes results for members and Table 3 does likewise for non-members. While not presented here, patterns were similar for weekdays/non-workdays and when comparisons were drawn between the second (June-July 2001) and fourth surveys as well as the third (October-November 2001) and fourth surveys.

### Travel Distances and Times

Mean daily travel distances remained the same during City CarShare's first two years (15.7 miles) and increased slightly among non-members, though changes were not

statistically significant. Mean travel times fell for both groups, although more rapidly for non-members. Because average travel times fell while distances increased, average travel speeds rose markedly among members, in part from the substitution of City CarShare trips for travel formerly by foot and bicycle. Clearly, carsharing has enhanced mobility, allowing members to conveniently reach more destinations in and around San Francisco and to do so more quickly.

**Vehicle Miles Traveled**

Did carsharing affect VMT? During City CarShare's first two years, average daily VMT fell slightly for members yet increased for non-members. While factors like changing fuel prices (which rose) and rainfall (which was much lower during Survey #4 than Survey #1) might have impacted VMT during survey periods, these potential confounders affected both members and non-members equally, meaning their influences are netted out when comparing trends.

Adjusting for mode and engine-size reveal even larger differentials over time. Mean MVMT fell by 47 percent for members yet increased by nearly 73 percent for non-members. (See the key of Table 2 for definitions of MVMT and other metrics presented in this and the following section.) Because CarShare members leased mainly Volkswagen Beetles, reductions in MVMT adjusted for engine size (i.e., the MEVMT variable) were even greater. Declines were not statistically significant, however, indicating there was a fair degree of variation in changes in travel consumption among members. Changes were not statistically significant among non-members either. Still, the evidence is persuasive: carsharing offers a fairly resourceful form of automobility to San Franciscans who have joined the program.

**Energy and Environmental Metrics**

Despite the fact that, upon becoming carshare members, a number of San Franciscans began driving in lieu of travel by transit, foot, or bicycle, average daily fuel consumption fell during the program's first two years. This likely reflected a combination of members reducing private car ownership, switching to more fuel-efficient City CarShare vehicles, and carrying passengers for many carshare trips (thus increasing average occupancy levels relative to private car trips). By comparison, mean fuel consumption rose among non-members over the two survey periods. Similar relationships held in terms of estimated changes in greenhouse gas emissions. Over the two year period, members' average daily transportation-related $CO_2$ emissions fell by an estimated three-quarters of a pound compared to an estimated one-quarter pound increase among non-members.

**Net Impacts**

In striking contrast to findings on first-year impacts, by the end of City CarShare's second year, there was considerable evidence of travel suppression – i.e., carshare membership generally reduced overall travel consumption. Table 4 presents the "difference of difference of means" results – i.e., the degree to which changes in travel

over the two time points differed among members and non-members. While none of the "differences of differences" were statistically significant at the 5 percent probability level, nonetheless total travel consumption during the February 2001 to March 2003 period generally went down for members and up for non-members. For example, the net change in daily VMT for members relative to non-members was -6.46 – a product of a 0.09 average decline for members and a 6.37 average increase for non-members.

While absolute differentials shown in Table 4 do not appear to be particularly large, in relative terms they were more substantial. Figure 6 summaries percentage point differences for the seven performance indicators. For example, the percentage point differential for mode- and engine-size adjusted VMT (i.e., MEVMT) was 173 – a product of a mean 38.8 percent decline for members and a mean 134.2 percent increase for non-members.

Although the sources of suppressed travel are not revealed by these statistics, we believe reduced car ownership had a substantial influence. Over time, carshare participation brings about structural adjustments like reduced car ownership and the foregoing of new purchases. Many members have also likely become more judicious in their travel habits, more conscientious of the marginal cost of driving (in light of being reminded upon receiving monthly City CarShare bills). This contrasts with car ownership where there is the perverse incentive to drive more to make full use of one's investment and motorists tend not to be cognizant of the marginal cost of depreciation, insurance, and other expenses for each mile they drive. The contention that, over time, carsharing can suppress travel through the reduction or relinquishment of private car ownership and by increasing awareness of the full cost of using a car seems to be borne out by these second-year results. Our findings on reduced travel, we note, are also consistent with those of a 1999 study that found carsharers in Switzerland who previously owned cars but sold them reduced their VMT, on average, by 18 percent (*8*).

## 6. PREDICTIVE MODELS

This section presents the results of three predictive models that shed additional light on City CarShare's intermediate-term impacts. All models are based on results of the fourth survey (from March 2003).

### Reduced Car Ownership Model

Table 5 presents a best-fitting binomial logit model that predicts whether a respondent reduced one or more cars in their household and/or forewent the purchase of a vehicle over the February 2001 to March 2003 period. Controlling for several demographic variables and vehicle ownership levels, being a carshare member significantly increased the likelihood someone got rid of a car and/or opted not to purchase another one. From a sensitivity analysis shown in Figure 7, the model revealed that for the "typical" survey respondent (i.e., non-Hispanic living in an unrelated-adult household with 0.3 cars per household member), the odds of reducing car ownership or foregoing a purchase jumps from 42 percent if the person is a non-member to 69 percent if he or she is a member.

### Private-Car Travel Choice Model

Again using binomial logit analysis, a reasonably good-fitting model was derived for predicting the likelihood a survey respondent chose a private car for a trip. Controlling for socio-economic factors (like car ownership levels), travel attributes (like trip purpose and frequency), and travel time (of transit versus car), Table 6 shows that being a City CarShare member lowered the likelihood of traveling by private car. While factors like comparative travel times, car ownership, and availability of a transit pass more strongly influenced private-car usage, belonging to City CarShare clearly sways many members to opt for other mobility options, particularly for non-work travel.

### Average Daily Gasoline Consumption Model

From a best-fitting multiple regression model, City CarShare membership was found to significantly reduce daily estimated gasoline consumption among survey respondents (Table 7). This was after controlling for the influences of other predictors, like type of travel day and respondents' socio-economic characteristics. All else being equal, City CarShare membership typically lowered daily gasoline consumption by nearly a quarter of a gallon. Although not presented, similar results were found in modeling VMT and estimated greenhouse gas emissions. Collectively, these results suggest that carsharing helps to shrink the urban transport sector's ecological footprint in cities like San Francisco.

## 7. CONCLUSION

Two years into San Francisco's City CarShare program, evidence of reduced travel among members was uncovered. We believe this was substantially a product of members having sold off private cars and foregone the purchase of additional ones. Almost three-quarters of surveyed members had reduced car ownership or stated they had opted against purchasing another car over the February 2001 to March 2003 period. Evidence of travel suppression stands in stark contrast to first-year impacts wherein members' average VMT had increased. Early adopters, many drawn from the ranks of environmentalists and avid cyclists who owned no car, began logging vehicle miles on the streets of San Francisco; with time, as the program has attracted a more mainstream clientele, the novelty of carsharing has worn off, and members have shed car ownership, "induced travel" appears to have been replaced by "reduced travel".

It was not just average VMT that fell among members relative to non-members. Because carshare vehicles tended to be small, fuel-efficient, and carry several people, per capita levels of gasoline consumption and greenhouse gas emissions have also trended downwards. Mindful of the cumulative costs of driving, car-share members, we believe, have also become more judicious and selective when deciding whether to use a car, take public transit, walk, bike, or even forego a trip. These factors, coupled with reduced personal car ownership, have given rise to a more resourceful form of automobility in San Francisco's transportation sector. Members appear to be taking City CarShare up on

the advice offered in its marketing brochure: "Think of car-sharing as a neighborhood-based, time-share car rental that allows people to use vehicles when needed, and pay based on how much they drive" (*9*).

Carsharing in the Bay Area holds considerable promise as the program expands into Oakland, Berkeley, and other parts of the region. Our surveys suggest that for every 25 households who join City CarShare, six of them give up a car within two years. For the control group, one in 25 added a car over the same period. This translates into each City CarShare vehicle taking seven private cars off of roads within two year's time. Altogether, City CarShare's current fleet of 74 vehicles has probably removed more than 500 vehicles from Bay Area streets, a number that will no doubt rise as the program expands elsewhere. Extrapolating our survey findings to the 2600 current members suggests that each weekday, City CarShare is saving some 13,000 miles of vehicle travel and 720 gallons of gasoline.

Whether experiences in San Francisco can be generalized elsewhere is debatable. We believe, however, that they are, though perhaps not quite to the extreme measured in the City by the Bay. San Francisco has many of the ingredients that make car-sharing a "natural": congested streets, limited and expensive parking, good public transit options, numerous non-traditional households, and a fairly socially progressive population. While the magnitude of impacts might vary elsewhere, the directions would likely be the same: car-sharing might initially stimulate motorized travel, however over time, it can bring about a more resourceful form of automobility, marked by a lowering of members' per capita VMT. On balance, carsharing is a welcomed addition to America's offering of mobility choices.

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**LIST OF TABLES AND FIGURES**

**TABLE 1 Change in Household Motor Vehicle Ownership Within the First Two Years of the San Francisco City CarShare Program: Members Versus Non-members**

| Change in Motor Vehicle Ownership | Members (A) | Non-members (B) | Difference between Members and Non-members (A-B) |
|---|---|---|---|
| **Reduced by Two and More** | 2.5% | 0 | 2.5% |
| **Reduced by One** | 26.6% | 8.0% | 18.6% |
| **Did Not Change** | 63.2% | 80.0% | -16.8% |
| **Increased by One** | 7.2% | 12.0% | -4.8% |
| **Increased by Two and More** | 0.4% | 0 | 0.4% |
| **Total** | 100.0% | 100.0% | |

**TABLE 2 Members: Trends in Daily Travel, Survey #1 to Survey #4, Weekday/Workday**

| | Survey #1 (February 2001) | | Survey #4 (March 2003) | | Difference of Means (S4 – S1) | T-Statistic (Sig.) |
|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Mean | Std. Deviation | | |
| **Travel Distance** | 15.7 | 21.2 | 15.7 | 17.7 | -0.01 | -0.005 (0.316) |
| **Travel Time** | 114.4 | 120.6 | 108.3 | 77.5 | -6.06 | -0.480 (0.01) |
| **VMT (Vehicle Miles Traveled)** | 4.50 | 11.32 | 4.40 | 13.10 | -0.09 | -0.053 (0.95) |
| **MVMT (Mode-adjusted VMT)** | 2.80 | 7.28 | 1.49 | 4.86 | -1.12 | -1.626 (0.02) |
| **MEVMT (Mode- and Engine-Size adjusted VMT)** | 4,313.5 | 14,547.1 | 2,641.8 | 9,817.4 | -1,671.7 | -0.946 (0.08) |
| **Gasoline Consumption** | 0.074 | 0.231 | 0.047 | 0.167 | -0.027 | -0.900 (0.07) |
| **$CO_2$ (Greenhouse Gas Emissions)** | 2.06 | 6.52 | 1.30 | 4.67 | -0.76 | -0.905 (0.07) |

*Key*:
**Travel Distance** = total daily highway-network travel distance, in miles;
**Travel Time** = total daily highway-network travel duration, in minutes;
**VMT** = vehicle miles traveled over highway network [representing total miles logged in motorized vehicles; all non-vehicle (i.e., walk and bicycle) trips were assigned zero values];
**MVMT** = mode-adjusted VMT (representing total miles logged in motorized vehicles adjusted for occupancy levels and accounting for whether new vehicle trips are added; values for walking, bicycle, and transit are zero since none of these trips add vehicles to city streets);
**MEVMT** = Mode and engine-size adjusted VMT{representing an overall index of travel consumption, accounting for occupancy level and engine size of vehicle; equals [(total highway VMT)*(engine displacement in cubic centimeters)]/(vehicle occupancy) wherein engine size was estimated given the make, year, and model of vehicle used for a trip};
**Gasoline Consumption** = estimated gallons of gasoline consumption per day adjusted for occupancy level and fuel economy of vehicles used for each trip; equals [MVMT/miles per gallon (mpg)] wherein mpg was estimated for city highway conditions given the make, year, and model of vehicle used for a trip; see (*7*);
**$CO_2$ (Greenhouse Gas Emissions)** = estimated pounds of carbon dioxide per day produced by vehicles used for travel, adjusted for occupany level and city-highway mileage of vehicle used for each trip; equals [MVMT/($CO_2$ emissions per mile based on the make, year, and model of vehicle used for a trip; see (*7*);
**S1** = Survey #1 (February 2001 – two weeks prior to City CarShare); and
**S4** = Survey #4 (March 2003 – end of City CarShare's second year of operation).

**TABLE 3 Non-Members: Trends in Daily Travel, Survey #1 to Survey #4, Weekday/Workday**

| | Survey #1 (February 2001) | | Survey #4 (March 2003) | | Difference of Means (S4 – S1) | T-Statistic (Sig.) |
|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Mean | Std. Deviation | | |
| **Travel Distance** | 19.2 | 19.6 | 23.2 | 28.4 | 4.0 | 0.801 (0.03) |
| **Travel Time** | 149.9 | 206.0 | 125.1 | 93.0 | -24.78 | -0.560 (0.33) |
| **VMT (Vehicle Miles Traveled)** | 6.73 | 15.49 | 13.10 | 28.30 | 6.37 | 4.409 (0.02) |
| **MVMT (Mode-adjusted VMT)** | 5.45 | 13.14 | 9.42 | 20.85 | 3.97 | 1.096 (0.02) |
| **MEVMT (Mode- and Engine-Size adjusted VMT)** | 12,122.9 | 32,058.1 | 28,391.9 | 90,496.6 | 16,268.9 | 1.295 (0.01) |
| **Gasoline Consumption** | 0.212 | 0.596 | 0.464 | 1.290 | 0.25 | 1.206 (0.02) |
| **$CO_2$ (Greenhouse Gas Emissions)** | 5.82 | 16.51 | 12.71 | 34.99 | 6.88 | 1.208 (0.02) |

*See Table 2 key for variable descriptions.*

**TABLE 4 Difference of Difference of Means: Changes of Members Minus Changes of Non-Members, Weekday/Workday, Surveys #1 to #4**

| | Difference of Difference of Means | T-Statistic |
|---|---|---|
| **Travel Distance** | -4.01 | -0.443 |
| **Travel Time** | 18.72 | 0.414 |
| **VMT (Vehicle Miles Traveled)** | -6.46 | -0.829 |
| **MVMT (Mode-adjusted VMT)** | -5.09 | -0.888 |
| **MEVMT (Mode- and Engine-Size adjusted VMT)** | -17,940.6 | -0.788 |
| **Gasoline Consumption** | -0.277 | -0.813 |
| **$CO_2$ (Greenhouse Gas Emissions)** | -7.64 | -0.823 |

*See Table 2 key for variable descriptions.*

**TABLE 5 Binomial Logit Model for Predicting Likelihood Respondents Reduced or Forewent Motor Vehicle Ownership; Survey #4**

| Variables | Coefficient Estimate | Standard Error | Probability |
|---|---|---|---|
| City CarShare Member (1 = yes; 0 = no) | 1.121 | 0.341 | 0.001 |
| Number of Vehicle Per Household Member | -1.071 | 0.278 | 0.000 |
| Hispanic (1 = yes; 0 = no) | -1.320 | 0.491 | 0.007 |
| Household Type: | | | |
| Married with No Children (1 = yes; 0 = no) | 0.660 | 0.313 | 0.034 |
| Unrelated Adults (1 = yes; 0 = no) | 0.544 | 0.265 | 0.040 |
| Constant | -0.025 | 0.345 | 0.942 |
| **Summary Statistics:** | | | |
| Number of Cases | | 423 | |
| -2 l (c): Log Likelihood Value, Constant-only Model | | 520.717 | |
| -2 l (*B*): Log Likelihood Value, Parameterized Model | | 479.183 | |
| Model Chi-Square (Probability): -2[l (c) - l (*B*)] | | 41.534 (0.000) | |
| Goodness of Fit (McFadden): 1 – [l(*B*)/l(C)] | | 0.080 | |

**TABLE 6 Binomial Logit Model for Predicting Likelihood Respondents Chose Private Car for Trip; Survey #4, All Trip Purposes**

| Variables | Coefficient Estimate | Standard Error | Probability |
|---|---|---|---|
| **Member Status:** | | | |
| City CarShare Member (1=yes; 0=no) | -.452 | .249 | .069 |
| **Modal and Travel Attributes:** | | | |
| Total Travel Time Differential: Transit–Automobile (minutes)[a] | .063 | .009 | .000 |
| Total Travel Time Differential Squared | -.002 | .000 | .000 |
| Have a Transit Pass (1=yes; 0=no) | .772 | .180 | .000 |
| More Than 10 Trips per Day (1=yes; 0=no) | 1.189 | .526 | .024 |
| Work Trip (1=yes; 0=no) | -.604 | .235 | .010 |
| **Socio-Economic Controls:** | | | |
| No. of Vehicles per Household Member | 3.997 | .495 | .000 |
| No. of Vehicle per Household Member Squared | -1.882 | .358 | .000 |
| Children in the Household (1=yes; 0=no) | 1.276 | .223 | .000 |
| Forgone Purchase of Cars over the past two years (of City CarShare operations) | -.376 | .172 | .029 |
| Constant | -3.172 | .339 | .000 |
| *SUMMARY STATISTICS (see Table 5 for descriptions)* | | | |
| Number of Cases | | | 1583 |
| -2l (c) | | | 1319.2 |
| -2l (*B*) | | | 972.9 |
| Model Chi-Square (Probability): | | | 346.4 (.000) |
| Goodness of Fit (McFadden) | | | 0.263 |

***Notes:***

[a] For transit travel, travel time consists of that occurring "in vehicle" (BART, Muni rail, or Muni bus) and "out-of-vehicle" (including walk time for access and transfers and waiting time, and driving to access transit, if any). For drive-alone travel, total time consists of in-vehicle network highway travel time.

**TABLE 7 Regression Model for Predicting Respondents' Average Daily Gasoline Consumption, in Gallons; Survey #4, All Trip Purposes, All Day Types**

| Variables | Coefficient Estimate | Standard Error | *Probability* |
|---|---|---|---|
| **Member Status:** | | | |
| City CarShare Member (1=yes; 0=no) | -.232 | .091 | .011 |
| **Modal and Travel Attributes:** | | | |
| Weekend, Work Day (1=yes; 0=no) | .330 | .132 | .013 |
| Drive Alone to Work (1=yes; 0=no) | .572 | .130 | .000 |
| **Socio-Economic Controls:** | | | |
| No. of Vehicles Per Household Member | .436 | .140 | .002 |
| No. of Vehicle Per Household Member Squared | -.153 | .091 | .095 |
| Asian American (1=yes; 0=no) | .250 | .099 | .012 |
| Age between 25 – 64 (1=yes; 0=no) | .224 | .130 | .086 |
| Constant | -.045 | .145 | .758 |
| *SUMMARY STATISTICS* | | | |
| Number of Cases | | | 248 |
| R square | | | .224 |
| F Statistics (Probability) | | | 9.962 (.000) |

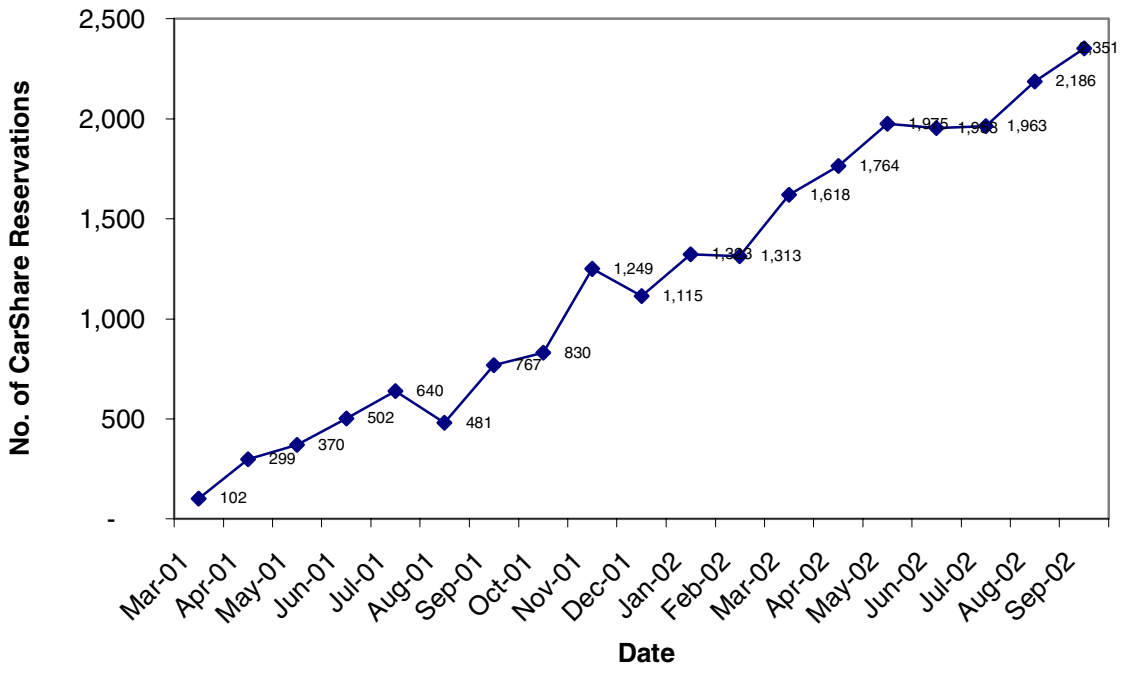


**FIGURE 1 Trends in San Francisco City CarShare Reservations, March 2001 – September 2002**

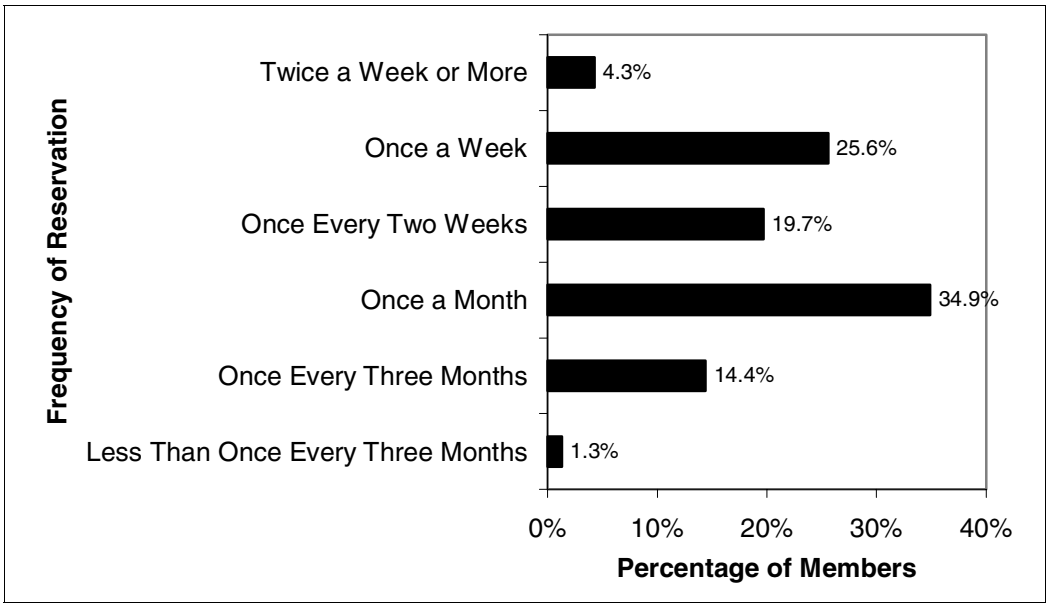


**FIGURE 2 Frequency of City CarShare Reservations Among Members, March 2001 – September 2002**

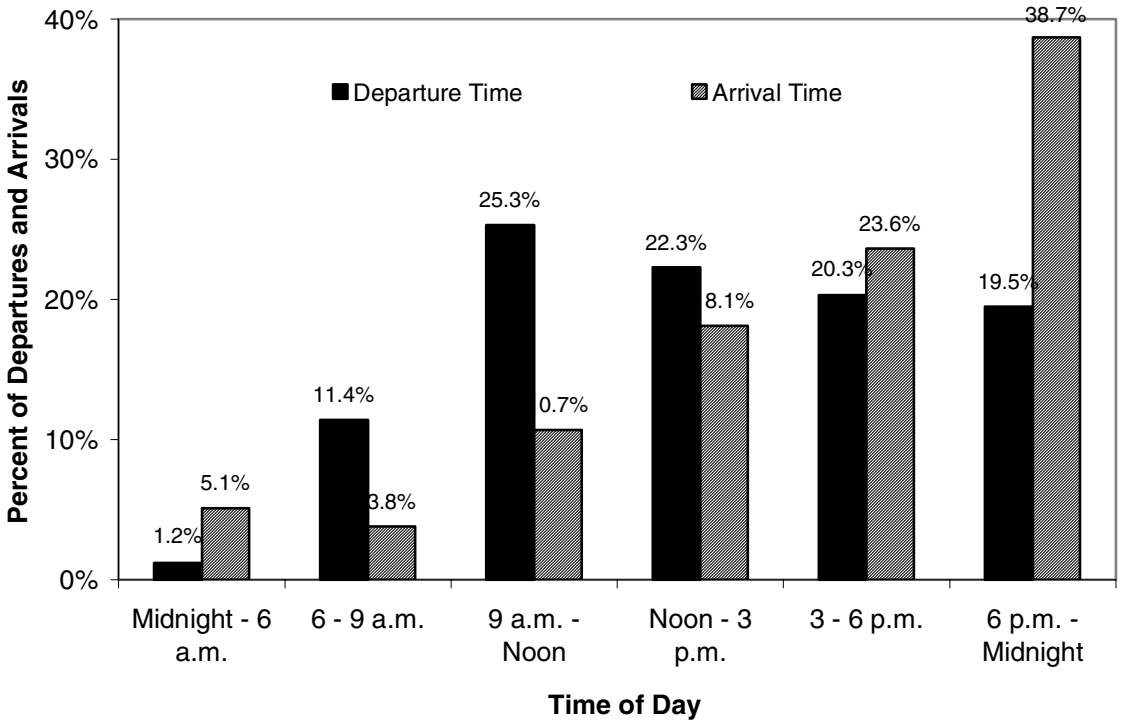


**FIGURE 3 Distribution of Departures and Arrivals of City CarShare Vehicles, March 2001 – September 2002**

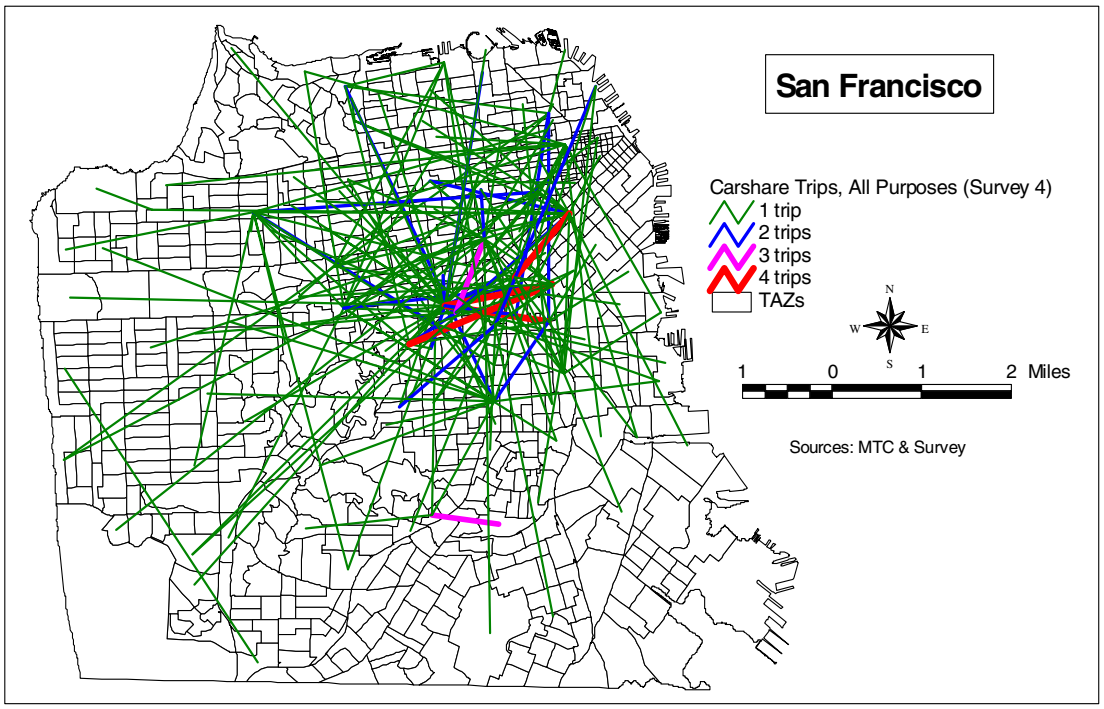


**FIGURE 4 Origin-Destination Patterns of All Surveyed CarShare Trips Within the City of San Francisco, September-October 2002 In-Vehicle Survey**

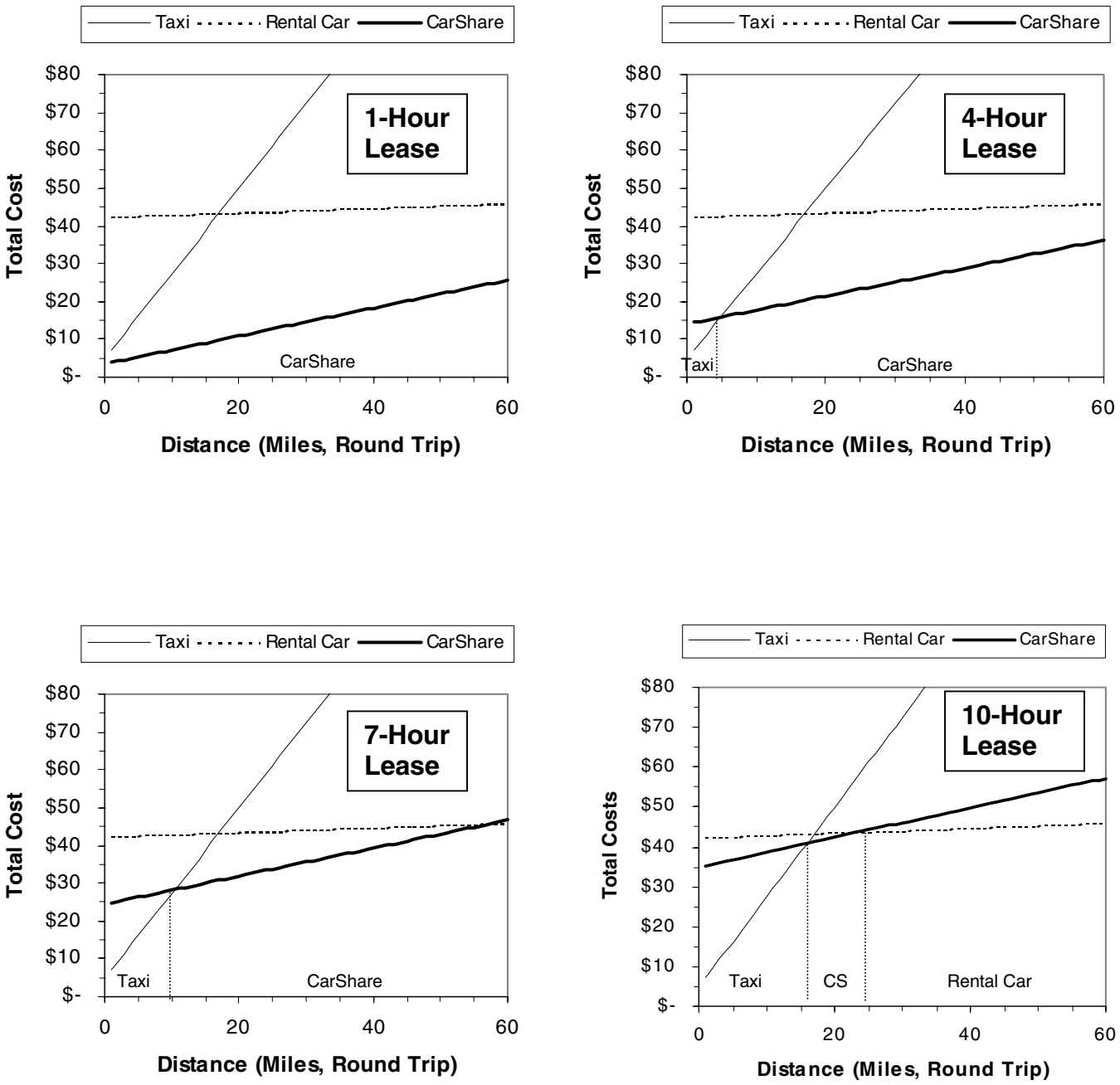


**FIGURE 5 Comparative Costs of City CarShare Leases Versus Costs for Other For-Hire Carriers: Scenarios for Leases of 1, 4, 7, and 10 Hour Durations Over Distance Ranges**

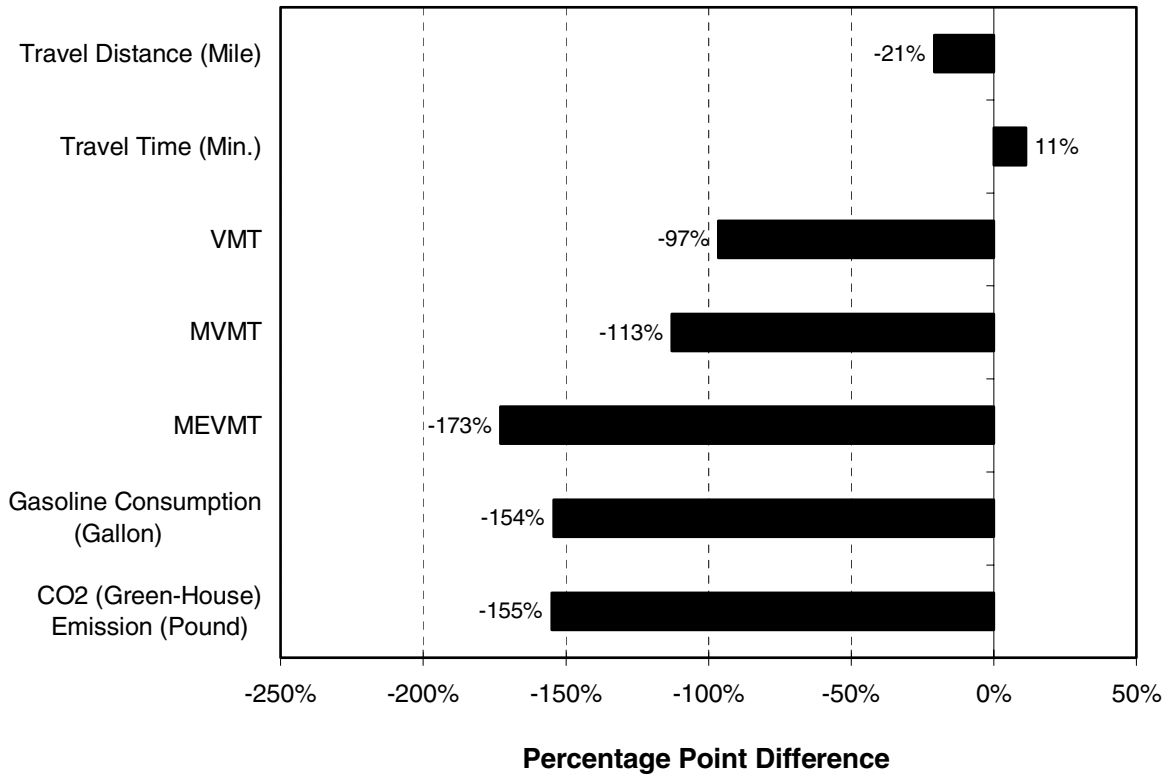


**FIGURE 6 Percentage Point Differences in Changes in Mean Daily Travel Characteristics: Weekdays that are Workdays, Members Relative to Non-Members, Survey #1 to Survey #4**

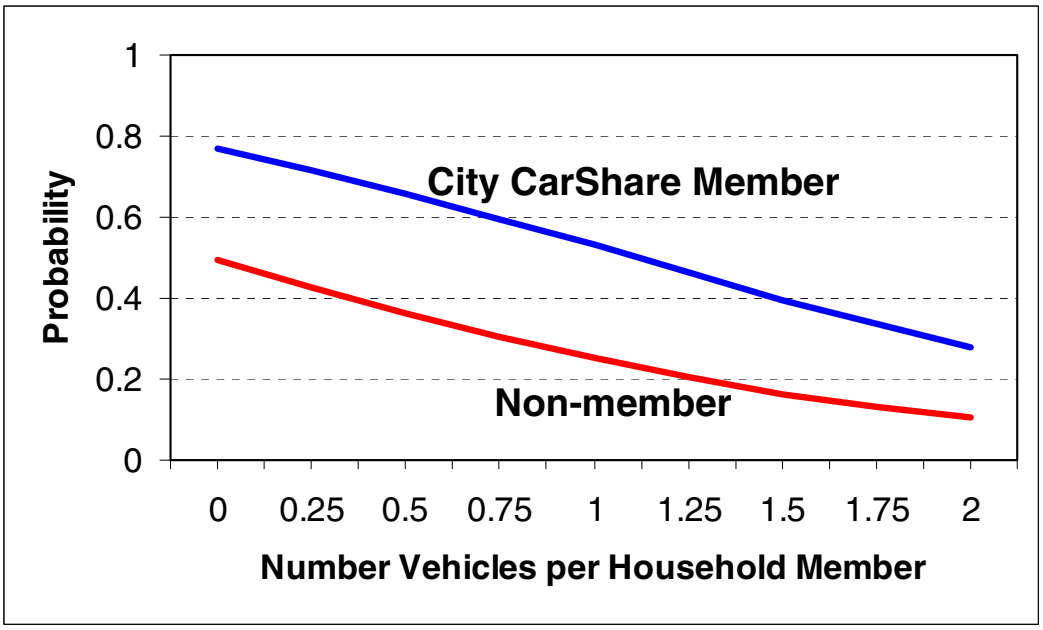


**FIGURE 7 Sensitivity Test: Probabilities of Reducing or Foregoing Motor Vehicle Purchase Relative to Vehicle Ownership Levels and City CarShare Membership Status**