ARE TAXES ON CARSHARING TOO HIGH?

A REVIEW OF THE PUBLIC BENEFITS AND TAX BURDEN OF AN EXPANDING TRANSPORTATION SECTOR

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June 28, 2011

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This report was made possible by internal financial support from the Chaddick Institute, which promotes effective planning and transportation. The Chaddick Institute receives no financial support from and has no affiliation with individuals or organizations involved in carsharing. The authors gratefully acknowledge Susan Shaheen, Ph.D., for her extensive technical assistance and Lauren Fischer, Nate Frey, Paige Largent and Rebecca McAlphine for editorial support.

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EXECUTIVE SUMMARY

This study evaluates the size and impact of taxes currently being levied on carsharing services–the sharing of motor vehicles through memberships in nonprofit and for-profit enterprises. By reviewing the tax burden that this sector faces against the backdrop of evidence about the effects of carsharing services on communities, this study makes four principal conclusions:

- The benefits of carsharing services have been extensively documented in peer-reviewed scholarly research and provide a strong rationale for units of government to adopt policies that encourage greater public participation in such programs. A number of these benefits are public goods, flowing to the community at large rather than only to those who use carshare vehicles.

- In many markets, including Miami, New York, Philadelphia, Pittsburgh, Seattle, and Tampa, one-hour carsharing reservations are taxed at well over twice the prevailing rate of sales tax. In seven of the 25 largest cities in the study's sample of 82 cities with carsharing services, taxes on one-hour reservations exceed 30%. Nationally, the average tax is 17.93% for one-hour carsharing reservations and 14.08% for 24-hour reservations. By comparison, sales taxes in cities with carsharing services average just 8.06%.

- Taxes on carsharing services substantially exceed those on other forms of consumer transportation including airline, bus, rail, waterway, and private automobile. Carsharing services are the only form of ground transportation in which consumers pay sales taxes twice on fuel purchases–first at the pump and again when they pay for their reservation.

- The "tax premium" paid by users of carsharing services relative to users of privately owned automobiles can be reasonably estimated to put 17,844 additional private vehicles on the road annually. Conservatively calculated, the tax premium results in an additional 48,727 tons of greenhouse gases being emitted annually.

The results illustrate some of the unintended consequences of the rising tax burden on car rentals, which are likely to grow more acute due to rising technological innovation. These findings specifically point to the need for states and municipalities to acknowledge and rectify the problems for carsharing organizations created by the fee system in place today. Several major cities, including Boston, Chicago, and Portland (Oregon), have created definitions for neighborhood carsharing organizations that are used to provide waivers from certain taxes.

I. INTRODUCTION

Since the first major carsharing organization emerged in the United States in 1998, the popularity of sharing of vehicles through memberships in nonprofit and for-profit enterprises has dramatically grown. Along with the sector's growth have come enthusiastic testimonials about the environmental, economic, and social benefits resulting from rising participation in formal vehicle-sharing programs. In addition to reducing emissions, pollution, congestion, and pressure on parking, many advocates claim that carsharing increases green and open space, improves public health and safety, and boosts local and state economies.

At the same time, it is apparent that many local and state governments do not share this view, at least with respect to the taxation policies they have established. Most impose higher taxes on carsharing services than on general consumer products. Many municipal governments appear to be unwilling to differentiate carsharing from traditional rental car companies, making it relatively common for rates of taxation to approach or exceed 20%.

To better understand the gap between the perceived public benefits of carsharing and the prevailing rate of taxation, this report explores the marketplace for this growing transportation sector. The analysis is divided into four sections. Section II provides background perspective and reviews the evolution of services and issues of taxation. Section III explores the evidence that carsharing generates significant benefits to users and to society as a whole. Section IV evaluates whether government agencies are treating carsharing in a manner consistent with what is justified on the basis of the sector's benefits through a review of prevailing levels of taxation. Section V offers conclusions and recommendations about how to improve policy.

The findings suggest that the appropriate level of taxation for carsharing is counterintuitive: although carsharing is a form of automobile travel for which the social costs can be high, it tends to complement—rather than be a substitute for—lifestyles oriented toward public transit and active transportation. Consumers as a whole drive significantly less and use non-motorized transport (e.g., walking and biking) considerably more after joining a carsharing organization (CSO) without substantially reducing their use of public transit. The associated social and environmental benefits suggest that policies discouraging carsharing are detrimental to the public good.

II. EVOLUTION OF CARSHARING IN THE UNITED STATES

Aptly described as "ownership by the hour" in a recent *New York Times* article, carsharing provides members access to fleets of vehicles for use on a pay-as-you-go basis[1]. Vehicles are picked-up and dropped-off at unattended locations called "pods" that are generally distributed throughout a service area rather than at a centralized location.

Figure 1
A Neighborhood Carsharing "Pod" in Chicago

This carsharing pod, maintained off-street in Chicago's Lincoln Square neighborhood, is one of many locations the nonprofit I-GO provides its members in the metropolitan region. (Paige Largent photo)

Members typically pay annual or monthly fees on top of variable fees based on the number of hours, and sometimes the mileage, associated with each trip. Special "day rates" are available for those seeking to use vehicles for longer periods. The reservation and "check in" process is fully automated, as bookings are made online or via a smartphone and vehicles are accessed using a smartcard. Any unpaid tolls or traffic tickets incurred by the user are generally added to that customer's credit card bill.

Although carsharing is growing more prevalent nationwide, it alone is generally not considered an attractive substitute for private vehicle ownership. Carsharing is rarely appropriate for a daily commute. Hourly fees accumulate whether or not the vehicle is in motion, making it expensive to pay for a vehicle as it sits idle at the workplace. More commonly, carsharing is used as a "missing link" in a package of transportation options. Members of CSOs often use transit service (or walk or bike) for their daily commute; taxis for one-way trips or those that are short in distance, but long in duration; rental cars, intercity buses, Amtrak, or airplanes for longer-distance trips; and carshare vehicles for other trips, such as those involving shopping or visiting family or friends in the suburbs (Millard-Ball et al. 2005, 3-12).

For consumers who make transportation choices in this way, carsharing is particularly pervasive for trips of "necessity and convenience" rather than for more discretionary purposes, such as for leisurely outings or recreation. According to Millard-Ball et al., many use carsharing to make multiple stops while on personal business, to transport groceries and other items purchased on shopping trips, or when a destination is difficult to reach via other modes of transportation (Ibid).

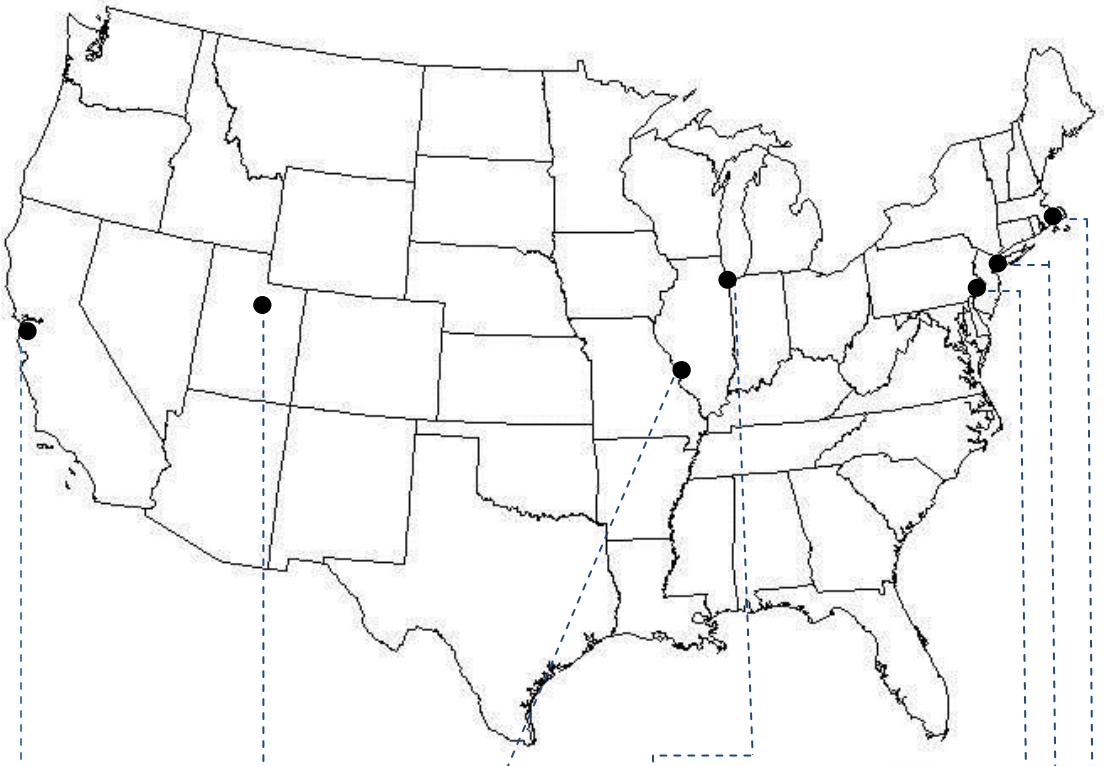
Growth of the Industry

Carsharing in the United States is generally still considered an infant industry. The first large-scale carsharing organization in the United States did not emerge until 1998 when the pioneering Car Sharing Portland opened for business in Oregon, building upon a business model developed in Canada and Europe. Most early entrants emphasized—and continue to emphasize—the neighborhood residential model, i.e., having pods scattered strategically throughout urban areas with relatively high densities. Along with the sector's growth, however, has come new investment in college and university markets and increased service to business and government clients.

All of the leading providers of carsharing services are either for-profit businesses or non-profit entities. Zipcar is by far the largest for-profit provider and now offers its services in 11 major metropolitan areas and on over 150 college campuses. Based in Boston, this company issued its first publically traded stock in April 2011 and now serves more than thirty states as well as Canada and the United Kingdom. Among nonprofits, City CarShare in San Francisco Bay Area, I-GO in metropolitan Chicago, and PhillyCarShare in the Philadelphia area are the largest. As recently as 2009, Zipcar and these three nonprofit operators cumulatively accounted for about 99% of total membership in carsharing organizations (Shaheen, Cohen and Chung 2009, 35).

Over the past several years, traditional vehicle rental companies have made sizable inroads into the carsharing business. Enterprise Rent-A-Car became the first to launch a domestic carsharing service when it established WeCar in St. Louis, Missouri, in early 2008 (Figure 2). WeCar now serves 14 states and emphasizes partnerships with universities, corporations, and governments (WeCar 2011; Brook 2008a). Since its inception in 2008, Connect by Hertz, an affiliate of Hertz Corporation, has also been a major player, having focused primarily on major world cities and university campuses. This provider has a foothold on 44 college campuses in 26 states and commands a significant presence in metropolitan New York (Connect by Hertz; Brook 2008b). On a smaller scale, U-Haul's U Car Share, primarily serves Salt Lake City, Utah, and ten college or corporate campuses in nine states (U Car Share 2011).

Figure 2
Some of the Notable Carsharing Providers in the United States
By Headquarters Location or Core Operating City



CITYCARSHARE
Founded in 2001
Bay Area

WeCar
Car Sharing by Enterprise
Founded in 2008
Multi-city Operator
First facility: St. Louis, Mo.

PhillyCarShare
Founded in 2002
Metropolitan Philadelphia

connect by Hertz
Founded in 2008
Multi-city Operator
Based in Metropolitan New York

Car Share sm
ucarshare.com
Founded in 2009
Multi-city Operator
First facility: Salt Lake City, Utah

CARSHARING igo
Founded in 2002
Metropolitan Chicago

zipcar
Founded in 2000
Multi-city Operator
Based in Boston, Mass.

Competition from traditional car-rental companies also takes the form of hourly rentals at established locations. Enterprise, Hertz and Avis, for example, both offer hourly rentals in selected cities, including at some airports. These services, however, are distinct from membership-based carsharing organizations on account of the fact that insurance is not automatically included and customers typically must to go to rental-car lots to pick up and drop off vehicles as well as complete paperwork before obtaining keys (although virtual car rental is becoming more prevalent), making them less-than-ideally suited for the brief neighborhood trips. Nevertheless, carsharing remains small compared to the neighborhood car-rental business, which when measured by the number of vehicles available is more than 20 times its size.[2]

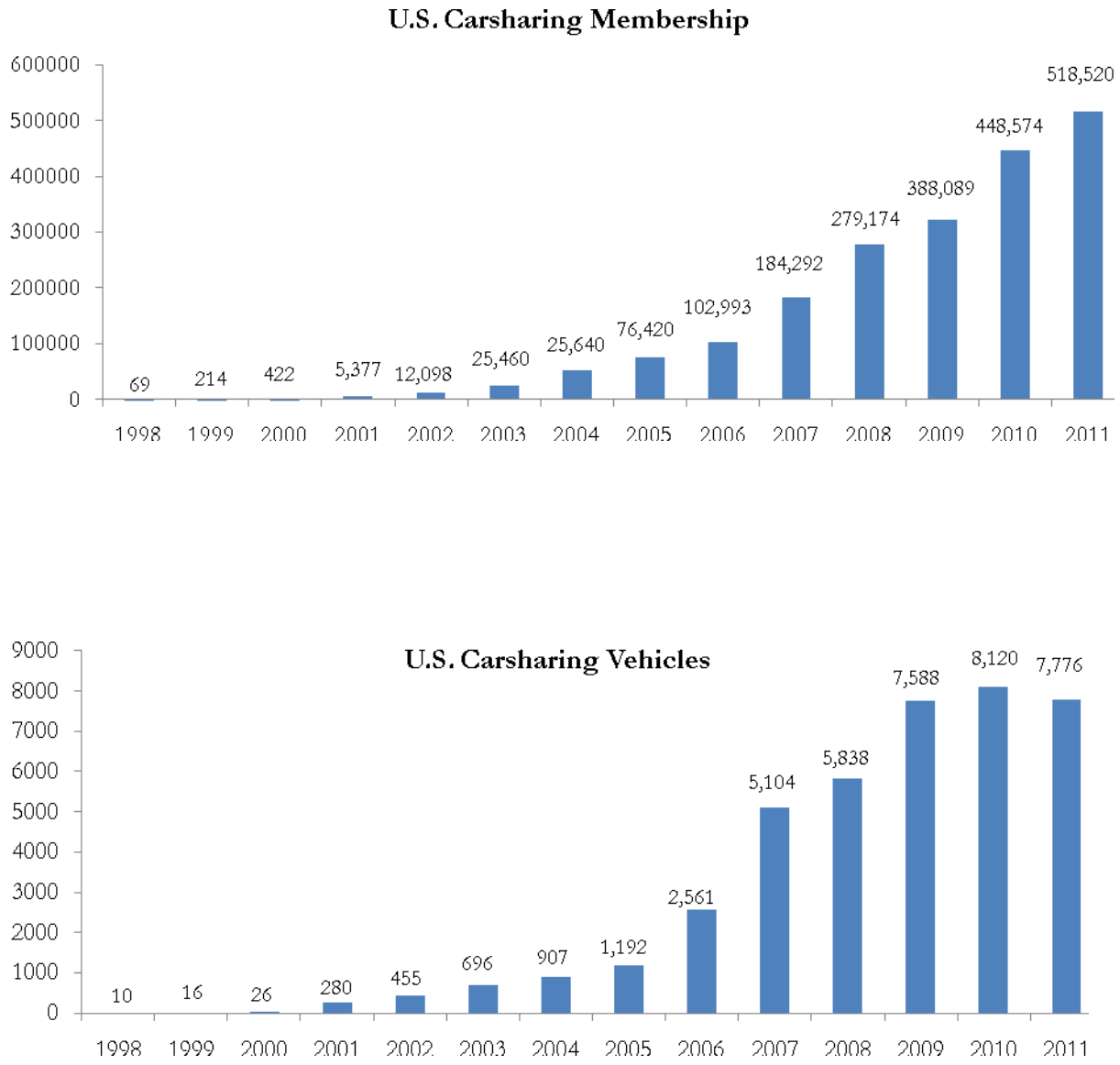
The recent push by rental-car companies into carsharing is motivated at least in part by a desire to protect segments of their business that are at risk of being lost to this expanding transportation segment. The entry of these players has triggered concerns that neighborhood-oriented operators not affiliated with a national chain might soon find themselves relegated to the margins of the industry. Traditional rental-car companies indeed have considerable strengths, such as access to abundant capital and national marketing programs, that most "pure" carsharing organizations lack. A recent assessment by Zipcar concluded that traditional rental-car companies are already its primary competitors and could soon exert significant downward pricing pressure (Zipcar 2010a, 14). Nevertheless, the nuances of the carsharing business, strong member loyalties, and the difficulty of simultaneously catering to two fundamentally different markets make this outcome anything but certain.

Along with escalating competition has come heightened concern that the carsharing business will likely not earn positive net income anytime soon. The profitability of carsharing has yet to be demonstrated unequivocally in any sector of the industry. Zipcar has experienced a net loss every year since its inception in 2000 and warns potential investors that losses are likely to continue in the near term—a point emphasized in media reports during its recent stock offering (Zipcar 2010a, 9). Although it is possible that many of Zipcar's more mature pods are already profitable, making this claim is speculative.[3]

Concerns over the bottom line aside, there is a virtual consensus that more dramatic growth lies ahead. In January of this year, 27 U.S. carsharing organizations reported having 518,520 members, up from 448,574 just six months earlier (Figure 3). (Innovative Mobility Research 2011). Carsharing organizations have a major presence, defined here as 50 vehicles or more, in at least 13 metropolitan areas and at least a nominal presence in 44 states. Only Alaska, Kansas, Montana, North Dakota, South Dakota and Wyoming appear to remain entirely unserved. Although the number of vehicles declined marginally from 8,120 to 7,776 over this period, the drop was due primarily to improved utilization of the fleet rather than reductions in availability.

Despite the marked growth of carsharing, most activity still occurs in residential neighborhoods. As recently as 2005, an estimated 82% of activity was in residential locations, with just 12% and 5% of activity generated in the business and university markets, respectively. The research team that made these estimates concluded that business and university markets could eventually grow to account for as many as 23% of all customers (Shaheen, Cohen and Darius 2005, 7-8). Since this study was published six years ago the non-residential market has indeed grown appreciably, although the precise share of each segment is not presently known.

Figure 3
Growth of Carsharing Membership and Vehicles in the United States, 1998-2010



1998-2010 data as of July; 2011 data as of January. *Sources*: Shaheen, Cohen and Chung 2009, 38; Innovative Mobility Research; AutoShare).

The expectation of growth is being fueled by the apparent presence of large and lucrative markets that are not yet served. Survey data collected by Shaheen, Cohen and Darius suggest that, based on conditions in 2004, carsharing could eventually serve up to 12.5% of the U.S. population over the age of 21 (Ibid). Considering that the market share of carsharing organizations remains almost negligible (about .2% of the country's urbanized population are presently members) the risk that the business will face saturation anytime soon seems low (US Department of Agriculture 2010).

Tax Issues

Since the inception of carsharing, this sector has attempted to demonstrate that its services are fundamentally different than those made available by traditional car-rental companies. In pursuit of this goal, carsharing organizations have supported the creation of clear definitions that distinguish them from their car-rental counterparts. Such definitions also serve to highlight some carsharing organizations' commitment to neighborhood improvement, entrepreneurial spirit, and civic-minded goals. Those providers that meet the formal definitions of carsharing organizations tend to be better positioned to attract governmental and philanthropic support, including technical assistance, land for vehicle parking under favorable terms, and waivers from certain taxes.

Such definitions have loomed large in the battles over taxation in several cities. In 1999 Multnomah County, Oregon, an area encompassing most of metropolitan Portland, amended its municipal code to exempt carsharing from a 17% tax on motor vehicle rentals. A definition was created to determine eligibility while requiring "commercial establishments" (rental car companies) to continue paying the tax (Multnomah County 2009; Nassauer 2008).

In Washington State, carsharing was exempt from taxes for roughly seven years. In 2007, however, the state's Department of Revenue announced that carsharing organizations would need to pay the 9.7% car-rental tax. In the wake of this announcement came vocal pleas and sometimes heated debate about the necessity of tax relief, culminating in a proposed state bill to clearly define carsharing and declare it exempt from the tax. Despite having support from multiple sponsors, the governor, the Seattle city council, and thousands of online petitioners, the bill did not pass (Curl 2008; Seattle Post-Intelligencer 2008; Williams 2010).

In 2005 Chicago, Illinois amended its municipal code to eliminate the city's 8% Personal Property Lease Transaction Tax for carsharing reservations less than 24 hours in duration. (Carsharing reservations of 24 hours or more are still subject to the tax.) The city defined a carsharing organization as one that is membership-based, provides access through a self-service reservation system with no written agreement required at each reservation, utilizes an environmentally friendly fleet, and has the required insurance (City of Chicago 2005). A similar effort to exempt carsharing from the state's vehicle rental excise tax (currently 12%) lacked the votes to move out of a House of Representatives committee (Jackson 2006).

Advocates of carsharing in Boston, Massachusetts, enjoyed partial success while providing an example for leaders in other cities. At issue was the $10 Convention Center Financing Surcharge imposed by the state's Department of Revenue's on every vehicle-rental transaction in Boston. In 2005, the state made an accommodation to carsharing organizations by deciding to assess the surcharge only on the first carsharing reservation per annual membership contract. The government stipulated that active carsharing members would need to pay the $10 fee only once per year.[4] The state sales tax (6.25%), however, still applies (Massachusetts 2005).

Most other outcomes have been less favorable to carsharing users. For example, after much debate, officials in Allegheny County (Pittsburgh) determined that the $2.00 fee per vehicle rental does indeed apply to carsharing organizations, and therefore, every carsharing reservation no matter how brief (Green 2008). Moreover, since 2000, many new taxes have emerged, including several "per transaction" fees (charges levied as a flat amount per transaction, regardless of the duration of

the trip), which are particularly onerous to carsharing.

The state of New Jersey levies a particularly large surcharge – a $5 per-transaction fee on vehicle rentals—that results in a tax rate of more than 60% on one-hour carsharing reservations (Whiten 2010). Passionate appeals from advocates of carsharing laid the groundwork for a bill presently under consideration to exempt carsharing organizations from this tax. The prospects for passage remain uncertain.

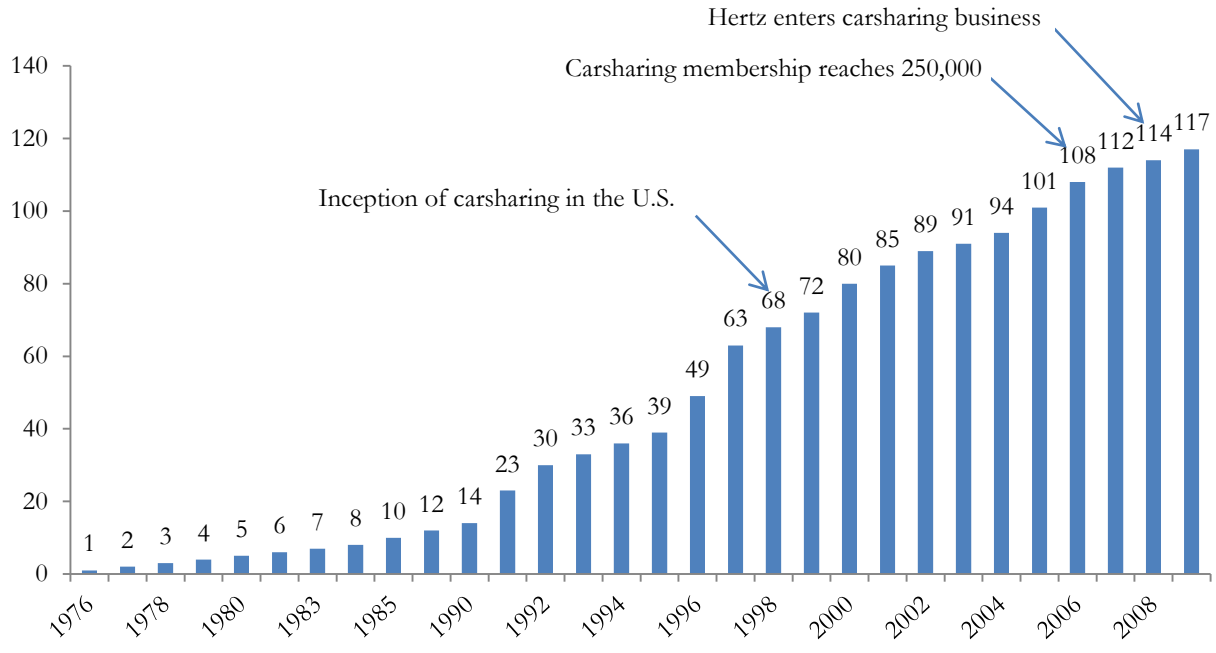
Among other examples of "per transaction" fees that apply to carsharing reservations are the following:

- The State of Pennsylvania charges a security fee of $2 per day per vehicle rental.

- Maricopa County (Phoenix), Arizona applies 3.25% fee with a $2.50 minimum on rentals.

- The states of Colorado, Connecticut, Florida, and New Mexico, and Allegheny County, Pennsylvania, each levy $2 surcharges on rentals. In Allegheny County, the tax is layered onto the aforementioned Pennsylvania tax, creating, in effect, a $4 transaction tax per reservation.

Figure 4
Cumulative Number of Excise Taxes on Car Rentals in the United States and the Notable Milestones in the Expansion of Carsharing



Source of tax data: Enterprise Holdings (2010)

Vehicle-rental taxes that are percentage based also add significantly to the tax burden. New York City offers a vivid example of this, having an 8.875% general sales tax combined with an 11% vehicle rental tax, resulting in a 19.875% tax.

Altogether, 117 excise fees were in place for car rentals nationwide in 2009, up from 72 in 1999 and just 12 in 1989, the vast majority of which apply to carsharing (Figure 4). Most of these fees were created prior to carsharings' emergence as a significant force in urban travel—and at a time when policymakers could not anticipate the dramatic ways in which technology and product innovation would transform the way in which vehicles were made available to the public. It seems unlikely that legislative bodies could have fully contemplated a time when large numbers of local residents would have "virtual" access to cars in their neighborhood and seek to use them for only a couple of hours.[5]

Efforts to lower the tax burden have been complicated by the severe budgetary shortfalls facing units of government since the economic downturn beginning in 2008. Opposition by traditional rental-car companies has also been a factor. The Coalition Against Discriminatory Car Rental Taxes strongly objects to legislative efforts to distinguish carsharing from traditional car rental, asserting that there are no meaningful differences between the two services. Coalition members argue that if the taxes are inappropriate for carsharing organizations, they are similarly inappropriate for car rentals (Jackson 2006; Enterprise 2010).

Making public policy still more complex are technological innovations that could eventually blur the distinction between carsharing and traditional car business. Investment in a "virtual car rental model" in which give customers can access cars in a few keystrokes and take advantage of hourly rentals at neighborhood pick-up locations have particular promise to transform the rental business.[6] The developers of these services face many of the same tax challenges as those facing carsharing organizations.

How the Market is Changing

What are the characteristics of the customer groups affected by carsharing taxes? The research suggests that carsharing users tend to be younger and more highly educated than the average motorists, but their incomes are widely dispersed. (See Appendix A for further discussion about the demographic profile of users). Moreover, many advocates believe that when consumers become acclimated to sharing vehicles at an early age, they will tend to remain highly receptive to a "carsharing lifestyle" later in adulthood. The heavy investments being made in university markets raises optimism that carsharing usage will remain high even as the clientele grows older.

Other factors, from the recent economic downturn to the rise of digital technology, may also contribute to the rising demand for carsharing, particularly among younger users. Broad attitudinal shifts appear to be reducing the perceived value and cultural significance of traveling by private automobile. Such shifts appear especially pronounced among millennials and other young people, a premise explored in a recent Zipcar study and our research at DePaul University. Both studies

suggest that privately owned automobiles have lost much of their symbolic value among the young.[7] In their place, sophisticated electronic devices, such as smartphones and iPads, have emerged as status symbols.[8]

The *neighborhoods* where carsharing thrives tend to have different (and more urban) qualities than non-carsharing neighborhoods—a point supported by a growing body of research summarized in Appendix A. Carsharing nevertheless appears poised to gradually become more prevalent outside of densely populated areas. One reason is the advent of *peer to peer carsharing* (P2P), which enables car owners to make their personal vehicles available for hourly use when they do not need them. P2P carsharing takes advantage of the fact that the average vehicle is idle for long periods of a typical day. Although this innovative strategy can supplement the income of participating vehicle owners, it suffers from several notable drawbacks, such as inconsistent quality of the customer experience as well as legal issues relating to automotive insurance.

P2P carsharing is gradually overcoming these obstacles and is positioned to expand even in suburban areas with low population densities. RelayRides, which began this type of carsharing in Boston last July and now serves the San Francisco Bay Area as well, is at the forefront of the movement. Spride, another P2P provider serving the Bay Area, launched its piloting phase last October following the passage of a new state law permitting this method of carsharing. Spride is partnering with City Carshare, a traditional carsharing organization, to pool membership and vehicle networks (Brook 2010c and 2010d). Although P2P seems to have great promise, it has not yet been extensively studied and is thereby considered only tangentially in our analysis.

III. DOES CARSHARING GENERATE PUBLIC BENEFITS?

Evaluating the appropriateness of taxes on carsharing requires an understanding of how this service affects vehicle ownership, greenhouse emissions, vehicle miles traveled, and transportation costs. These effects as well as some of the more speculative impacts of carsharing are the focus of an expanding body of academic and nonacademic literature. Critiquing this literature offers a framework for evaluating the industry's tax burden in Section IV.

Much of the available research is based on self-reported data, particularly on information obtained from member surveys. Although this raises questions of possible reporting bias and measurement error, evidence suggests that survey respondents can accurately estimate behaviors such as miles traveled, and even when biases exist, compensatory measures can be taken. For example, two studies show that people report the extent of their driving fairly accurately, overestimating their annual vehicular miles by just 4% and 11%, respectively (Moorhead 2000). (See the endnote section for a discussion of the potential issues associated with self-reported data.[9])

Evidence that Carsharing Reduces Vehicle Ownership

The most solidly documented effect of carsharing is the reduction in the rate of vehicle ownership among participating households. This effect is definitively documented in "Greenhouse Gas Emission Impacts of Carsharing in North America," by Elliot Martin and Susan Shaheen. This Mineta Transportation Institute study targeted more than 100,000 members of carsharing organizations throughout Canada and the United States, including those of Zipcar. The authors

screened responses to enhance accuracy and assure a representative sample, although they acknowledge that their final dataset (with 6,895 responses) skews slightly toward older, and therefore higher income, members (Martin and Shaheen 2010, 31). To lessen the risk of measurement error, this study screens out respondents who may have adjusted ownership and travel behavior due to unrelated factors, such as a household move or change of employment and adjusts for possible response biases.[10]

The results paint a compelling portrait of the effects of carsharing. The number of owned vehicles per household falls by nearly 50% when a family member begins carsharing. Only 12% of households that own a vehicle before using carsharing retain the same number of vehicles afterwards, while the remainder eliminate at least one vehicle. Among carsharing households, the average number of vehicles drops from .55 to .29 vehicles (Ibid, 63-64). The study also found that, for each carsharing vehicle added to the system, between 9 and 13 privately-owned vehicles are removed from the road (Ibid, 70). Such findings allowed the authors to conclude that carsharing on the whole has removed between 90,000 and 130,000 vehicles from the transportation system, either through the elimination of an owned vehicle or by joining carsharing in lieu of purchasing a new vehicle.

Table 1
Impacts of Carsharing Membership on Vehicle Ownership

Study	Location	% Selling Owned Vehicle	% Avoiding Vehicle Purchase	Number of Privately Owned Vehicles Removed per CSO Vehicle
Martin and Shaheen (2010)	North America	25	25	9 to 13
Econsult (2010)	Philadelphia	25	7	15.3
Cervero (2007)	San Francisco	24.2	…	…
Price (2006)	Arlington, VA	29[a]	71[b]	…
Millard-Ball (2005)	North America	55.2[a]	70.5[b]	14.9
Lane (2005)	Philadelphia	24.5	29.1	10.8
Cervero (2004)	San Francisco	29.1	67.5	…
Katzev (2003)	Portland	26	53	…
Zipcar	North America	…	…	15 to 20
I-Go	Chicago	…	…	Up to 17

Source: Data from Martin and Shaheen 2010 as reported in Shaheen and Cohen (2011), 70; Econsult 2010, 4; Cervero, Golub and Nee 2007, 74; Price, DeMaio and Hamilton 2006, 11; Millard-Ball et al 2005, 4-10,11; Lane 2005, 163; Cervero and Tsai 2004, 121; Katzev 2003, 79; Zipcar 2010c; I-GO 2011.

[a] % that strongly agreed or agreed that they were able to sell one or more cars due to carsharing

[b] % that strongly agreed or agreed that they were able to postpone buying a car due to carsharing

These findings are corroborated by at least nine other studies and surveys conducted by independent researchers and carsharing organizations (Table 1). A remarkable consistency exists between these studies, with much of the variation likely explained by differences in methodological approach, geographic factors, and member-to-fleet ratios at the time of the study rather than measurement error.

A reduction in vehicle ownership among households is not an economic benefit in itself, but is widely associated with other outcomes that are shown in the scholarly literature to be economically and socially beneficial. These include: i) benefits derived from reduction of vehicle miles traveled (VMTs) in crowded urban settings; ii) a reduction of greenhouse gas emissions; and iii) benefits derived from reduced transportation costs as households take advantage of improved mobility options. These outcomes and others are reviewed in separate subsections below.

Benefit 1: Social and Economic Gains from Reduced Vehicle Miles Traveled

Reductions in the number of vehicle miles traveled on streets and roads can reduce congestion and demand for additional publicly financed infrastructure. Furthermore, it can generate benefits with societal impacts of a more speculative nature, such as the health advantages resulting from a more active lifestyle that places greater emphasis on walking and biking.

Attempts to precisely measure changes in vehicle miles traveled are confounded by the uncertainties associated with self-reported data. At least five reports, however, offer credible estimates of the changes. Among these, the median reduction in vehicle miles traveled per member is found to be between 33% and 37% (Table 2). The latter estimate is made in the Millard-Ball study, a particularly comprehensive effort drawing upon data of driving behavior in 13 metropolitan areas.[11] As noted in the endnote section, studies made by carsharing organizations largely corroborate these findings.[12]

Table 2
Impacts of Carsharing Membership on Vehicle Miles Traveled

Study	Location	% Change in Average VMT (%)
Martin and Shaheen (2011)	North America	-27%[a]
Cervero (2007)	San Francisco	-33%
Price (2006)	Arlington, VA	-43%
Millard-Ball (2005)	North America	-37%
Cervero (2004)	San Francisco	-3

Source: Data from Martin, Elliot and Shaheen, 2011, Cervero, Golub and Nee 2007, 35-36; Price, DeMaio and Hamilton 2006, 9; Millard-Ball, et al. 2005, 4-22; Cervero and Tsai 2004, 123.
[a] Martin and Sheen estimate the "observed impact" to be 27% and the "full impact" to be 43%. For a discussion of these measures, see Benefit 2 below

Given the relative consistency of peer-reviewed research and industry-provided data (with

Cervero's 2004 study being a notable outlier apparently due to the methodological approach used[13]), it appears reasonable to conclude that average vehicle miles do decline dramatically, by at least a quarter.[14]

There is widespread sentiment for the idea that the reduction in vehicle miles traveled reduces congestion, diminishes the need for costly infrastructure, and generates health-related benefits linked to increased walking and biking. Exactly how carsharing generates such benefits, and how significant these benefits might be, remain speculative.

Reduced Congestion. The only apparent attempt to quantify the congestion-reducing effects of carsharing is Econsult's study of PhillyCarShare. This consulting firm places the annual reductions in traffic attributable to carsharing at about .04%, thereby reducing traffic delays by 47,000 hours and congestion costs by about $980,000 (Econsult 2010, A-9). Annual traffic delays fall by about two hours for every carsharing user.

For reasons discussed earlier, these estimates are subject to considerable uncertainty. By necessity, Econsult makes a variety of simplifying assumptions, and one might argue that some of the congestion reductions will induce additional travel, thus offsetting part of the gains.[15] However, the study offers a useful framework for measuring VMT reductions and supports the view that carsharing can be an important component of a congestion-reduction strategy.

Increased Walking and Biking. The evidence shows that some urban dwellers substantially increase their use of public transportation and active transportation (walking and biking) after joining a carsharing organization. Studies by Price (2006), Millard-Ball (2005), and Scott (2003) found that an appreciable percentage of carsharing users walked, biked, and used public transit more. Nevertheless, estimating the *net* effect of carsharing is more difficult as it requires

Table 3
Impacts of Carsharing Membership on Biking, Walking and Use of Public Transit

	% Increasing after Carsharing	% Decreasing after Carsharing	Net Change
Bicycling	10%	4%	+6%
Walking	12%	9%	+3%
All Public Transit (rail, bus, carpool, and ferry)	19%	20%	-1%
Traditional Public Transit (rail and bus only)	16%	19%	-3%

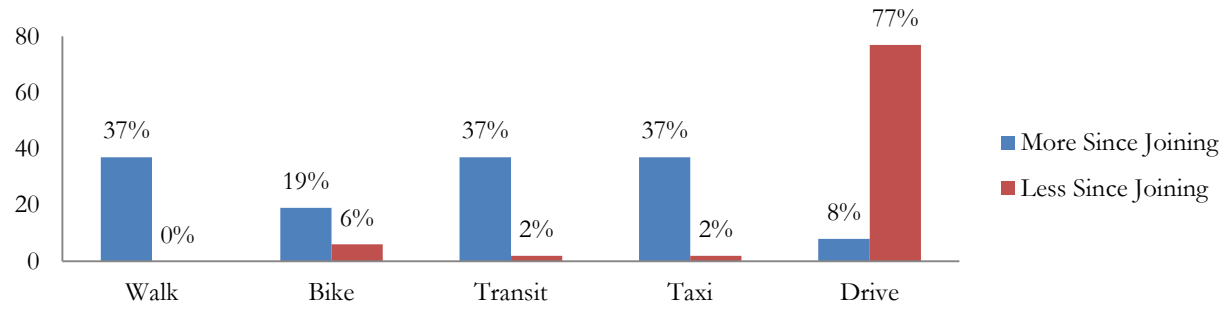
Source: Martin and Shaheen (2011b)

measuring both the number of people who make greater use of alternate modes and the number who use these modes less. Martin and Elliot (2011b), using survey data, find that three percent more respondents indicated they walked more than indicated they walked less. Similarly, six percent more respondents indicated they bicycled more than responded that they did so less. Conversely, one percent more respondents reported that they used public transit less extensively after joining a carharing organization than reported using transit more (Table 3).[16]

These data do not measure the *intensity* of the increases or decreases in travel on these modes and thereby cannot be used to measure the changes in mileage. Nevertheless, they support the view that carsharing fosters an increase in active transportation while having little effect on use of public transit.

The propensity for many car sharers to place greater emphasis on walking and biking and to rely more heavily on transit is also explored by Clayton Lane in another study of Philadelphia carsharing (Figure 5). His work shows that among those who reduced their car ownership, nearly 40% had increased the amount of walking and nearly 20% increased bicycle use, while only a small percentage walked or biked less. At the same time, reliance on public transit rose (Lane, 2005, 165).

Figure 5
Change in Travel Mode Choice among Carsharing Members
Members Who Reduced Their Car Ownership After Joining Car Sharing



Source: Lane 2005, 165.

The extent to which consumers derive nonmonetary benefits (rather than merely incur costs) from greater physical exertion, of course, varies by individual and situation. Many travelers pay large premiums for greater convenience, speed, and ease—so much so that they rely on private automobiles even in situations where the monetary cost is several times higher than other modes. However, a growing body of research suggests that *some* of the disadvantages of walking, biking, and using transit, such as the longer travel times and greater rates of exertion, can be offset by the non-pecuniary benefits of an active lifestyle.

Todd Litman, a prominent researcher in this area, draws attention to the increased physical

activity of a transit-oriented lifestyle while making reference to Centers for Disease Control findings, which suggest a need for a minimum of 22 minutes of moderate physical activity per day (Litman, 2010). At present, North Americans walk an average of just six minutes per day while transit users walk an average of 19 minutes. Body mass index measurements and obesity rates tend to be inversely correlated to a person's propensity to engage in active transportation (Ibid).

The difficulty of quantifying the health benefits of these lifestyle changes remains a persistent and confounding factor that broadly affects these types of research inquiries. Such quantification is not only technically difficult, but is often encumbered by the absence of clear measurement criteria and suffers from the problems inherent in self-reported data. These types of issues also affect the persuasiveness of claims that carsharing fosters declines in traffic casualty and fatality rates. At a minimum, one can say that some of the benefits of an active lifestyle, such as its potential to promote weight loss, are positive and amenable to measurement with additional research.

Benefit 2: Reduced Greenhouse Gas Emissions

Estimating the effect of carsharing on greenhouse gas emissions (GHG) requires detailed before-and-after data about changing travel behavior, including the mileage traveled via various modes of transportation. The calculations also must consider the make and model of vehicles used.

A comprehensive data set assembled by Martin and Shaheen allows for such estimates. These researchers measure both the *observed impact* of carsharing, such as the changes in emissions generated when a household sheds a privately owned vehicle, as well as the *full impact*, a more comprehensive measure that includes the emissions avoided when a household foregoes the planned purchase of a vehicle (Martin and Shaheen 2010, 21-27). (See the endnote section for more discussion of these measurements and related methodological issues[17]). Martin and Shaheen place the average reductions of GHG emissions at approximately .58 tons/year per household (observed impact) and .84 tons/year per household (full impact). They estimate the cumulative observed impact for all carsharing members to be 109,000–155,000 fewer tons of emissions per year, and the full impact to be 158,000–224,000 fewer tons (Table 4). The observed impact can be considered lower bound, and the full impact upper bound.

Table 4
Effect of Carsharing on Annual Household Greenhouse Gas (GHG) Emissions

Impact	Average Change in GHG emissions (per household)	Cumulative Reduction in GHG Emissions U.S. and Canada
Observed	-.58 tons	109,000 – 155,000
Full	-.84 tons	158,000 – 224,000

Source: Martin and Shaheen 2010, 33-34.

These benefits are partially due to a shift to more fuel-efficient vehicles. Martin and Shaheen estimate that private vehicles achieve an average of 23.3 mpg while those used by carsharing households achieve 32.8 mpg. These estimates appear reasonable, if not conservative, on the basis

of industry claims. I-GO reported that its fleet averaged 36 mpg in 2010 and 40% of its fleet are gas-electric hybrid vehicles.[18] At PhillyCarShare 45% of miles driven were reportedly in hybrid cars in 2009 (Econsult 2010, A-9).

Carsharing organizations have also released data regarding the impact of their services on emissions. PhillyCarShare and I-GO report that their services reduced green house gas emissions by 7,000 tons and 45,000 tons, respectively, while Zipcar reports reducing gasoline usage by 32 million gallons annually. It is important to note that I-GO and Zipcar rely on internally conducted surveys and have not fully shared their methodology; therefore, these claims must be viewed with caution.[19]

Benefit 3: Reduced Transportation Costs

Carsharing effectively unbundles the fixed cost of owning a car so that members pay a portion of the cost of ownership each time they travel rather than in large lump-sum amounts, such as through a monthly payment. Such unbundling can dramatically alter motorist behavior, particularly in urban settings where the majority of expenses for many motorists are fixed. For example, among conventional motorists lease payments, license fees, and insurance coverage do not change in accordance with vehicle mileage traveled. Once these costs are paid, vehicle owners naturally decide whether or not to drive primarily on the basis of the variable costs, such as gas, parking, and tolls.

The differing incentives facing car sharers and owners of private vehicles stem primarily from the former's ability to share the fixed costs with others on the basis of the number of hours they use the vehicle. Car sharers can more efficiently blend private and public transportation modes, thereby achieving significant savings in travel costs. Research shows that carsharers tend to be more nimble in choosing modes based on the characteristics of each trip and more acutely aware of the true costs of driving (Lane 2005, 164-165; Katzev 2003, 81-82). Many naturally increase their use of trip-chaining by combining trips to multiple destinations (Millard-Ball et al. 2005, 4-25; Katzev 2003, 81-82). Among the drawbacks are the opportunity costs of time spent finding an available car, booking a reservation, and traveling to a pod, which can result in appreciable transaction costs.

Carsharing users, however, can be rewarded with substantial monetary saving. Studies place the annual savings between $2,057 per year (in the case of Lane's study in Philadelphia) and $7,200 per year (in the case of the claim made by Zipcar). Other efforts do not quantify the savings but report user opinion about the annual savings (Table 5). A study focusing on Baltimore, meanwhile, found that the owners of 4.15% of the metropolitan area's vehicles would be economically better off as carsharing members (Schuster et al. 2005, 177). Another focusing on San Francisco found that 26% of households meet criteria that render them "predisposed" to carsharing due to the potential savings, often by eliminating a second car (Duncan 2011).

Local governments and business can reduce travel expenses for similar reasons. Some are able to meet employee needs with a smaller fleet while also reaping the benefits of greater employee accountability. For example, carsharing can reduce the use of vehicles for personal trips on company time (Cohen, Shaheen and McKenzie 2008, 7). Several cities, including Berkeley, California, New York City, and Philadelphia, report significant savings from such arrangements (see Appendix B for a summary of the estimated savings). This segment of the carsharing business, however, has not yet been extensively studied in the scholarly literature.

Table 5
Estimated Impacts of Carsharing Membership on Member Transportation Costs

Study	Location	% of Members Reporting Reduction in Costs	Annual Savings	Notes
Econsult (2010)	Philadelphia	…	$2,850	Savings are for members that gave up a vehicle. Estimate compares average cost of owning & operating a car in Philadelphia to estimated costs for high-usage members (actual annual billings + transit pass)
Price (2006)	Arlington, VA	65%	…	% that strongly agreed or agreed that they saved money; 19% disagreed or strongly disagreed
Millard-Ball (2005)	North America	62%	…	% that strongly agreed or agreed that they saved money; 21% disagreed or strongly disagreed
Lane (2005)	Philadelphia	40%	$2,059	16% reported spending more
Zipcar	North America	…	$7,200	…
I-Go	Chicago	…	$4,799	Comparison of typical member transportation costs of $2,520 to cost of vehicle ownership for average American ($7,319)

Source: Data from Econsult 2010, 4; Price, DeMaio and Hamilton 2006, 10; Millard-Ball et al. 2005, 4-27; Lane 2005, 163; Zipcar 2010f, 2; Feigon 2008.
Note: Figures represent the national averages for a small sedan, such as the Honda Civic.

More Speculative Benefits: Reduced Parking Needs, Lower Development Costs, and More Open Space

Some of the apparent benefits of carsharing are of a more speculative nature. Among these is the value of allowing land otherwise devoted to parking to become available for other purposes. Some municipalities consider the associated benefits to be large enough that they allow developers to reduce parking capacity in exchange for including carsharing parking stalls. These types of incentives can be incorporated into municipal code or negotiated on a case-by-case basis as part of

planned unit developments.

The policies of Chicago, Philadelphia and Seattle are particularly instructive in this regard. The Chicago municipal government grants parking reductions in exchange for inclusion of carsharing stalls in planned developments (Feigon 2008). In Philadelphia's Central Delaware Riverfront Overlay District, developers can substitute one carsharing stall for four required parking spaces for up to 40% of total required spaces devoted to residential and hotel uses (Philadelphia Code). For developments in Seattle requiring 20 parking spaces or more, each space set aside for a carsharing vehicle reduces the required minimum by three spaces, or 15%, whichever is less (Seattle Municipal Code).

Quantifying the benefits from such reductions in the demand for parking is nevertheless made difficult by the relatively small scale of most carsharing programs. The avoidance of a handful of parking spaces does not translate into benefits that are significant on a regional scale. If carsharing is able to eventually allow for substantive reduction of parking needs, however, the following types of benefits could result[20]:

Lower development costs: In *The High Cost of Free Parking*, Donald Shoup demonstrates that the minimum parking requirements imposed by communities are often excessive and that they can inadvertently increase the costs of development. These associated costs are passed on to consumers in the form of higher prices for purchasers, tenants and customers of residential and commercial spaces (Shoup 2005, 127-164). His research suggests that consumers can benefit from the reduced inefficiency made possible through elimination of poorly utilized parking places.

Increased development density: When parking requirements are lowered, developers have the option of increasing the density of other aspects of their projects. Litman argues that such increases in density can, in turn, make other modes of transportation, such as bus service, more practical. One result could be a greater number of dwelling units per acre without added congestion (Litman 2011).

Reduced costs for parking search: Carsharing can reduce the social and private cost incurred when drivers cruise the streets searching for parking. Shoup colorfully illustrates this idea in his description of how, in the 15-block Westwood Village neighborhood in Los Angeles, motorists searching for parking generate enough vehicle miles per year to make two round trips to the moon (Shoup 2005, 353-354).

Increased open space: Developers can respond to lowered parking requirements by increasing the amount of green or open space in a development, thereby decreasing the amount of paved or impervious surfaces. A decrease in impervious surface results in less stormwater runoff and management cost (Litman 2011).

Localizing Investment: The reduction in expenditures on travel can boost local spending as households invest their savings into appreciating assets, such as in education or home ownership, rather than depreciating vehicles (Feigon 2008). A model used by Econsult shows that savings from carsharing in Philadelphia are more likely to be spent locally than those devoted to purchasing and financing a car, resulting in additional indirect and induced expenditures in the region that exceed $20 million annually (Econsult 2010, 4-5).[21] It should be noted, however, that when additional

spending in one region of the country comes at the expense of spending in another, these impacts should not be included in estimates of the *national benefits* of carsharing. Moreover, a distinction also needs to be made between consumer spending and economic benefit, a subtlety often ignored in urban-impact analyses.

It is noteworthy that there is little research, either in scholarly journals or other publications, refuting the aforementioned benefits or questioning the assumptions behind this research. One can credibly argue that in the research community a consensus exists that the benefits of carsharing are quantifiable and real, and that many of the benefits flow to the general public rather than just to those who use the carsharing fleet.

IV. MEASURING LEVELS OF TAXATION

This section explores the sales taxes and excise taxes levied on users and providers of carsharing services. It compares the rate of taxation to the general sales tax and traditional car rental taxes in the same neighborhoods to develop perspective on the effects of public policy on the carsharing sector's performance and outlook.

To measure the tax burden, information about the fees and surcharges added to carsharing reservations of various lengths was gathered from 91 locations in 82 cities throughout the United States. These cities included those in all 13 metropolitan areas with a significant carsharing presence, defined as having 50 vehicles or more, except for Austin, Texas. (Austin's carsharing provider, Car2Go, employs a variant of the more traditional carsharing model that may limit comparability.)

Several locations were sampled in numerous metropolitan areas to ensure that differences in tax rates between municipalities and counties would be captured. In the San Francisco metropolitan area, for example, carsharing pods are in three different counties (Alameda, San Francisco and Santa Clara), each of which have different sales-tax rates. The prices of reservations were also collected from various campus locations to ensure representation in the data set of every state in which the sampled carsharing organizations provide service.

The data for this analysis was collected using the reservations websites of three carsharing organizations: Zipcar, Connect by Hertz, and I-GO. The data set assembled encompasses the base reservation rate, all applicable taxes, and all applicable government-imposed fees and surcharges. The reservations were priced whenever possible for a compact vehicle, such as a Honda Civic, which are common in carsharing fleets. Reservations of various lengths were sampled because some taxes are imposed on a per day or per transaction basis, rather than as a percentage of the base price. In such cases, the effective rate of taxation will fall as the duration of the carsharing reservation increases; therefore, a one-hour reservation will capture the maximum tax on a carsharing consumer and a 24-hour reservation the minimum tax to the consumer.

This information allows for comparisons with traditional (24-hour) car rentals in the same locations. For the latter, data was obtained using the Enterprise Rent-A-Car website. (Six of the sampled locations did not have Enterprise services.) Downtown or neighborhood based rental locations, rather than airport locations, were selected to better match typical carsharing areas. This approach avoided inclusion of special taxes and surcharges applied to airport-based transactions that

limit comparability. The general sales-tax rates were also collected for each sampled location.

To show the approximate *national* rate of taxation on carsharing, two weighting schemes are used to aggregate local rates: i) a population-based weighting, and ii) a weighting based on the approximate number of carsharing vehicles in a community.[22] As discussed below, the resulting weighted averages allow for a more refined, although not perfect, measure of the taxation scheme facing the typical carsharing member.

Analysis of the data allowed for the following key findings:

Finding 1: Nationally, carsharing is being taxed at between 1.7 to 2.2 times the general sale-tax rate. Using population-based weighted averages, one-hour carsharing reservations are taxed at 17.93% and 24-hour carsharing reservations are taxed at 14.08%. Meanwhile, sales taxes in communities with carsharing average just 8.06%.

In 21 of the 91 pods sampled, the tax rate for one-hour reservations was 20% or more. Such appreciable taxation is noteworthy considering that most consumer services and neighborhood transportation offerings, such as taxicab fare and bicycle rental, are usually not subject to any sales or excise taxes. The prevailing rates for the 25 most populous carsharing cities in the sample appear in Figure 6.

The highest observed taxes on one-hour reservations were in Hoboken, New Jersey (62.56%), Pittsburgh, Pennsylvania (52.32%), Mesa, Arizona (42.50%), Phoenix, Arizona (40.50%) and Philadelphia, Pennsylvania (39.86%) (Figure 7). The lowest rate was found in Portland, Oregon, which has neither taxes on carsharing nor a general sales tax. The *mean* rate of taxation on one-hour reservations (17.93%) is more than five percentage points higher than the *median rate* (11.50%). This is due to the tendency for larger cities to have higher tax rates than smaller cities.

Another notable finding is that the rate of taxation on one-hour carsharing reservations, when weighted by population, is significantly higher than that on traditional 24-hour car rentals (15.93%) in the same neighborhoods (Table 6). (Our data did not consider airport locations, where taxes are often higher.) Taxes on car rentals are typically justified on the basis that they extract revenue from out of town customers, particularly business travelers, who are regarded as being insensitive to price. Such rentals (whether rightly or wrongly) are often seen as complementing other forms of travel, making demand relatively inelastic with respect to price, thereby reducing the level of market distortion. In the endnotes we discuss more fully the differences between carsharing and car rentals.[23]

Table 6
Average and Median Tax Tates of Carsharing

Measure	Sales Tax	One-hour Carsharing Reservation	24-hour Carsharing Reservation	24-hour Traditional Car Rental
Average - Weighted by Population	**8.06%**	**17.93%**	**14.08%**	**15.93%**
Average – Weighted by CSO Fleet Size	7.89%	15.85%	13.68%	15.33%
Simple Average	7.08%	16.10%	10.90%	12.48%
Median	7.00%	11.50%	10.52%	11.49%

Figure 6
Tax Rates on One Hour Carsharing Reservations
25 Most Populous Cities with Carsharing in Sample of 82 Cities Reviewed

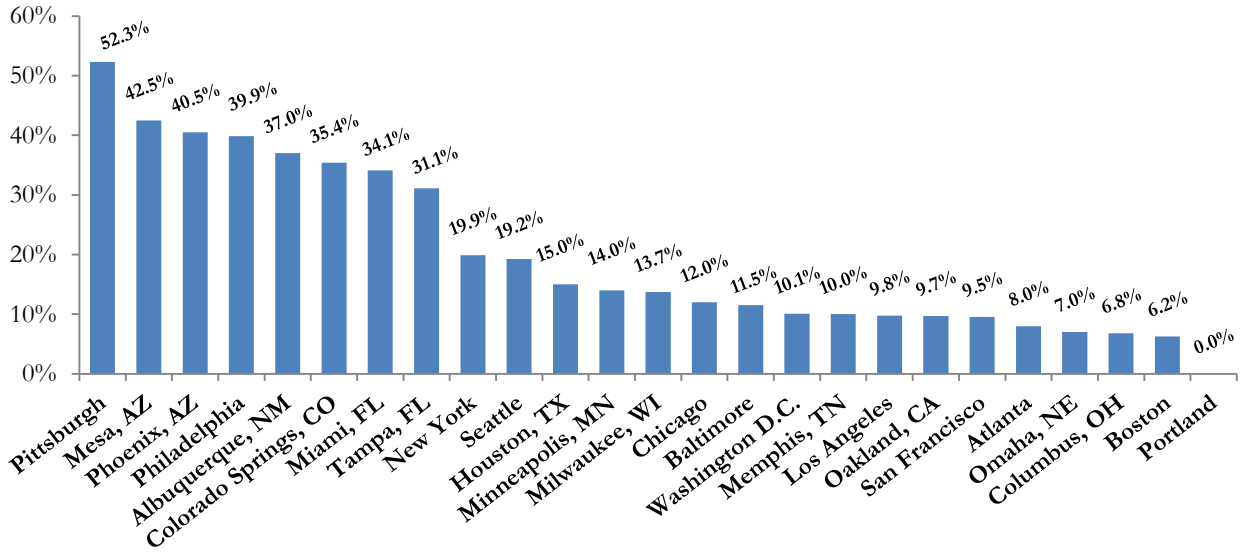
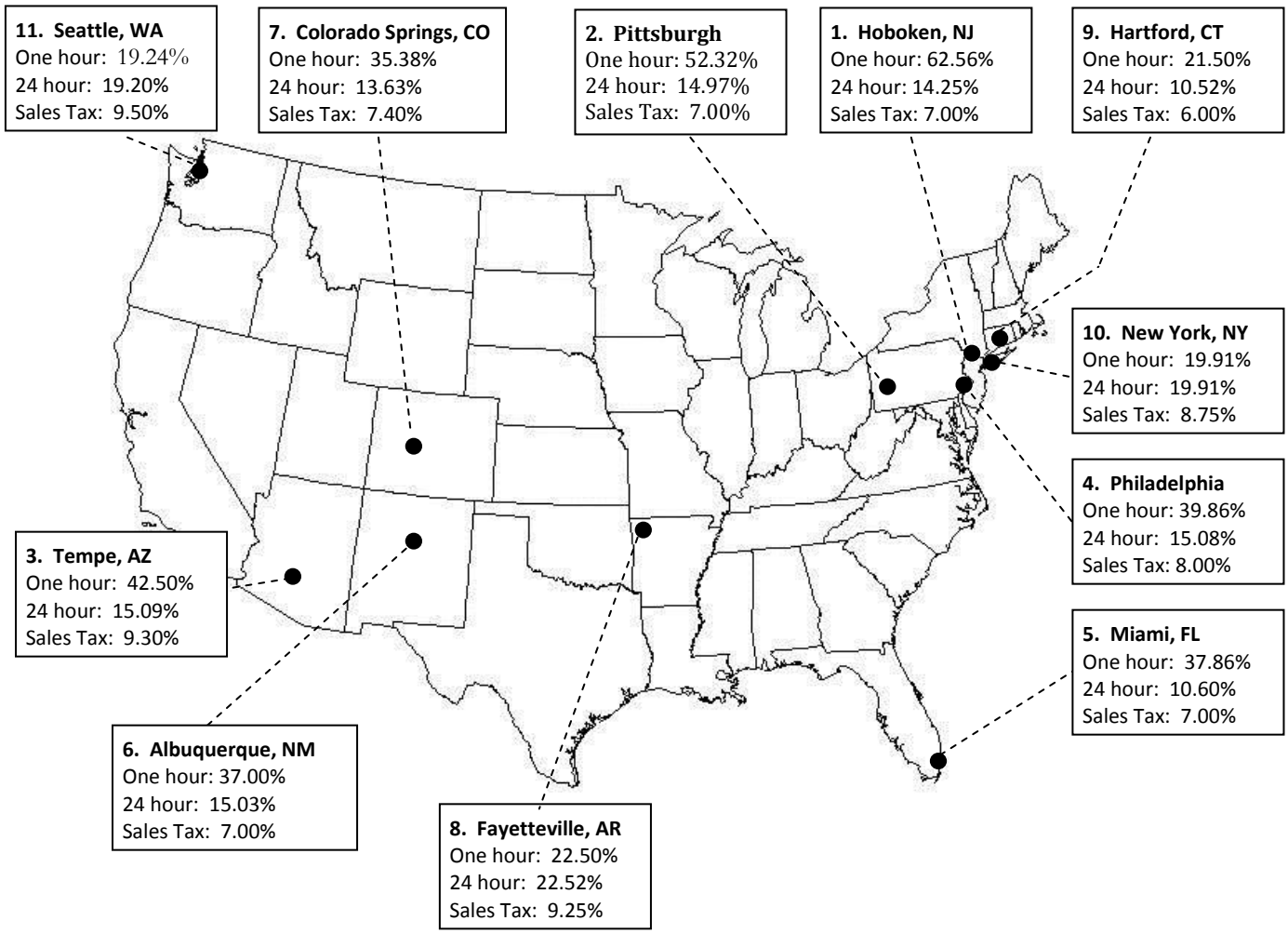


*Figure 6 shows the 25 largest cities in the study's sample of 82 cities. The sample includes all cities that have a significant carsharing presence (50 vehicles or more) except for Austin, Texas.

Figure 7
Highest Rates of Taxation for One-Hour Carsharing
Among 82 Cities in Sample - Ranked on Basis of Taxes as a % of Base Prices
With Comparison to 24-Hour Carsharing Taxes and Sales Taxes



When tax rates are weighted on the basis of the *approximate number of carsharing vehicles*, the average tax falls marginally; the average tax is found to be 15.85% on a one-hour reservation and 13.68% on a 24-hour reservation. Population-based weighting, in effect, shows the average tax on the *potential* carsharing market while weighting on the basis of fleet size captures the average tax on the *existing* market. When evaluating the effects of taxation on the expansion of carsharing, the populated-based estimate is arguably most relevant, as population is a proxy of the size of the market. The vehicle-based average, conversely, is most relevant when discussing the burden facing current members of carsharing organizations.

Table 7
Total and Component Costs of Highly Taxed
One-Hour Carsharing Reservations

City	Total Cost	Base Rate	Tax	Effective Tax Rate	Applicable Taxes
Hoboken, NJ	$14.63	$9.00	$5.63	62.56%	7% sales tax (state) $5 fee per auto rental (state)
Pittsburgh, PA	$14.09	$9.25	$4.84	52.32%	7% sales tax (state & county) 2% auto rental tax (state) $2 fee per auto rental (county) $2 fee per auto rental (state)
Tempe, AZ	$11.40	$8.00	$3.40	42.50%	9.3% sales tax on rentals (state, county & city) 3.25% rental surcharge (county), minimum $2.50
Philadelphia, PA	$10.14	$7.25	$2.89	39.86%	8% sales tax (state & county) 2% vehicle rental tax (state) 2% vehicle rental tax (county) $2 fee per day per rental (state)
Miami, FL	$9.65	$7.00	$2.65	37.86%	7% sales tax (state & county) $2 per day auto rental surcharge (state)
Albuquerque, NM	$10.96	$8.00	$2.96	37%	7% sales tax (state, county & city) 5% auto rental tax (state) $2 per day auto rental surcharge (state)
Colorado Springs, CO	$10.83	$8.00	$2.83	35.38%	7.4% sales tax (state, county & city) 3% auto rental tax (county & city) $2 per day auto rental fee (state)
Fayetteville, AR	$9.80	$8.00	$1.80	22.5%	9.25% sales tax (state, county & city) 10% auto rental tax (state) 3.25% auto rental tax (local)
Hartford, CT	$9.72	$8.00	$1.73	21.5%	6% sales tax (state) 3% auto rental tax (state) $1 per day tourism surcharge (state)
New York, NY	$13.19	$11.00	$2.19	19.91%	8.875% sales tax (state, city) 6% auto rental tax (state) 5% auto rental tax (metro commuter district)
Seattle, WA	$12.52	$10.50	$2.02	19.24%	9.5% sales tax (state, county, local) 9.7% auto rental tax (state/local)

When evaluating a representative mix of reservations of varying lengths and using the population-based weightings discussed earlier, we estimate that the national carsharing market is taxed at 15.6%.[24] Regardless of the scenario considered, however, it is relatively rare for rates of taxation on carsharing to be below that of local sales tax, which averages just 8.06%. Carsharing is taxed at a higher rate than general consumer products in 58 of the 82 locations sampled while being taxed at a lower rate in only three. (In the remaining 21 locations, carsharing is taxed at the same rate.) Consumers in the eleven cities shown on Table 7 will find tax rates on one-hour reservations that are well over twice the local sales-tax rate.

As previously noted, vehicle rental fees levied in fixed amounts per transaction have particular distortive effects due to the heavy reliance on carsharing for relatively brief shopping trips. These per day/per transaction fees are in place in 21 of the 82 cities sampled, with some of the highest fees shown in Table 7. The State of New Jersey's $5.00 fee for each day or part thereof that a vehicle is rented adds just 10.5% to the price of a traditional car rental but add 55.6% to the price of a one-hour carsharing reservation. The State of Pennsylvania's $2 per day motor vehicle rental fee adds just 5.2% to the price of a traditional car rental, but adds 28.6% to the price of a one-hour carsharing reservation. The $2 statewide surcharges in Colorado, Connecticut, Florida, and New Mexico, and Allegheny County, Pennsylvania, also are burdensome. In Allegheny County, the tax is layered onto the Pennsylvania tax, creating, in effect, a $4 transaction tax per reservation.

Vehicle rental taxes that are percentage based also add significantly to the tax burden. New York City has a cumulative tax burden of 19.875% tax, while Seattle's 9.5% general sales tax is combined with a 9.7% vehicle rental tax to create a 19.2% tax.

Finding 2: Although taxes on carsharing exceed the general sales-tax rates in all regions of the country, carsharing faces its highest tax burdens in the Northeast and West. This is partially due to the prevalence of per day and per transaction vehicle rental fees.

The Northeast has the country's highest average tax rates for both one-hour and 24-hour carsharing reservations. The 21.80% average tax rate for a one-hour reservation in this region is about 2.5 times the general sales-tax rate, while the tax rate for a 24-hour reservation is 16.68%, slightly more than twice the general sales-tax rate (Table 8).

Table 8
Comparison by Region
Average Tax Rates as a % of Base Price
Weighted by Population

Region	Sales Tax	One-hour Carsharing Reservation	24-hour Carsharing Reservation	24-hour Traditional Car Rental
Northeast	8.06%	21.80%	16.68%	17.10%
Midwest	8.81%	11.24%	17.83%	24.94%
South	7.15%	14.38%	11.00%	11.99%
West	8.86%	16.24%	10.65%	8.86%

Taxes in the West, at 16.24% for one-hour reservations, are slightly less than twice the general sales-tax rate of 8.86%. As in the Northeast, per day/per transaction fees explain much of this difference. Seven of the nine per day and per transaction fees found in the data set are in the Northeast and West.

The burden placed on carsharing in the Midwest and South are lower but still substantially higher than that on general merchandise. Only in the Midwest, however, are 24-hour carsharing reservations (17.83%) subjected to a higher tax rate than one-hour reservations (11.24%). This anomaly is attributable primarily to Chicago's fees on reservations of 24 hours or more—something not observed in any other city surveyed.

Finding 3: The sales and excise taxes on carsharing greatly exceed the taxes on expenditures on air, bus, rail, waterway and private-automobile transportation. Carsharing is the only surface-travel mode in which users have to effectively pay sales tax on fuel purchases twice—first at the pump and again when they pay for their reservation.

Fares providing passage on intercity buses, marine vessels, passenger trains, and most taxicab services are exempt from sales taxes. (Sales taxes are added to taxicab rates in a few locales.) In certain airports and convention-center districts, surcharges are imposed on commercial bus and taxicab fares. These fees, however, are intended to recoup the costs of specific investments made to support travel-related activity, such as investments in facilities, making them akin to user fees. Moreover, such fees typically apply to only a small fraction of bus and taxi services throughout a region. Similarly, owners of private automobiles incur sales tax when purchasing their vehicles and buying replacement parts, but they generally do not pay sales tax on labor on vehicle maintenance, insurance, tolls, cleaning and washing, and other ancillary costs.

Conversely, all consumer expenditures on carsharing and air travel are subject to taxation. A federal 7.5% tax and a $2.50 per-segment fee make the average tax on airline tickets about 10%. These fees are earmarked primarily for airport-related improvements, and thus might be reasonably classified as user fees rather than taxes, but this is a distinction ignored for purposes of this analysis. Air travelers also pay passenger facility charges, up to $4.50 per passenger each way, and a security fee of $5 per one-way trip to support investments in the airport improvements or anti-terrorist operations. Since these fees directly support air travelers, they are recognized as user fees and not considered to be taxes in this analysis.

The *overall* rate of taxation on the final price of transportation services, excluding taxes on fuel, differ widely between modes (Figure 8). Travelers using private automobiles, we estimate, pay tax that is the equivalent of about 3.9% of total expenditures. (This is the amortized cost of sales taxes on the vehicle and replacement parts.) All are taxed substantially lower than carsharing, with bus, rail, and water-transport tickets and taxicab fares untaxed at the point of sale.

Figure 8
Taxes Paid on Retail Expenditures on Various Transportation Modes
Excluding Taxes Embedded in Fuel Purchase

Taxes on fuel are excluded from the above estimates as they apply to all modes that use petroleum products and are embedded into the price of diesel, gasoline, and jet fuel rather than being added onto the final bill. Moreover, due to the fact that the majority of the revenues from this source are earmarked for infrastructure improvements, they are in many respects user fees.

As previously noted, part of the reason for the relatively high burden facing carsharing is that consumers using this mode, like air travelers, have to pay sales and excise taxes on top of the sales taxes that they have already paid on fuel purchases. Carsharing organizations pay sales tax, as do all motorists, when vehicles are filled up at retail gas stations. (The users of carsharing vehicles fill up at retail gas stations using a special credit card typically kept on the visor or in the glove compartment.) The cost of fuel is incorporated into the price of using the vehicle, upon which sales tax is applied again. Such double-taxation typically does not occur in traditional rental-car transactions as most renters handle fuel purchases independently.

For carshare users, this "double taxation" accounts for about 5% of the total tax burden.[25] Although additional research is needed on how such tax discrepancies affect mode choice, these calculations illustrate why the taxes facing carsharing are uniquely burdensome.

Finding 4: The levels of taxation on carsharing are comparable to certain federal and state "sin" taxes, such as those on beer and wine.

Alcohol taxes are largely justified on the basis of their propensity to discourage

consumption, which appears to be an *unintended outcome* of taxes on carsharing. On average, carsharing faces tax rates comparable to or higher than those imposed on retail purchases of beer and wine. We estimate that, when weighted on the basis of the population of carsharing markets, these taxes average 32.0% on distilled spirits, 16.3% on cans of beer, and 13.3% on bottles of wine, while carsharing is taxed at an average of 15.6%.

The above analysis is based on comparisons of relatively inexpensive alcohol products in retail stores—a $10 bottle of wine, a $15 bottle of distilled spirits, and a $1 can of beer. When more expensive alcohol products, or those purchased in restaurants and bars (which sell at much higher prices), are considered, the effective tax rate falls as many taxes are levied on alcohol content rather than the retail price. These estimates should be recognized as approximations due to the lack of a definitive data source on local alcohol taxes, making measurement difficult. Nevertheless, the tax rates for alcohol products described here are likely near the lower bound of actual rates.

Finding 5. The tax premium paid by carsharing members has economically undesirable effects. Conservatively estimated, it results in 17,844 privately owned vehicles being added to the transportation system and additional emissions of 48,727 tons per year.

The rate of taxation in most cities appears well beyond a socially desirable level—that is, a rate that does not have distortive effects on consumer behavior. When taxes are too high consumers under-invest in carsharing and complementary goods, such as public transit and taxicab services, and over-invest in private-vehicle transportation, which results in an inefficient allocation of resources. The resulting "deadweight loss" is detrimental to the public good.

Estimating the scale of the losses from excessive taxation requires an estimate of the elasticity of demand for carsharing with respect to price. At present, there are no published estimates of this elasticity. Several factors, however, suggest that it is relatively high.

First, recent research suggests that price sensitivity of motorists is higher today than it was decades ago. One meta-analysis puts the elasticity of auto travel with respect to fuel cost in the -0.4 to -0.6 range (Litman, 2011). (For every 1% fuel prices rise, vehicle miles will fall by between .4% and .6%.) Since fuel is only one component of the cost of driving, a corresponding increase in total costs (both fuel and non-fuel costs combined) will have a larger effect on travel behavior.

Second, carsharing is primarily used for non-work trips, such as for shopping and entertainment, for which the price elasticity of automobile travel tends to be much higher than for commutation. For these types of trips, Button estimates the elasticity to as be high as -2.7 to -3.4, although other studies suggest it may be lower (Button, 1998; Litman, 2011).

Third, research on other modes using conventional motor vehicles to compete with privately owned vehicles in urban settings, such as vanpooling and ridesharing programs, suggests that their customer base is quite sensitive to price. As we discuss in the endnotes, scholarly estimates place the elasticity of vanpooling between -1.0 and -1.5.[26]

Fourth, the elasticity may be heightened by the fact that a small change in the use of carsharing may constitute the difference between having a carsharing service being provided and not provided. The loss of a few customers can result in a pod being unavailable, thus having

disproportionate effects by preventing all consumers in the area from using carsharing. By discouraging expansion, taxes can deny many consumers *the opportunity* to use carsharing.

This latter issue is evident in studies showing that many customers are near the threshold at which they can justify giving up their car and replacing it with carsharing (Schuster et al. 2005; Duncan 2011). Small swings in the price can therefore have a large effect on the attractiveness of a carsharing lifestyle.

All of these factors suggest the elasticity of demand for carsharing is markedly higher than for the typical urban motorists. They suggest that it is reasonable to place the elasticity in the -0.75 and -1.75 range. The midpoint of this range, -1.25, is used in the analysis below.

The taxation data previously described suggest that, for a representative mix of reservations, carsharers pay an average tax about 15.6%, whereas private vehicle owners pay an average tax of 3.9%. (As noted earlier, these estimates exclude motor-fuel tax). The difference, 11.7%, represents the "tax premium" paid by carsharing users. When this cost is passed onto these consumers under a price-elasticity scenario of -1.25, the number of carsharing transactions is 14.6% lower than it would otherwise be if rates were the same (Table 9).

Table 9
Social Costs of Avoidance Behavior From Tax Premium Paid by Carsharing Users Relative to Other Vehicle Users

				Additional Greenhouse Gas Emissions (in tons)		
Elasticity	% Loss	Lost Membership	Vehicles	Low	Mid	High
-0.75	-8.8%	-41,178	-10,706	23,883	29,236	34,589
-1	-11.7%	-54,903	-14,275	31,844	38,981	46,119
-1.25	**-14.6%**	**-68,629**	**-17,844**	**39,805**	**48,727**	**57,649**
-1.5	-17.6%	-82,355	-21,412	47,766	58,472	69,178
-1.75	-20.5%	-96,081	-24,981	55,727	68,218	80,708

Assuming a proportional drop in the carsharing fleet and the number of members, it results in additional emissions of between 39,805 and 57,649 tons per year, with 48,727 being the representative midpoint of the range. Using the midpoint estimate, it suggests that the tax premium results in an additional 17,844 vehicles being added by households and results in the loss of about one-sixth of the potential greenhouse gas benefits of carsharing. These estimates, of course, are only approximations subject to the limits of available data. As noted below, additional research would allow for more refined measurements.

V. CONCLUSION

The evidence presented earlier in this report shows that carsharing reduces emissions, decreases vehicle miles traveled, increases active transportation, and reduces transportation costs for its users. Although several of these benefits are extensively documented, others, such as the benefits of reduced congestion, the diminished need for parking space, and ability for carsharing to allow for higher density development, are as yet only partially quantified.

Chicago, Boston, and Portland, as noted in Section II, offer noteworthy examples of how efforts to lower tax rates can achieve political success. These cities and several others make distinctions between carsharing and traditional car rental in their municipal codes. In other locales, efforts to achieve lower rates of taxation have been sidetracked or altogether blocked. The following recommendations warrant the attention of policymakers:

Recommendation 1: Policymakers should push first to align carsharing tax policy with the general sales tax rates in cities where carsharing is presently taxed at a higher rate. The rapid rate of carsharing growth makes this an important short-term priority. While carsharing is still a relatively small industry, the immediate financial consequences of having certain taxes waived are much smaller than they will likely be several years from now. Educating policymakers about the social benefits of carsharing would help them understand the arguments for taxing the sector at a rate more comparable to other goods and services.

These efforts may be made more difficult by opposition of traditional rental-car companies, who themselves face taxes that are usually far higher—in some cases two or three times higher—than prevailing sales taxes. The Coalition Against Discriminatory Car Rental Taxes strongly objects to legislative efforts to distinguish carsharing from traditional car rental. Many legislators, accordingly, may be wary of creating exemptions for carsharing. Concerns are likely to arise that exemptions will encourage traditional car rental agencies to claim exemptions as well (Curl 2008).

As noted in the following recommendations, several viable strategies can be used to help alleviate this problem.

Recommendation 2: Utilize codified definitions or certification processes to ensure that only organizations generating the significant public benefits associated with carsharing are recognized as carsharing organizations during efforts to reduce the level of taxation. Having governments ratify formal definitions of carsharing and make clear distinctions between various types of operators will bring credibility to efforts to reduce taxation. Governments that have done this in Chicago, Multnomah County (Portland, Oregon), and Massachusetts have encountered few apparent problems.

The certification process created by the city government of San Francisco is particularly instructive as it restricts the distribution of parking spaces to organizations meeting well-specified environmental goals (San Francisco 2010). This process, with its clearly articulated definitions, is easily transferable to local, county and state governments nationwide seeking to use targeted policies to encourage the growth of carsharing.

These policies can be enforced by requiring carsharing organizations to compile information,

assembled and certified by a third party, showing that the services they provide meet clearly articulated criteria, and also that they generate significant benefits for the community at large. The policies should require periodic reviews to ensure that the operator continues to generate the benefits. Due to the relative paucity of research on the social impacts of corporate, government, and peer-to-peer carsharing, governments may seek to tailor the eligibility requirements limiting tax waivers and reductions to those services in which the benefits are convincingly documented.

These definitions will need to be periodically changed to assure that the waivers granted are consistent with public intentions. Due to the rapid pace of innovation, the changing mix of clientele served, and competition between carsharing and traditional car-rental services, the sector is likely to change in ways impossible to predict. As private companies simultaneously invest in car sharing and car rental services—and experiment with new services that could blur the distinction between car sharing and car rental—governments must regularly revisit the tax policy so that its more dynamic than it has been in the past, a point considered in great detail in Recommendation 5 below.

Recommendation 3: Develop programs to make carsharing exempt from taxation in challenged urban locations, such as those with disadvantaged populations and high unemployment. Carsharing pods in lower-income neighborhoods are particularly appropriate for exemptions of sales and excise taxes. In these areas, which often suffer from poor mobility and unpredictable taxicab service, foregoing tax revenue may be a small price to pay for the mobility benefits that sharing vehicles provides. Using clearly defined eligibility criteria, governments can expand the availability of carsharing while reducing the short-term fiscal impact.

Recommendation 4: When reducing taxation is not possible, governments can enhance the vitality of carsharing in other ways. When measures to reduce taxation are not politically possible, municipalities can support carsharing in other ways, such as by rewarding developers for the heightened productivity of parking spaces assigned to carsharing. They can provide developers who embrace carsharing with more generous floor-area ratio limits or reduced overall parking requirements. Public bodies can also follow the lead of San Francisco by mandating the inclusion of carsharing stalls in new residential or non-residential developments in which parking is made available (San Francisco 2010). Leasing parking spaces, either on-street or off-street spaces in municipally owned facilities, to carsharing organizations at reduced or market prices is another potential strategy.

Alternatively, governments can also support carsharing providers as *customers*. In addition to the examples mentioned earlier in this report, Chicago contracts significant parts of its vehicle fleet-management operations to a carsharing organization.[27] Others cities have also used this strategy.

Recommendation 5: Expand research and policy awareness of the unanticipated consequences of the rising tax burden on car rentals and carsharing in urban neighborhoods. Rapid technological innovation and the changing nature of the business render some of the assumptions made by governments when imposing new taxes on car rentals (and by default on carsharing) increasingly inappropriate. The idea that the burden of taxes falls overwhelmingly on out-of-town travelers is particularly problematic. Although this report explores some of the implications for neighborhood carsharing, a much broader set of issues will likely emerge as new product offeringscome to the fore. A particular need exists to study how taxes affect the choices available to urban residents seeking alternatives to owner-occupied vehicles

VI. APPENDICES

Appendix A: Demographic Qualities of Members of Carsharing Organizations

The demographic qualities of carsharing users are richly documented in two large-scale studies. The first of these, by Millard-Ball, Murray, Schure, Fox and Burkhardt (2005), evaluates survey results from users of all major carsharing organizations in North America, with the exception of Zipcar. Published by the Transportation Research Board in 2005, this study draws upon data from 1,340 individuals, almost 5% of the membership of the participating carsharing organizations at the time (Millard-Ball et al. 2005, 3-3,4).

The second, "Greenhouse Gas Emission Impacts of Carsharing in North America," by Martin and Shaheen, draws from an even larger sample. As noted in Section III, the authors screened responses to enhance accuracy and assure a representative sample, although they acknowledge that their final dataset (with 6,895 responses) skews slightly toward older, and therefore higher income, members (Martin and Shaheen 2010, 31). The consistency in the findings of these studies suggests that industry stakeholders now have a reliable portrait of the market being served. Consider the key demographic categories of age, gender, income, and education:

Age: Both surveys found the greatest number of users were in the 25 to 35 age range, which is consistent with the popular perception that relatively young and upwardly mobile urban populations are particularly apt to carshare. According to Martin and Shaheen, however, a full one-quarter of users are over the age of 45, suggesting that carsharing has also become quite prevalent among older residents. To better understand the dynamics of carsharing among seniors, a more recent study by Shaheen evaluates the gap between the *expressed interest* in carsharing services and *actual usage* of this service in retirement communities (Shaheen, 2011).

Gender: More females than males use carsharing by margins of 55% - 45% and 57% - 43%, respectively, according to the Millard-Ball and Martin/Shaheen studies. This finding is corroborated by other research showing that females have historically had less access to privately-owned automobiles and have had a greater propensity to utilize more "public" forms of transportation than males.[28]

Education: Carsharing members tend to be highly educated, with both surveys showing that at least 80% of members have attained at least a bachelor's degree. The need for carsharers to have access to and proficiency with digital electronics may partially explain these rates of educational attainment.

Income: Income is widely distributed, with a median income of $60,000 or $50,000-$60,000 according to the two respective surveys. Carsharing members are divided relatively equally between those making less than $40,000, those making between $40,000 and $80,000, and those making higher incomes. Nevertheless, both studies show that the incomes of users are more heterogeneous than is perhaps commonly believed. The consistency in the results between Millard-Ball, et al and Martin and Sheheen (2010) is evident in the following summary (Table 10).

Another body of literature explores the neighborhood factors that affect the viability of carsharing. As a general rule, when holding other factors constant, the *physical* properties of

Table 10
Demographic Characteristics of Carsharing Users

Demographic Category	Millard-Ball et al (2005)	Martin and Shaheen (2010)
Age	Mean: 37.7 years Median: 35 years … Range: 55 years (ages 20 to 75) … Ages 25 to 34: 39% Ages 35 to 44: 27.4% …	Mean: 36.6 years Median: 33 years Mode: 38 … Age 25 and under: 7.4%[a] Ages 25 to 35: 43.2% Ages 35 to 45: 23.5% Ages 45 and over: 25.8%
Gender	Female: 55% Male: 45%	Female: 57% Male: 43%
Income	Median: $60,000	Median Interval: $50,000 to $60,000
Education	Less than some college: 2% … Bachelors: 35% Advanced Degree/Post-graduate work: 48%	Less than some college: 2% Some college/Associates: 16% Bachelors: 42% Masters/ Advanced Degree: 39%
Household size/ composition	Average: 2.02 persons Children present: 24.4%	Average: 1.9 persons …
Race	White/Caucasian: 87% Asian: 6% Black: 4% Other: 4%	…
Vehicle ownership	Live in car-free household: 72%	Average cars per household: .24

Source: Data from Millard-Ball et al. 2005, 3-5,6; Martin and Shaheen 2010, 31-33.
Note: Age statistics in the Martin & Shaheen report represent the final dataset; income and education statistics represent the full (unfiltered) dataset.
[a]Age statistics from the final dataset skew somewhat older due to the application of several data filters, including one that removes university and college students. When all filters are removed, the percentage of carsharing users under the age of 25 is close to 11%.

neighborhoods are better predictors of demand than demographic factors. Neighborhoods with successful carsharing pods tend to support "transit lifestyles" and thus have relatively low rates of vehicle ownership and high rates of transit connectivity.[29]

In general, this research shows that larger households are less apt to use carsharing (Table 11). Older and more established pods have the benefit of greater recognition and acceptance among nearby residents. These pods tend to be strategically located in transit- and active transportation-friendly environments. The coefficient of determination, R^2 (a measure of the predictive power in multiple regression models) for the various studies are shown near the bottom of the table.

The multiple-city Millard-Ball et al (2005) study found that carsharing neighborhoods have more one-person households, fewer children, and more rental units than other neighborhoods. These areas are also more likely to be comprised of residents with at least a bachelor's degree, who commute by transit and walking, and who own fewer vehicles on average than other neighborhoods.

Median incomes, however, are within 1% of regional incomes (Millard Ball et al. 2005, 3-33). This study uses the number of vehicles at each pod – i.e., the neighborhood supply – as a proxy for usage, or demand. Grasset and Morency evaluate membership data provided by CSOs to explore the market share of "pod" locations in Montreal against census data (Grasset and Morency 2009, 10.)[30] Stillwater, Mokhtarian and Shaheen evaluate carsharing usage data for approximately 18 months in 2006 and 2007 from an unidentified CSO in an unidentified city (2009, 28-29). Among this study's findings is that larger households are less likely to use carsharing and that established locations tend to see higher usage.

Table 11
Neighborhood Characteristics Contributing to Carsharing Demand

Category	Millard-Ball et al.	Stillwater, Mokhtarian and Shaheen	Grasset and Morency
Household characteristics	…	…	Average household size (-)
Commute behavior	Number who commute by walking (+)	Proportion of commuters that drive alone (-)	…
Vehicle ownership	Average number of vehicles per household (-)	Proportion of households with one vehicle (+)	…
Transit connectivity	…	No rail (-) Light rail only (+) Regional rail only (-) Combined rail service[a] (+)	Custom variable based on number of bus/subway stops in pod neighborhood (+)
Economic indicators	…	…	Neighborhood employment rate (+)
Location/built environment	…	Street width (-)	Pod distance from central business district (-)
Pod age	…	(+)	(+)
R^2	.477	.52	.85

Source: Millard-Ball et al. 2005, 3-36; Stillwater, Mokhtarian & Shaheen 2009, 32; Grasset & Morency 2010, 10.
Note: The direction of the relationship between the variable and carsharing activity is given in parentheses after each variable.
[a]Rail services measured are: light rail, subway and regional rail. Amtrak service is not included.

Appendix B: Institutional Savings from Carsharing

At least three cities have reported estimates of monetary savings from carsharing. **i) Berkeley, California.** The city government replaced 15 of its fleet vehicles with carsharing vehicles in 2004, resulting in an estimated savings of $400,000 over three years (Cohen, Shaheen and McKenzie 2008, 7). **ii) New York, N.Y**. The city's Department of Transportation announced it will pilot a partnership with Zipcar to provide fleet management for 300 employees with 25 vehicles. The department anticipates savings of $500,000 over a four-year period from 2010 to 2013 (City of New York). **iii) Philadelphia, Pennsylvania**. The city government partnered with PhillyCarShare to provide vehicle fleet replacement and management. In the first year of partnership, 2004-2005, the city was able to reduce its fleet by 330 vehicles; overall cost savings were projected at $9 million over five years (Millard-Ball et al. 2005, 5-21; City of Philadelphia 2004). In 2010, the City announced that it had contracted with Connect by Hertz to install its vehicle sharing and monitoring technology in 25 city-owned vehicles for enhanced fleet management (Government Fleet 2010).

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VIII. ENDNOTES

[1] Ken Belson, "Carsharing: Ownership by the Hour", *New York Times*, September 10, 2010.

[2] At present, car-rental agencies have more than 1.5 million cars in their U.S. fleet and reportedly earn the majority of their revenue at non-airport locations (see "Local Market Revenue Grows Past Airport", *Auto Rental News*, January/February 2006). This suggests, conservatively, that more than 500,000 vehicles may be available at non-airport location. The carsharing fleet encompasses about 7,000 vehicles.

[3] Recently submitted Internal Revenue Service documents suggest the financial viability of large nonprofit carsharing organizations remains mixed. Philly Carshare and I-Go both incurred deficits in 2007, 2008 and 2009, despite having a positive net income in 2006. Among the encouraging signs are the modest net income reported by Bay Area's City Carshare through 2009 and appreciable market value of Zipcar's common stock.

[4] The State defines CSO as a membership-based provider of self-service vehicle access for primarily hourly/short-term use, which does not require a separate written agreement for each use of a vehicle.

[5] For a discussion of the expansion of carsharing at non-airport locations, see."Local Market Revenue Grows Past Airport, *Auto Rental News*, January/February 2006. P. 12 and Chris Brown, 2011. 'The Challenge of Car Sharing." *Auto Rental News Fact Book 2011* .

[6] For a discussion of this, see Jay Boehmer, "Redefining Rental: Evolving Car Rental Programs Target Corporate Users", *Business Travel News*, June 13, 2001.

[7] See Joseph Schwieterman, "The travel habits of Gen Y: How the widespread use of portable-digital technology is changing the way they experience the public realm," Planning, May 2011.

[8] A 2010 study by KRC Research, commissioned by Zipcar, found that members of the "millennial generation" (defined in their report as respondents ages 18-34) are deliberatively driving less. Nearly half of the millennials surveyed reported that they had consciously decreased vehicle miles driven and increased travel by transit, walking and biking in the past year. Moreover, 45% of millennials cited environmental conservation as a motivation for decreasing miles driven, and a full 80% agreed the economy and the high cost of owning and operating a vehicle makes car ownership difficult (KRC Research 2010, 4-11; Zipcar 2010b). Meanwhile, the availability of digital technology facilitates the convenience and accessibility of various alternatives to vehicle ownership. Owners of a smartphone can easily reserve and unlock a carsharing vehicle; purchase a paperless ticket for a curbside intercity bus service; locate a rideshare partner; or identify when the next transit train will reach the closest station. For a study of the growing use of portable electronic technology in travel, see Joseph Schwieterman and Lauren Fischer. *Privacy Invades Public Space: The Growing Use of Portable Electronic Technology on Intercity Buses, Trains and Plane*s, Chaddick Institute for Metropolitan Development, DePaul University, 2011.

[9] Self-reported data is susceptible to several potential problems. Respondents may find it difficult to recall or accurately estimate a previous or current behavior. Some carsharing supporters may unconsciously exaggerate the positive impacts of carsharing. However, other methods of data collection, such as direct observation, maintenance of travel diaries or use of monitoring equipment, have their own problems and are often prohibitively expensive, impractical or only partially corrective. As a result, research on carsharing will likely continue to focus heavily on self-reported data.

Additionally, survey design can assist respondents in constructing an estimate by guiding them through a multi-step, methodical process, which seems likely to improve accuracy (Martin and Shaheen 2010, 77). Sensitivity analyses can also be used to develop an understanding of the possible effects of response bias.

[10] The study conservatively assumes that while inactive members comprise 9% of the survey respondents, they likely represent 15% to 40% of actual carsharing membership (Ibid, 69). This last assumption is particularly important when aggregating impacts across all membership in order to minimize the potential to overstate the benefits of carsharing.

[11] First, there are multiple methodological approaches that can be employed. For example, as previously noted, current member VMT may be calculated using self-reported estimates, self-reported travel diary data, or actual CSO usage data. The current VMT may then be compared to self-reported estimates of pre-membership VMT or VMT members would incur in the absence of carsharing; current usage by a control group; or the average or median in a geographic area. This can create a

variety of measurement problems. Second, carsharing can have complex and opposing effects, reducing travel for some members and inducing travel for others. It appears that members that sell one or more vehicles upon joining often experience dramatic declines in VMT, while members who do not own a vehicle upon joining generally increase their VMT by a modest amount (Lane 2005, 165-166; Millard-Ball et al. 2005, 4-22).

[12] Major CSOs make the following claims about changes in VMT among their members. I-GO claims that members drive 97% less than the typical Chicago car owner (I-GO 2010). Philly Carshare claims that members collectively drove 17,300,000 miles less than the typical Philadelphia driver (Econsult 2010, 6). Zipcar claims that 90% of members drive less than 5,500 per year (Zipcar 2010c). The per capita VMT in top Zipcar markets is 6,136 in New York; 7,049 in Chicago; 7,415 in Philadelphia; and 8,401 in Boston (Litman 2009).

[13] The Cervero study, unlike most other research efforts, made estimates based comparing vehicular mileage of carsharing users with a control group, rather than on self-reported changes in travel.

[14] A report by University of California—Davis post-doc and lecturer Gil Tal (2009) points to the potential risk that self-reported data and other inputs generate "optimism bias," resulting in a systematic overstatement of the benefits. Such research, however, focuses primarily on the potential error associated with measuring the magnitude of the reductions in driving rather than on whether significant reductions actually take place.

[15] For example, the study compares the median VMT for a Philadelphia driver to the average VMT for Philly Carshare drivers in the 90th percentile. Different assumptions will result in differing estimates of congestion reduction.

[16] The public-transit data from this study indicates whether individuals reported a change in usage of any of the listed modes. Because the modes were individually queried, a person could "increase rail" and "decrease bus" simultaneously. In this table, such respondents would be counted in both increase and decrease the tally of public transit change. Those that exclusively increased or decreased their transit use are counted only once in their respective directional change.

[17] The *observed impact* measures the changes in emissions generated when a household sheds a privately owned vehicle or the growth in emissions that occurs when a carfree household gains access to a carsharing fleet. The *full impact* includes emissions avoided when a household foregoes the planned purchase of a vehicle. The authors also note the difficulties of calculating the emissions impact of travel shifted to transit as a result of carsharing. Most bus and rail transit lines run fixed routes regardless of capacity utilization. An additional passenger—or the loss of a passenger—from the transit system may not affect the scale of the operations, leaving emissions virtually unchanged. The complexity of forecasting such outcomes, the authors note, are outside the scope of the study (Martin and Shaheen 2010, 19). The majority of households actually *increased* their emissions as a result of joining a carsharing organization. Households that did not have a privately owned vehicle when joining carsharing tended to drive more for obvious reasons, but the effects on emissions was generally quite small, typically less than .25 tons per year. When subjected to a sensitivity analysis, their analysis shows that the aggregate reductions are still statistically significant even if respondents overestimate their driving by 40% or more (Martin and Shaheen 2010, 48).

[18] For a summary of these estimates, see I-GO reports (2010, 2011) listed in the reference section.

[19] The "before" miles travelled are based on an estimate for the average Philadelphian and the "after" miles travelled are estimated at the 90th percentile for members. In addition, average fuel efficiencies are assumed for all VMT, although the Philly Carshare fleet is likely more fuel efficient than the private vehicle stock (Econsult 2010, 6). Because of these assumptions, the magnitude of the calculated impact is at best a rough estimate.

[20] In addition to those listed here, other speculative benefits that have not yet been systematically explored include the possible reduction in the environmental footprint from a decrease in the manufacturing of motor vehicles (Millard-Ball et al. 2005, 4-3; Martin and Shaheen 2010, 17). Litman also argues that amplified street activity created by transit-oriented lifestyles enhance security and reduces crime, although this has not yet been subjected to detailed statistical evaluation (Litman, 2010, 4-14).

[21] The study adhered to U.S. Department of Commerce modeling techniques and thus offers a useful prototype of other studies.

[22] Estimates of the number of vehicles were obtained through a combination of direction measurements using information provided on carsharing web sites as well as information provided to us from a major carsharing organization.

[23] While carsharing and traditional vehicle rental share some characteristics (both provide temporary, non-ownership access to

motor vehicles), their business models and customer bases are different. Traditional car rental agencies do serve local customers, but according to their business model, a significant proportion of customers are visitors from out of town. Because of this difference in clientele, traditional car rental is not likely to replace private vehicle ownership for most of its users and is therefore unlikely to generate the same environmental, social and economic impacts as carsharing. Indeed, while there is a significant and growing body of evidence documenting the positive impacts of carsharing, a literature review did not identify similar impacts attributable to traditional car rental.

[24] To determine the approximate rate of taxation for carsharing observations, we considered various mixes of short (one-hour), mid-duration (four hour) and long (24 hour) reservations. The estimated rate of taxation of 15.6% is based on an even mix of one-hour, four-hour, and 24-hour reservations.

[25] This estimate is based on the assumption that fuel accounts for 30% of the cost of a carsharing reservation. In metropolitan areas, taxes account for about 20 percent of the price of fuel (fuel taxes are roughly 50 cents per gallon plus applicable sales tax that range from 4% to 10%). As a result, about 6% of the cost of a carsharing reservation is attributable to fuel-related retail taxes. The 16% average tax on carsharing, therefore, adds 0.8% (16% times 6%) of the cost of a carsharing reservation that is attributable to "double taxation" on fuel. This is the equivalent of a 5% increase in the rate of taxation.

[26] Studies of vanpooling show that consumers making choices between using private automobile and ridesharing in vans are quite price elastic. York and Fabricatore (2001) estimate the price elasticity of vanpooling to be roughly -1.5. Wambalaba, Concas and Chavarria (2004) found the price elasticity for vanpooling to be approximately -1.14. One might reasonably expect the price elasticity of carsharing to be at the high end of the range, since it involves nonwork trips in which temporal and modal substitution can be very high. Another branch of research focuses on the effects of tolls on the amount of driving. This research is instructive since represents the effects of applying a fix surcharged on driving trips, much as certain carsharing taxes do. Washbook (2002) found that, among long-distance commuters, a $3 per round-trip road toll reduced commutation mileage by about 25% (Washbrook 2002). Assuming a $15 cost per driving roundtrip, such a fee would represent a 15% increase in costs, implying an elasticity of -1.67.

[27] Chicago initiated a pilot with I-GO in 2005. The pilot secured the exclusive use of two carshare vehicles for city employees during business hours and the partnership between the City and I-GO expanded significantly in subsequent years (City of Chicago 2005; City of Chicago 2011). Chicago has also worked with I-GO and Zipcar to provide not only access to the full CSO fleet for city employees, but also fleet management (reservation system and smartcard access) for city-owned fleet vehicles (City of Chicago 2010).

[28] The dependence of women traveling alone on intercity bus service, for example, in the past is well documented in the literature. For a discuss of this, see Margaret Walsh, *Making Connections, The Long-Distance Bus Industry in the USA*. Aldershot: Ashgate Publishing Limited, 2000. This pattern still exists today. Our DePaul University research suggests that females account for a disproportionate share of both Greyhound and new "curbside bus" (BoltBus and Megabus) travelers.

[29] Conversely, areas with wide streets and those located long distance from the central business districts tend to have less carsharing available or none at all. Wider streets are more amenable to intensive vehicle use than narrow ones, while proximity to the Central Business District implies factors such as greater density, walkability and parking expense, as well as accessibility to multiple transit services.

[30] Market share is defined as the percentage of residents within one-half mile of a pod that are Communauto members and was evaluated in January of 2006, 2007 and 2008.