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ESSAYS ON INFORMATION, INCOME, AND THE SHARING ECONOMY

A Dissertation Presented

by

ANDERS FREMSTAD

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

SEPTEMBER 2015

DEPARTMENT OF ECONOMICS

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Approved as to style and content by:

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Nancy Folbre, Chair

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DEDICATION

This dissertation is dedicated to the family and friends who inspired and supported my research. I am grateful for the countless discussions and debates I have enjoyed with my fellow graduate students in the Economics Department at UMass-Amherst. Many of the ideas in my research originated from those conversations. My comrades also showed me the value of investing in one's intellectual community.

Neither my graduate studies nor my doctoral research would have been possible without my family's help and encouragement. I am especially indebted to Janessa, who gracefully built her life around mine during our seven years in Amherst. She has been my partner throughout this project, and she has deepened my understanding of sharing, in theory as well as in practice.

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I have received a great deal of assistance in writing this dissertation, though I bear full responsibility for any errors. I am grateful to all my professors at UMass-Amherst for imparting me with a broad understanding of economics and a clear vision of the purpose of the economy.

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Empirical analysis is seldom as straightforward as it seems, and I thank my advisors for helping me make sense of the data. Early on, Ryan Acton sent me a lifeline by helping me convert databases into datasets. James Kitts helped me focus my own analysis, while the seminars he organizes at the Computational Social Science Institute expanded the horizons of my future work. I am especially indebted to Arindrajit Dube, who showed me how new tools can help us answer important questions.

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ABSTRACT

ESSAYS ON INFORMATION, INCOME, AND THE SHARING ECONOMY

SEPTEMBER, 2015

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Many privately-owned items are somewhat non-rival in consumption, so there are often benefits to borrowing and lending underutilized goods and exchanging used goods. Although sharing is ubiquitous, it is understudied in economics. This dissertation seeks to help develop an economics of sharing.

Chapter 1 presents a simple mathematical model of the "gains from sharing", which connects the literatures on club goods, household economies, collective action, community governance, and decentralized cooperation. I argue that the level of sharing in society depends not just on technology but also on the norms that govern how people cooperate, on people's preferences around privacy and independence, and on economies of scale in matching people with underutilized goods. Since institutions that facilitate new forms of sharing are still gaining users, experimenting with rules and etiquette, and developing tastes for peer-to-peer interactions, the level of sharing is likely to increase in the years to come.

Chapter 2 investigates the current and potential value of sharing goods across households. Analyzing unique data from the online platform NeighborGoods, I find that the level of sharing among relatives, friends and neighbors makes informal borrowing and lending an important component of inter-household cooperation. The potential gains from sharing are even larger. My investigation of consumer expenditures reveals that the average household spends over $9,000 a year on goods that could, in principle, be shared across households. Given the large sums of money Americans spend on private vehicles, the greatest opportunities may be in increased ride-sharing and car-sharing. Finally, I address the relationship between income and sharing. Although traditional methods of sharing goods are disproportionately used by low-income people, I find that people of all incomes are equally likely to use new institutions for sharing goods, such as Craigslist, Airbnb, and Zipcar. This suggests that new forms of sharing may maintain their popularity as incomes rise in the long run.

Chapter 3 studies the effect of Craigslist's market for secondhand goods on solid waste generation. Economic theory suggests that falling transaction costs may increase incentives for owners to sell goods on secondhand markets and for buyers to purchase used goods instead of new goods. I use difference-in-difference methods to estimate Craigslist's effect on waste by exploiting a natural experiment in how the platform expanded across California and Florida between 1996 and 2009. My results provide evidence that Craigslist led to substantial reductions in waste generation. This paper suggests that other online platforms may similarly generate economic as well as environmental benefits.

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CHAPTER 1

QUASI-PUBLIC GOODS, INSTITUTIONS, AND THE FUTURE OF SHARING

1.1 Introduction

Many goods are somewhat non-rival in consumption, and there can be "gains from sharing" these goods that are analogous to gains from trade. People have historically shared a wide range of items, including lodging, vehicles, and tools, with their family, friends, and neighbors. The internet has recently reduced the cost of sharing goods among strangers. Platforms like Craigslist, Airbnb, Couchsurfing, Zipcar, and RelayRides are changing how people borrow, lend, and exchange physical goods in a way that echoes how Wikipedia, YouTube, Twitter, and Facebook revolutionized how people share information. By harnessing digital technologies, exploiting economies of scale, promoting cooperative norms, and developing pro-sharing preferences, new institutions associated with the "sharing economy" may transform consumption patterns in the decades to come.

Merriam-Webster defines "to share" as "to have or use something with others" or "to let someone else have or use a part of something that belongs to you". People freely share some goods, but in other cases the use of a good is determined by collective rules or market prices. There are so many ways to share a good over its lifetime that the best way to illustrate the breadth of the term may be to describe a hypothetical economy in which nothing is shared. In such an economy, every individual owns everything they use. Nothing is held in common, so families do not share homes, communities do not share parks, and nations do not share roads. People do not borrow and lend goods, nor are there libraries, hotels, or rental markets. When an individual no longer has any use for something, they discard the good rather than selling it on a secondhand

market or donating it to a charity. Of course nothing like this world has ever existed, and an economy without any form of sharing would be extraordinarily wasteful.

Although sharing is ubiquitous, it is under-studied in economics, even as it attracts growing attention from the popular media. *The Economist* recently made "the rise of the sharing economy" its cover story (*The Economist* 2013). Researchers have noted how new platforms for sharing could increase access to goods, build community, and reduce ecological damage (Agyeman et al. 2013, 14-19; Belk 2010, 729-730; Botsman and Rogers 2010; Schor 2010, 137-143). This paper focuses on the first claim, the economic case for sharing goods.

Sharing generates value whenever the benefits of relaxing the private ownership of non-rival goods exceed the costs. The precise costs and benefits depend on a number of factors, including the degree of a good's rivalry, the transaction cost of matching people with underutilized goods, the cost of enforcing cooperative behavior, the (un)pleasantness of social interactions, the value people place on economic independence, and the role of status in determining consumption. It is an open question how the relative costs and benefits of sharing will evolve over time or whether people will share goods more or less in the years to come. On the one hand, economic growth may blunt incentives for people to share goods. On the other hand, new institutions may make it more convenient to share goods and facilitate a resurgence in sharing. This paper makes the case that the future of sharing is bright.

I start my analysis by reviewing the relevant literature on club goods, household economies, collective action, community governance, and decentralized cooperation. Next, I present a simple mathematical model that specifies both the benefits and costs of sharing quasi-public goods. My theory stresses that equilibrium sharing levels depends on social as well as technological factors, and I apply this theoretical framework to understanding the sharing economy. I argue that online platforms are likely to lead to greater sharing as they take advantage of economies of scale, promote cooperative norms, and develop pro-sharing preferences.

1.2 Literature review

My review of the literature begins within neoclassical economics. James Buchanan's (1965) theory of clubs and Alejandrina Salcedo, Todd Schoellman, and Michèle Tertilt's (2012) theory of households suggest that rational individuals automatically share goods at efficient levels. Because neoclassical models assume that norms and preferences are exogenous and fixed, sharing is mainly a function of the good's rivalry and the sharing technology. Mancur Olson (1965) stresses the difficulty of providing collective goods in large groups. Although Elinor Ostrom (1990) argues that close-knit communities can govern common goods efficiently, her principles for community governance are not met in the case of most quasi-public goods. In contrast, Yochai Benkler (2004) contends that decentralized sharing among weakly connected individuals is an effective and increasingly important form of economic cooperation. A closer look at these contending views will reveal the need to model both the costs and benefits of sharing quasi-public goods.

1.2.1 Theory of clubs

Buchanan's groundbreaking 1965 paper, "An Economic Theory of Clubs", opens by highlighting the pervasiveness of what I call quasi-public goods.

> As an extreme example, take a good normally considered to be purely private, say, a pair of shoes. Clearly your own utility from a single pair of shoes, per unit of time, depends on the number of other persons who share them with you. Simultaneous physical sharing may not, of course, be possible; only one person can wear the shoes at each particular moment. However, for any finite period of time, sharing is possible, even for such evidently private goods. (Buchanan 1965, 3)

Buchanan ultimately focuses on goods that are commonly shared through formal clubs, such as golf courses, but his analysis also applies to what Benkler calls shareable goods. Like club

goods, shareable goods are excludable and non-rival, since people can take turns using them. Of course most items in the real world fall somewhere between the pure categories of goods illustrated in Table 1.1. Nevertheless, Buchanan's work stresses that not all privately-owned goods are actually private goods. In this paper, I will use the term quasi-public goods to refer to excludable goods that are at least partially non-rival in consumption.

Buchanan assumes that clubs accept new members until the cost of sharing the good with the marginal member exceeds the benefit of sharing the expense with the marginal member (Buchanan 1965, 5). The cost of sharing can be negative in some domains, due to camaraderie (Sandler and Tschirhardt 1980). However, in equilibrium it must cost current members something to share the good with an additional member. (If it did not, a profit-maximizing club would admit another member without reducing the fees paid by current members.) This model suggests that the market will guide individuals to share some goods efficiently through clubs. It is fairly straight-forward to generalize Buchanan's theory to other forms of sharing. For example, rational owners should rent underutilized goods to their peers whenever the benefit to the borrower – measured in dollars – exceeds the cost to the lender. From this perspective, the thinness of peer-to-peer rental markets suggests that the gains from sharing these goods are slim.

Salcedo, Schoellman, and Tertilt's 2012 paper "Families as Roommates" essentially describes households as clubs. In their model, people live together if the benefit of sharing the expense of household public goods outweighs the time cost of "forming and maintaining relationships" with each of their housemates. (Without such a cost, utility-maximizing individuals would share a single, enormous household.) Salcedo *et al.* calibrate their model to fit data from the Consumer Expenditure Survey (CES), which shows that people with higher incomes tend to live in smaller households and spend a smaller proportion of their incomes on household public goods. Their calibrated model is fairly consistent with established household equivalence scales. For example, it suggests that two median-income adults who live together are

about 12 percent better off than their single peers earning the same income (Salcedo *et al.* 2012, Table 5).

Buchanan's theory of clubs and Salcedo *et al.*'s theory of households assume that individuals share goods when the benefits outweigh the costs, which implies that prevailing levels of sharing are always efficient. Although their models highlight the costs of sharing, they ignore how these costs might change. In fact, after calibrating their model using current CES data, Salcedo *et al.* argue that income growth explains 37 percent of the decline in the number of adults (and 16 percent of the decline in the number of children) in the average household from 1850 until 2000 (Salcedo *et al.* 2013, 153). Their claim rests on the heroic assumption that the amount of time it took to maintain relationships with each housemate remained constant for one hundred and fifty years, while the opportunity cost of that time increased with wages.

However, it seems likely that the costs of sharing a home increased due to gradual shifts in norms and preferences. For example, the norms that clearly defined individuals' rights and responsibilities within multi-generational households may have deteriorated over time. Preferences against living with non-relatives may have also developed endogenously, as children increasingly grew up in single-family households. It is, therefore, unclear to what extent the historical decline in household size is an optimal response to higher incomes, and to what extent prevailing norms and preferences make it more difficult to share housing today than it did in the past. For similar reasons, I will argue that sharing among strangers is likely to increase in the future. As people gain experience borrowing, lending, and exchanging goods on new online platforms, they will likely develop norms and preferences that are conducive to these new forms of cooperation.

1.2.2 Community governance

Not all economists are optimistic that individuals will form clubs, households, or other institutions to efficiently share goods. Olson's 1965 *Logic of Collective Action* emphasizes the difficulty of sharing a collective good. He argues that in groups of rational, self-interested individuals, no member receives the full benefit of their marginal contribution to the group, so all members will do too little to promote the group's interests (Olson 1965). In the context of quasi-public goods, Olson's argument suggests that individuals will rarely place their privately-owned goods in the commons, even if the collective benefit would exceed their private cost. His theory implies that large groups face the greatest challenge of advancing their collective interest, since each member's share of the group benefits will tend to decline with group size.

In her 1990 book *Governing the Commons*, Ostrom argues that groups can and do share some goods effectively. However, she finds that enduring institutions for sharing common goods are characterized by seven design principles, including clearly defined boundaries, established appropriation rules, and collective participation in setting those rules (Ostrom 1990, 90). When these design principles are absent, community governance fails. As such, community governance does not provide a solution for allocating many quasi-public goods, because privately-owned items are dispersed and heterogeneous, making it impractical for a community to set and enforce universal rules governing their use.

1.2.3 Decentralized sharing

Benkler draws attention to forms of sharing that are distinct from both Buchanan's clubs and Ostrom's community governance. The legal scholar's 2004 article "Sharing Nicely: On Shareable Goods and the Emergence of Sharing as Modality of Economic Production," focuses on environments in which loosely-connected individuals successfully share goods in a

decentralized manner. Benkler distinguishes shareable goods from club goods and common pool resources because they are "mid-grained". Unlike large-grained goods such as golf courses and irrigation systems, mid-grained goods are owned by many individuals. However, unlike fine-grained goods such as coffee and paper, mid-grained goods can only be acquired in discrete quantities, which leads to an excess capacity of shareable goods (Benkler 2004, 297).

Benkler turns to two case studies to make the case for decentralized sharing. First he describes the system of "slugging" in which drivers transport riders between established locations free of charge. By sharing the trip, "slugs" get a free ride, and "body snatchers" get to drive in the less-congested High Occupancy Vehicle (HOV) lanes. Slugging emerged organically in Northern Virginia when HOV lanes were created there in the 1970s. Over time, slugs and body snatchers have developed norms that reduce the social cost of sharing, including: first come first served; no talking (unless everyone wants to talk); no payment; no eating; and the slug line does not leave a woman alone at night (Slugging Etiquette).

Another example of decentralized sharing is SETI@home, a network of millions of personal computers that make up the largest virtual supercomputer in the world (Benkler 2004, 291). SETI@home takes large problems related to the search for extraterrestrial life and breaks them into small parts that can be solved by personal computers. Volunteers contribute to this project by installing a program on their computers that automatically solves these problems when the computer is idle.

These cases illustrate how sharing privately-owned goods like vehicles and computers can increase their utilization at little cost to owners. Benkler specifically contrasts decentralized sharing with Ostrom's notion of community governance. He addresses arguments made by Sam Bowles and Herb Gintis that the community governance works because it provides people with background knowledge about other participants, repeat interactions that create incentives to cooperate, and rules for enforcing cooperative behavior.

> 'Community governance'… gains robustness because it involves tightly connected social groups. But social sharing is a broader phenomenon, one that includes cooperative enterprises that can be pursued by weakly connected participants or even by total strangers and yet function as a sustainable and substantial modality of economic production. Indeed, in the context of the digitally networked environment, it is this type of sharing and cooperative production among strangers and weakly connected participants that holds the greatest economic promise (Benkler 2004, 333-4).

Benkler stresses the "fluidity" of participation in slugging and SETI@home. These institutions require a much lower level of commitment than community governance. Benkler acknowledges that these forms of cooperation may be less attractive to "communitarians", who prefer the forms of cooperation found in communes or Amish communities. But he contends that this fluidity makes these decentralized institutions attractive to "many more people" so that they are "likely to be more economically effective and efficient on a larger scale" (Benkler 2004, 343). In sharp contrast to Olson, Benkler argues that bigger groups can be *more* effective at sharing goods because they do not place heavy burdens on their members (Benkler 2004, 342-344).

1.3 Theory

Although scholars disagree on the relative benefits and costs of sharing goods, a simple model may clarify the opportunities and challenges noted by Buchanan, Olson, Ostrom, and Benkler. Assume first that the utility that individual, *i*, derives from costlessly sharing a quasi-public good, *g*, with *n-1* other people can be expressed by a simple equation:

$$u_i = \frac{g}{n^a} \qquad (1)$$

in which *a* is a measure of the good's non-rivalry or shareability. For quasi-public goods, $0<a<1$. When $a=1$, the good is perfectly private, there are no potential benefits from sharing it, and each individual would be equally well off with their per capita share, $\frac{g}{n}$. When $a=0$, the good is a pure public good. In the real world, many goods are quasi-public, including housing, vehicles, tools, and toys, and there can be gains from sharing these types of goods with others.

Economists tacitly acknowledge the importance of quasi-public goods when they use household equivalence scales to compare the incomes of households of different sizes. For example, the common square root scale implies that a household with four people needs only twice as much income as a single-person household to attain the same standard of living. Of course, households spend their income on a range of goods. Some of the goods purchased by households are more shareable than others - i.e. furniture is less rival than food. The square root scale suggests that on average a=0.5, or that:

$$u_i = \frac{Y}{n^{0.5}} = \frac{\sum_{g=1}^{k} p_g q_g}{n^{0.5}} \quad (2)$$

where all household income, *Y*, is spent on goods 1…*k*. Although a wide range of studies use household equivalence scales to compare incomes across households, they provide incomplete models of sharing. Equations 1 and 2 recognize the benefit but ignore the cost of sharing goods.

To share goods in groups, individuals must create rules and norms that ensure that all members benefit at least somewhat from sharing. It may take time for members to learn to share goods effectively, just as it may take time for them to learn to enjoy it. This coordination and development can be costly. A related problem with the above equations is that they implicitly assume that all individuals provide equal contributions and make equal use of the quasi-public good when in fact sharing may be rife with distributional conflict. Equation 2 models household members as altruists, but individuals often have different interests. The task of equitably sharing goods is probably even more difficult in other contexts. Consider the potential problems for a neighborhood car-sharing coop. The average American car is driven about one hour a day, so it is a good example of an expensive quasi-public good with a fairly low *a*. Households could, in principle, save money by contributing their vehicle(s) to a neighborhood coop in exchange for the right to borrow a neighbor's car when they need an additional vehicle or a different type of vehicle. However, households' net benefits from car-sharing will depend on the quantity and quality of vehicles they contribute, the frequency with which they borrow neighbors' cars, at what

times they borrow others' vehicles, and how carefully they drive. Without creating and enforcing a number of rules, there is no guarantee that all households will benefit from the cooperative effort.

If a group adopts an egalitarian institution in which everyone makes equal contributions and withdrawals to the quasi-public good, then:

$$u_i = \frac{ng}{n^a} - \mathrm{g} - c(n) \qquad (3)$$

where each member contributes *g* to the group, the shareability of the good is given by *a*, and the cost of sharing the good, *c*, depends partly on the size of the group, *n*. In practice, it is difficult to distinguish the shareability of a good, *a*, from the cost of sharing it, *c*. In my discussion, I will present the shareability of a good, *a*, as if it is determined solely by technical qualities of the good. In contrast, I will describe the cost of sharing a good, *c*, as a function of a broad range of factors, including the technology used to facilitate cooperation, the rules and norms in the group, and members' preferences for sharing.

Olson's *Logic* provides a theory for why the cost of sharing may increase sharply in group size, or why *c'(n)* is large. On the other hand, Benkler's treatise on shareable goods argues the opposite, that *c'(n)* is small. Salcedo *et al*. (2012) stake out a position somewhere in the middle and assume that the cost of sharing household public goods increases linearly with household size, because it takes a fixed amount of time for someone to maintain a workable relationship with each other member of the household. I assume only that $c(n)>0$ and that the exact structure of the cost of sharing depends on institutions, social norms, and individual preferences.

Since there is a cost to sharing a good with the additional person in Equation 3, there is also an optimal number of people with whom to share. In some cases, there is no net benefit to sharing a quasi-public good, in which case it will remain private. When the benefit does exceed the costs, differentiating u_i with respect to *n* reveals the optimal group size:

$$n^* = \left(\frac{(1-a)g}{c'(n)}\right)^{\frac{1}{a}} \quad (4)$$

From this result we see clearly that $\frac{dn^*}{da} < 0$, or that optimal group size is smaller for a good that is less shareable. Similarly $\frac{dn^*}{dc'(n)} < 0$ and optimal group size decreases with the cost of admitting an additional person into the group, *c'(n)*. How exactly the cost of sharing, *c*, varies with the number of people, *n*, depends on a number of factors, including technology as well as the rules, norms and preferences within a group.

At any point in time people use a variety of institutions to share a wide range of goods. To some degree, these institutions are substitutes for one another. For example, an individual may share a hundred books with their family members using a common bookshelf and a hundred thousand books with their fellow citizens using a public library. If they borrow a book from the library that they really enjoy, they may purchase it and add it to the household collection. I classify institutions for sharing goods along three dimensions:

- Institutions for exchanging goods vs. institutions for borrowing and lending goods
- Centralized institutions vs. decentralized institutions
- Market institutions vs. non-market institutions

Common forms of sharing can be organized in a $2*2*2$ matrix. Table 1.2 provides examples of all eight types of institutions. Some sharing arrangements, like public libraries, fit Equation 3 quite neatly. The case for public libraries is that the benefit of sharing *ng* books with *n* people exceeds the cost, *c*, of building the library, paying a librarian, teaching patrons how to behave and so on. Equation 3 fits other methods of sharing less well, but the basic logic still holds. For example, there are clear gains from sharing children's dress clothes. Households may do this by passing hand-me-downs to younger siblings, donating used clothing to charity, or selling items at garage sales or on Craigslist. The shareability of the clothing, *a*, depends on its durability, while

the costs of sharing, *c*, depends on how it is shared. The gains from sharing may not be distributed equally, as Equation 3 assumes, but everyone usually receives some benefit from sharing the good. Even in the case of giving used clothing to charity, donators get a reduction in clutter and a tax write-off. When used clothes are sold on the secondhand markets, the gains are split between the buyer and seller. Although markets do not ensure that gains from sharing are equally distributed, they do generally benefit both buyers and sellers or borrowers and lenders. While Equation 3 does not explain the distribution of gains from sharing, it does suggest that the overall level of sharing will decrease in *a* and *c'(n)*.

With some minor modifications, Equation 3 can also be used to determine how many times individuals will use a particular institution for sharing goods. Whereas *n* originally represented the number of people making equal contributions and use of the quasi-public good, it can also represent the number of instances in which individual, *i*, engages in a particular mode of sharing. Again, there are benefits as well as costs to using any sharing institution, and individuals arguably choose how often they carpool to work or peruse garage sales in much the same way they decide how many people to live with.

1.4 The sharing economy

My simple model of the benefits and costs of sharing provides a theoretical basis for understanding recent developments in how people share goods. Online platforms have lowered the cost of sharing goods with the marginal person, and in doing so they facilitate cooperation among much larger groups. By centralizing information on the availability of quasi-public goods, platforms have sharply reduced the amount of time it takes to locate an underutilized item to buy, borrow, or rent. Websites also provide feedback mechanisms and promote norms and preferences that facilitate sharing and punish opportunism. Many online platforms rely heavily on markets to

share goods. While introducing money to the practice may undermine some of the solidarity that group members feel for one another (Willer *et al.* 2012), markets may also encourage individuals to share goods with more people since they provide benefits to people on both sides of one-time transactions.

In terms of Equation 3, new institutions for sharing goods have changed the structure of the cost of sharing many important items, $c(n)$, so that it no longer increases much with the number of people in *i*'s group or the number of transactions *i* conducts. For example, once someone learns to use Craigslist - to read and write posts, to deal with other users, to avoid scams - there is little cost to engaging in the marginal transaction as a either a buyer or seller. Compare this to the cost of buying or selling the marginal good at a garage sale. To the extent that online platforms have reduced $c'(n)$, they have also probably led to an increase in n^*, the number of people per group, or the number of people that *i* transacts with on the platform.

In many cases, online platforms represent a clear improvement over traditional institutions for sharing. Craigslist and eBay allow people to purchase specific secondhand items from thousands of strangers instead of relying solely on discards from family and friends. Airbnb and Couchsurfing help travelers find hosts anywhere in the world rather than tracking down distant relatives or friends-of-friends. Fluid networks of loosely-connected individuals often out-perform closely-knit communities in sharing the benefits of quasi-public goods. Economic theory predicts that people are less likely to cooperate in one-time interactions than in repeat interactions, but the success of online platforms suggests that sharing with strangers can be less costly than sharing with close family and friends, as Benkler argues. Perhaps the reason is that when things go badly one can quickly cut weak ties but not strong ties. The key to the sharing economy might be that it allows people to share goods *without* necessarily building long-term relationships.

The sharing economy aims to match people with quasi-public goods more effectively than informal networks of relatives, friends, and neighbors. Online platforms facilitate sharing in

three ways: they organize information about goods that a large number of members would like to share, they provide feedback mechanisms and norms that encourage cooperative behavior, and they work to develop preferences for sharing. Consider how NeighborGoods and Couchsurfing encourage people to share durable goods and lodging with strangers.

Members of NeighborGoods can post items they would like to share to their inventories, and they can search local inventories for items they would like to borrow. If a member cannot find an item they would like to borrow, they can post it to their wish list. If someone requests to borrow a certain good, and the lender agrees, the borrower agrees to follow the "three golden rules of sharing" and arranges to pick up the good at a mutually-convenient time and place. When the transaction is complete, the lender may rate and comment on the borrower, and the borrower may rate and comment on both the lender and the good.

Couchsurfing similarly organizes information and provides feedback mechanisms to help travelers find free places to stay all around the world. The website also stresses the advantages of connecting with other members, traveling like a local, and fostering cultural exchange (Couchsurfing 2015 "About"). General reciprocity is vital to Couchsurfing, since direct reciprocity is only possible if two members travel to each other's home cities – an unlikely coincidence of wants. That said, 12 to 18 percent of Couchsurfing stays were directly reciprocated between 2004 and 2008, suggesting that Couchsurfing experiences often lead to new friendships (Lauterbach, Truong Shah and Adamic. 2009, 348). A challenge for Couchsurfing is getting would-be users to recognize that the costs of sharing lodging may be much lower than they think.

My theory suggests that online platforms increase the gains from sharing by reducing the cost of borrowing, lending, and exchanging quasi-public goods on decentralized networks of loosely-connected individuals. However, as my descriptions of NeighborGoods and Couchsurfing reveal, minimizing the costs of sharing consists of more than simply centralizing information about the availability of non-rival goods. Platforms must work to build effective

feedback mechanisms, develop norms, and mold preferences to facilitate sharing. Paradoxically, the difficulty of facilitating new forms of sharing is what leads me to argue that the practice will increase in the years to come.

1.5 The future of sharing

Next, I consider the future of online platforms like Craigslist, NeighborGoods, and Couchsurfing. My analysis begins with the recognition that there are huge stocks of quasi-public goods in the United States today. The rivalry or shareability of a good, *a*, depends largely on its utilization. Fully-utilized goods are completely rival, but there are potential gains from sharing underutilized goods. The utilization of goods varies greatly, even for very similar goods. Recall Buchanan's example of shoes. Formal shoes are fairly shareable, because people wear them only on special occasions. Casual shoes are not very shareable, because people tend to wear them every day. The gains from sharing a good depend on its utilization over its entire lifetime. Some rarely-used goods are fully depreciated by the time they are discarded. We brush our teeth for a few minutes a day, so we could, in principle, share toothbrushes (Frank 2010, 576). However, since we use toothbrushes until they are worn out, toothbrushes are not underutilized, and there are no gains from sharing them.

There is little accurate data on utilization rates, but existing data suggests that many goods are surprisingly unused. The average power drill is reportedly used for just a few minutes over its lifetime (Botsman and Rogers 2010, 83). Assuming that these drills could operate for dozens of hours, the lifetime utilization rate of privately-owned drills may be less than one percent. The utilization rates of more expensive goods can also be surprisingly low. Average vehicle occupancy in the United States is 1.7 (Santos *et al.* 2011, 33), which means the utilization

rate is about 33 percent when private vehicles are in use.[1] Moreover, private vehicles are driven a bit less than one hour a day, or 4 percent of the time (Santos *et al.* 2011, 7, 31). Vehicles would depreciate more rapidly if they were driven more often, but doubling a vehicle's annual mileage does not double its rate of depreciation. The effective lifetime utilization rate of the average privately-owned vehicle may be around 25 percent. Low utilization rates suggest that there may be substantial opportunities for greater sharing of quasi-public goods. Indeed, the underutilization of a nation's consumer goods represents a form of waste similar to the underutilization of a nation's capital and labor stocks, as measured by the rate of capacity utilization.

However, within the context of Equation 3, the lack of sharing is efficient if the marginal cost of sharing with one more person, $c'(n)$, exceeds the marginal benefit of making better use of quasi-public goods. Moreover, there is no reason to expect equilibrium levels of sharing to rise unless costs fall. If the cost of sharing is determined solely by technology, then we have already realized the potential gains from online platforms. In 2014, 55 percent of Americans exchanged secondhand goods on websites like Craigslist, 10 percent used peer-to-peer platforms like Airbnb or Couchsurfing, and 9 percent shared cars using services like Zipcar or RelayRides (Center for a New American Dream 2014), but the sharing economy has not dramatically increased utilization rates or radically transformed consumption patterns. To some degree, online platforms have probably just crowded-out other institutions for sharing goods. If the costs of sharing are exogenous and unchanging, then sharing is unlikely to grow.

I make three theoretical arguments for why equilibrium levels of sharing will probably increase substantially in the years to come. Setting aside the possibility that further technical advances will make sharing more convenient, there is good reason to think that over time people

[1] Assuming five-seat cars

and institutions will make better use of existing sharing technologies. The sharing economy may facilitate substantially high levels of sharing if platforms can take advantage of economies of scale, if norms are sticky and adjust slowly to the advent of new technologies, and if preferences are endogenous and people must develop their taste for sharing. I provide some evidence that online platforms are working to address each of these challenges. While it is impossible to estimate the effect of each factor on equilibrium levels of sharing, together they suggest that there is considerable potential for increased sharing.

1.5.1 Economies of scale

The analysis so far has ignored the likely possibility that there are returns to scale in sharing goods. I have argued that the sharing economy has reduced the cost of sharing a good with one more person, $c'(n)$. However, the cost of sharing a quasi-public goods on a sparse network is likely to be quite high. As an extreme example, an online platform with two users will facilitate very few transactions, even if both members own a number of highly shareable goods (with low a). Among the reasons for this is that each user may not have the type of good that the other needs, their goods may not be available for use at the right time, and they may not live in close proximity to one another. If there are economies of scale in matching people with shareable goods, then $c'(n)$ declines with n until a critical mass of people is using a particular platform to share a good. As a result, there may be tipping points in which people move from low levels of sharing to high levels of sharing quickly, without any change in technology, norms, or preferences.

Different platforms face different challenges in building a critical mass of users. Economies of scale may explain why peer-to-peer lodging platforms like Airbnb and Couchsurfing have been among the most successful sharing economy platforms to date. Even

though most people may be wary of hosting or staying with strangers, these platforms do not require a large number of users in any given city to be useful. On the contrary, the networks were able to effectively match travelers with local hosts even when there were just a handful of users in major cities. That is not to say that there are no economies to scale in peer-to-peer lodging. Now that many more people use the platforms -- ten percent of Americans reported using one of these platforms in the previous year (Center for a New American Dream 2014) -- it may be easier to find lodging in more locations and to generate better matches between guests and hosts. However, the global nature of peer-to-peer lodging platforms made it relatively easy for them to achieve the necessary economies of scale to succeed.

Platforms that facilitate local forms of sharing can face much greater difficulties in building a critical mass of users. NeighborGoods allows people to share household goods, such as tools, gear, and media. As noted above, the platform makes it very easy to search other member's inventories. However, there are no gains to sharing most goods unless users live in close proximity to one another. If the borrower has to travel across town to borrow a quasi-public good like a lawnmower or a tent, then the cost will likely exceed the benefit. In my survey of NeighborGoods users, 71 percent of respondents report that they do not borrow more items because there are not enough users in their area (see Section 2.2.1 and Appendix A for survey details). Indeed, this was the single most-cited reason users gave for not making better use of NeighborGoods.

Economies of scale may also explain the lack of widespread car sharing in the United States. The extreme underutilization of private vehicles suggests there are huge potential gains from borrowing and lending privately-owned cars. Peer-to-peer platforms like RelayRides allow people to rent out their cars when they do not need them. If enough people used these sorts of services, many Americans might have access to a neighbor's car 24 hours a day. However, currently most local car-sharing markets are thin, so it is usually easier for people to take mass

transit, rent a car from a rental company, or buy their own car -- even if it will only be used a few hours a week.

While online platforms face real difficulties in achieving a critical mass of users, the returns to scale in matching people with underutilized goods suggests that equilibrium levels of sharing are likely to increase over time. Once platforms reach a certain tipping point, they may expand quickly as additional users reduce the marginal cost of sharing and attract even more users. There is already historical precedent for platforms attempting to facilitate local forms of sharing. In 2014, 31 percent of Americans reported using an online markets for secondhand goods such as Craigslist at least monthly, compared with the 43 percent of people who use thrift stores and garage sales on a monthly basis (Center for a New American Dream 2014). If there are economies to scale on online platforms, existing technologies may facilitate substantially greater sharing in the years to come.

1.5.2 Sticky norms

A second reason for why people are likely to share more is that norms are sticky or slow to change, so that it will take time for the designers and users of online platforms to fully harness current technologies. The cost of sharing a quasi-public good with the marginal person, $c'(n)$, depends fundamentally on the norms within a group, including the level of trust between members, the clarity of social scripts, the etiquette around a particular mode of sharing, and the ability to punish malfeasance. It would be a mistake to assume that we have already developed the ideal norms for sharing goods among fluid networks of loosely-connected individuals.

Buchanan and Salcedo *et al.* explicitly recognize the cost of sharing goods, but they unrealistically assume that these costs are exogenous and fixed. The internet has substantially reduced the transaction costs of finding quasi-public goods to borrow, rent, or purchase, but it has

probably not yet shifted norms to minimize the cost of sharing. In the same way that norms that reduced the cost of living in multi-generational households gradually eroded as more children grew up in homes without their grandparents, norms that reduce the cost of sharing goods with strangers will probably develop slowly as more people use online platforms.

Online platforms try to foster norms to facilitate greater sharing, in the same way that "slugs" and "body snatchers" developed an etiquette to facilitate casual carpooling. For example, when someone requests to borrow a good from another member on NeighborGoods, the website asks the borrower to agree to the "three golden rules of sharing: play nice, treat other people's stuff the way you'd want your stuff to be treated, and show up on time." In the context of my theoretical framework, fostering friendliness, carefulness, and punctuality reduces the cost of sharing a good with the marginal member, $c'(n)$. Similarly, Zipcar asks its users keep their vehicles clean, transport pets in carriers, and promptly report a car that is dirty, damaged, or with low fuel (Zipcar 2015). Craigslist encourages users to avoid scams by making deals locally and face-to-face (Craigslist "Avoiding Scams" 2015).

Online platforms have not yet fostered the ideal norms for peer-to-peer sharing, but the plethora of sites ensures steady experimentation as platforms compete for users. This competition is not entirely zero-sum. Promoting cooperative norms benefits all online platforms that facilitate peer-to-peer sharing. Sticky norms provide a powerful argument for why the costs of sharing goods will likely decline over time due to "learning-by-doing". As people and platforms develop better norms around sharing goods on fluid networks, those new forms of sharing are likely to grow in importance.

1.5.3 Endogenous preferences

A third reason for why levels of sharing are likely to increase over time is that preferences are endogenous. Just as people may learn to share by sharing, they may develop a taste for sharing by borrowing, lending, and exchanging quasi-public goods. The cost of sharing, *c(n)*, surely depends on preferences, including the value people place on status, privacy, flexibility, and independence. It is a mistake to assume that these preferences are exogenous or fixed, because people's preferences around sharing will likely adapt to new technologies and institutions over time.

Economists have long been wary of arguments for how shifts in preferences can drive behavior. Bowles (1998) argues that while this reluctance to consider endogenous preferences "expresses a prudent antipathy toward paternalistic attempts at social engineering of the psyche, it modestly acknowledges how little we know about the effects of economic structure and policy on preferences, and it erects a barrier both to ad hoc explanation and to the utopian thinking" the notion that preferences are exogenous and fixed is not very realistic (Bowles 1998, 102). Reviewing a broad literature in experimental economics as well as sociology, anthropology, and history, Bowles presents a persuasive argument that markets have molded individuals' preferences by framing choices, crowding-out intrinsic motivations, and changing the process of cultural transmission (Bowles 1998, 77).

New institutions for sharing goods may similarly change preferences around status, privacy, flexibility, and independence. For example, by stressing the value of "access" over "ownership", the sharing economy may reduce the status that comes with owning underutilized goods (see Heffetz and Frank (2008) for an overview of positional goods). Similarly, car-sharing and ride-sharing platforms may gradually change people's perceptions of the supposed convenience and freedom of owning a private vehicle. Peer-to-peer platforms may also transform

our understanding of what it means to be economically independent and demonstrate that equitable sharing can further both individual and collective goals.

Perhaps the greatest obstacle to greater sharing is that many people have little interest in getting to know people with whom they can share. In my survey of NeighborGoods users, "meeting new people" is by far the weakest motivation for joining the platform, after "reducing waste", "saving money", "helping others", and "building community". As noted above this hesitation towards dealing with strangers may decline as people develop better norms and social scripts around sharing. Meeting new people may also become less stressful when people realize that the vast majority of interactions are pleasant and that when interactions are unpleasant it is easy to terminate the relationship and report any uncooperative behavior to the group. The best argument for sharing may be that it occasionally introduces people to new friends. In a sense, friendship is the ultimate endogenous preference. It takes time to "make" a new friend and, whatever one's view of love, there is no such thing as "friendship as first sight". Over time online platforms may help people recognize the endogeneity of this preference. For example, Couchsurfing promises new members "you have friends all over the world, you just haven't met them yet" (Couchsurfing "How it Works").

As in the arguments concerning economies of scale and sticky norms, it is impossible to quantify how changing preferences will affect equilibrium levels of sharing. Although there is good reason to believe that people do compare the marginal benefits and costs of sharing quasi-public goods, we cannot decompose *c(n)* to account for the relative importance of a group's size, density, norms, and values in determining how much people share. Instead the purpose of this section is to highlight how economies of scale, sticky norms, and endogenous preferences affect levels of sharing now and in the future. Recognizing these factors should dispel any notion that equilibrium levels of sharing are necessarily efficient or stable. Even in the absence of further technological innovations, there are good reasons to think that people will share goods more, not less, in the years to come.

1.6 Conclusion

Economic theory recognizes both the costs and the benefits of sharing goods. In a simple model, improved technology for borrowing and lending items leads immediately to an increase in the level of sharing. However, this paper argues that it takes time for new institutions to exploit economies of scale, shift sticky norms, and mold endogenous preferences. As a result, we should expect the role of sharing to grow, as people build a critical mass of sharers, create a new set of rules and etiquette, and develop their tastes for borrowing, lending, and exchanging items on fluid networks of loosely-connected individuals. My analysis provides support for Benkler's (2004) argument that going forward sharing will be an increasingly important "modality of economic production".

1.7 Tables and figures

Table 1.1: Taxonomy of goods

	Excludable	**Non-excludable**
Rival	private goods	common goods
Non-Rival	club goods, shareable goods	public goods

Table 1.2: Institutions for sharing

	Exchange		**Borrowing and lending**	
	Centralized	**Decentralized**	**Centralized**	**Decentralized**
Market	thrift stores, pawn shops	garage sales, Craigslist, eBay	rental stores, Zipcar, Netflix	Airbnb, RelayRides, Blablacar
Non-market	free stores, clothing swaps	Freecycle, "borrowing" a cup of sugar	public libraries, households, communes	slugging, SETI@home, Couchsurfing, NeighborGoods

CHAPTER 2

CURRENT AND FUTURE GAINS FROM SHARING

2.1 Introduction

While there are theoretical arguments for why we should expect substantially more sharing in the digital economy, theory alone cannot reveal the economic importance of sharing now or in the future. This paper addresses three broad empirical questions: What is the current value of decentralized sharing among relatives, friends, and neighbors? What is the potential value of sharing on online platforms, and where are the largest gains most likely to be? Finally, what is the relationship between income and sharing, and how should we expect economic growth to impact different forms of sharing in the long-run?

Data on sharing are limited, leading Benkler to refer to it as the "dark matter of the economic production universe" (Benkler 2004, 337). My empirical analysis sheds light on current and future gains from sharing using six sources of data: the General Social Survey (GSS), the Consumer Expenditure Survey (CES), the American Community Survey (ACS), the Center for a New American Dream survey (CNADS), my own survey of users of the sharing platform NeighborGoods (NGS), and anonymous user data from NeighborGoods. In the following three sections I address the current value of sharing, the potential value of sharing, and the long-run effect of income on sharing. Section 2.5 concludes with a synthesis of my main results and a discussion of directions for further research.

2.2 The current value of decentralized sharing

The value of sharing among closely-knit individuals within households is immense. Economists use household equivalence scales to compare the standard of living of households of

different sizes. The assumption is that people save money by sharing household public goods -- or, perhaps more accurately, *quasi*-public goods -- including living space vehicles, furniture, appliances, and utilities (as well as housework such as meal preparation and childcare). Although economics pays little attention to sharing, economists routinely assume there are massive benefits to sharing within households. Using the common square root scale, the 2010 ACS reveals that equivalent household income is about 70 percent greater than per capita income. In other words, a standard equivalence scale suggests that about 40 percent of U.S. equivalized income can be attributed to sharing goods within households. From this perspective, the value of borrowing and lending privately-owned goods across households will inevitably seem small. Nevertheless, sharing items with non-household members may still represent one of the most important forms of inter-household cooperation. Moreover, in an era of declining household size (Salcedo *et al.* 2012), sharing among loosely-connected individuals may be increasingly important.

2.2.1 Data and methodology

I use data on how often people borrow and lend goods across households and the price of those goods to estimate the current value of decentralized sharing. The GSS provides self-reported data on how frequently respondents lend goods with people in other households. The survey's 2002 and 2004 topical modules on altruism ask respondents how often they performed nine altruistic acts, including how often they "let someone [they] didn't know very well borrow an item of some value like dishes." I pool data from the 2002 and 2004 surveys for a sample of 2,712 people, and I convert the categorical values like "once a month" and "two or three times a year" to annual values following Einolf (2007). Unfortunately, the GSS only asks people how often they share items with someone they do not know very well, because the module is focused

on altruism, not reciprocity. Most decentralized borrowing and lending probably occurs within reciprocal networks of relatives, friends, and neighbors, but the GSS misses these transactions.

To address this shortcoming of the GSS question, I designed and conducted my own online survey. My survey consists of eighteen questions and takes about ten minutes to complete. Respondents had a one-in-fifty chance of winning a $100 Amazon gift card "to purchase something [they] (and [their] neighbors) need". The survey asks how often subjects borrow and lend items with people they do and do not know well. The survey also asks users about their motivations and obstacles to sharing goods online. The full survey is available in Appendix A. NeighborGoods emailed a link to the survey to 22,000 active and inactive members in August 2013, and 333 people completed the survey, giving me a response rate of 1.5 percent. Although this response rate is low, it is common for surveys of large online communities. For example, Willer *et al.*'s survey of 47,492 Freecycle users achieved a response rate of 1.7 percent (Willer *et al.* 2012, Appendix A).

Descriptive statistics for my NeighborGoods sample are quite similar to those for the GSS sample. Respondents to my survey include slightly more men, are slightly younger, and live in slightly smaller households, as shown in Table 2.1. Individuals in the two surveys report nearly identical levels of happiness. The most significant discrepancy between the two samples is that my subjects report a mean household income that is 42 percent larger than GSS respondents in 2002 and 2004. Despite the significant differences in income, my sample of NeighborGoods users is quite similar to the GSS's nationally representative sample, which suggests that my results can be generalized to the U.S. as a whole.

Like the GSS, my survey does not ask respondents to report the monetary value of each good they borrowed over the course of the last year. I estimate the average gains from sharing using anonymous data from NeighborGoods. This data provides information about 14,937 items posted on NeighborGoods and 1,281 items shared from March 2009 to November 2012. When users add an item to their inventory, NeighborGoods asks them to list its value. Table 2.1 lists the

median and mean value of goods that were posted and goods that were shared over this period. I assume that the items people shared offline are similar to the items users shared on NeighborGoods. If anything, the typical good shared among relatives, friends, and neighbors is probably worth more than the typical good shared on NeighborGoods.

The next step is to translate the value of a good into the value of borrowing the good. There is ample data on the cost of purchasing goods but little data on how much it is worth to use a good for an hour, a day, or a week. Rental markets are very thin for most household goods, so they do not provide a measure of the value of borrowing goods. However, my survey asks users if they would "consider sharing more expensive items on NeighborGoods if lenders could charge a fee." Many users worry that allowing fees would undermine the cooperative spirit of the network, but 55 percent of respondents are amenable to the idea. The survey asks those users to list specific goods they would be willing to borrow or lend for a fee, how much the goods are worth, and what rental fees they would be willing to pay or accept. I interpret the willingness to pay for a rental good as the net benefit of sharing that good, given current norms and preferences. Borrowers and lenders have very similar ideas about the value of using a good. It is worth more to borrow more valuable goods, but the proposed rental/asset price ratios decline as the value of the good increases. Figure 2.1 shows the actual rental/asset price ratios that respondents would pay as borrowers and accept as lenders, as well as my estimates of the rental/asset price ratio for goods of any value. My local polynomial estimator allows for a non-linear relationship between the variables, and it provides good estimates of the ratios near the endpoints. My predicted ratios suggest that people are willing to pay 9.4 percent of the asset price to borrow an item worth $50, 5.8 percent to borrow an item worth $500, and 1.9 percent to borrow an item worth $5,000.

Rental companies often lend goods at significantly higher rental/asset price rates, which may explain why rental markets for most shareable goods are thin even though gains from peer-to-peer sharing may be large. For example, bike shops often rent $300 to $500 bicycles for $30 to $50 a day (Citibike Resources), so the rental/asset price ratio is about 10 percent, rather than

the 5.8 to 6.4 percent that most people are willing to pay to borrow a good of that value. The gap between the ratio rental companies charge and the ratio most individuals are willing to accept suggests there are significant gains from decentralized borrowing and lending. I use the predicted rental/asset price ratios from the polynomial regression to assign a value to goods actually shared on NeighborGoods. I estimate that the mean benefit of a good borrowed on NeighborGoods in my sample is $14.88. I use this estimate to assign a monetary value to self-reported frequencies of sharing. My results are discussed in the following section.

2.2.2 Results

According to my survey, 8 percent of Americans report lending an item of some value to someone they didn't know very well once a month or more, which is consistent with the GSS and again suggests my sample is representative of the U.S. population. Respondents to my survey report sharing with people they know well about five times as often as they report sharing with people they did not know well. Table 2.3 shows that 35 percent report lending items to people they know well, and 29 percent report borrowing items from people they know well, at least once a month.

Self-reported data is imperfect. First, the wording of the questions probably misses occasions when people share some valuable goods, such as car trips or lodging. Second, the question asks how often the respondent borrows and lends goods, so it may miss borrowing and lending by other members of the individuals' household. Third, people report lending items slightly more often than borrowing items. While it is possible that respondents to my survey genuinely lend goods more often than they borrow them, it seems likely that they mildly

exaggerate how often they lend goods or how seldom they borrow goods.[2] These three shortcomings of the data may all downwardly bias my estimates of households' current gains from sharing.

My survey finds that current levels of peer-to-peer sharing are economically significant for some Americans. If the average gain from sharing is $14.88, as indicated by the NeighborGoods Survey, then borrowing goods is worth at least $179 annually to 30 percent of respondents, and it is worth at least $774 annually to 8 percent of respondents. My estimates suggest that sharing goods is an important component of non-market cooperation between households. The value of borrowing and lending goods can be compared to the value of time spent helping non-household children, helping non-household adults, and volunteering. The American Time Use Survey reports how much time people spend on each of these activities. I then value these forms of non-market work at $10 per hour, which is somewhat higher than Nancy Folbre's lower-bound valuation of childcare time (Folbre 2008, 121-135) and consistent with Woods Bowman's analysis of the value of volunteer time (Bowman 2009). Table 2.4 compares the value of sharing goods with the value of helping non-household members and formal volunteering. Borrowing and lending goods across households may not be quite as valuable as the time people spend helping each other outside the market, but it is an important form of cooperation. In the following section I will consider the potential benefits of sharing goods on online platforms like NeighborGoods, Airbnb, and RelayRides.

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[2] The data does suggest that decentralized sharing is fairly reciprocal. The correlation between annualized measures estimates of lending to anyone and borrowing from anyone is 0.58.

2.3 The potential value of decentralized sharing

The next task for this paper is to estimate the potential gains from sharing, *if* platforms are able to facilitate high levels of sharing between strangers. I do this by calculating households' expenditures on six categories of shareable goods. This does not provide an exact estimate of the potential gains from sharing, but it does provide a rough upper bound on the amount of money households could save by borrowing, rather than purchasing, shareable goods. The exercise also reveals which categories of goods promise the largest gains from sharing.

2.3.1 Data and methodology

As I note in Chapter 1, online platforms have had some success in facilitating borrowing and lending among weakly connected individuals. Although there are good reasons to expect the sharing economy to expand in the years to come, it is not clear how many transactions these platforms will ultimately facilitate or how valuable the shared goods will be. This makes it impossible to estimate the potential value of decentralized sharing in the same way I estimate the current value.

Instead, I use the Consumer Expenditure Survey (CES) to calculate how much U.S. households spend on different categories of shareable goods. I measure expenditures on shareable goods in the same way Salcedo *et al.* (2012) measure expenditures on household public goods. I determine which Universal Classification Codes (UCCs) represent spending on the sort of goods that are most commonly shared on general platforms like NeighborGoods, such as tools, media, gear, electronics, and toys, as well as those goods that are usually shared on specialized platforms, such as lodging, vehicles, and pets. My classification of 490 UCCs into six categories of shareable goods is listed in Appendix B.

Clearly, no level of decentralized sharing can save households more money than they currently spend on shareable goods. Still, current spending on shareable goods provides a rough upper-bound for the potential value created by online platforms. Spending on shareable goods exaggerates some of the economic benefits of sharing and ignores others. On the one hand, households cannot eliminate their expenditures on shareable goods because the gains from sharing are constrained by the utilization of goods. Even if online platforms are able to exploit economies of scale, develop favorable norms, and promote pro-sharing preferences over time, there will still be some costs to sharing. On the other hand, not all gains from sharing will result from people borrowing items they currently purchase, because people will also benefit from borrowing items they currently forego. Despite these problems, average household expenditures on shareable goods provides a rough upper-bound on the potential gains from sharing, as well as information about which categories of goods promise the greatest gains from sharing.

2.3.2 Results

The CES reports that U.S. households spend an average of $820 a year on tools, media, gear, electronics, toys and other goods that are typical of the items shared on general platforms like NeighborGoods. Even if these goods are highly underutilized, households could save no more than $820 a year by borrowing these goods instead of purchasing them. It may be useful for designers of online platform to recognize that households spend a limited amount of money on the tools, media, gear, electronics, and toys that often clutter our homes. The largest gains from sharing may lay elsewhere.

Members of NeighborGoods occasionally borrow and lend other types of goods, including pets, vacation homes, lodging, and vehicles. Table 2.5 lists households' mean annual expenditure on each category of these goods, as well as platforms designed specifically for

sharing these goods. On average, households spend $9,090 each year on all types of shareable goods. Although it is impossible to say exactly how this upper bound translates into potential gains from sharing, it seems reasonable to conclude that the average households' gains from sharing could exceed one thousand dollars annually, *if* people gain access to dense sharing networks with rules and etiquettes that are conducive to decentralized borrowing and lending. In other words, peer-to-peer sharing could potentially become the most valuable component of inter-household cooperation.

Pets offer a particularly striking example of the potential gains from sharing. The cover of *The Economist*'s March 9th-15th 2013 issue depicts a household that rents its lawnmower for $6 a day, its surfboard for $80 a week, and its dog for $5 a walk. The dog stands out as the only good for which it seems just as plausible for the "borrower" to charge the "lender" as vice versa. Many pet owners need someone to care for their pets when they leave town, and many people would like some animal company without the responsibility of owning a pet. There are clear gains from "sharing" pets, even if is unclear who should pay whom.

Table 2.5 shows that the largest potential gains from sharing are in transportation. Households spend an average of $7,397 on the fixed and variable costs of owning private vehicles, which accounts for 80 percent of all spending on shareable goods. While car rental companies and taxi services provide centralized means for sharing vehicles, annual household expenditures on car rentals and taxis are just $31 and $28 respectively. Peer-to-peer platforms like Blablacar, RelayRides, and UberPool facilitate ride-sharing and car-sharing. It is not yet clear how successful these companies will be in the U.S., but research suggests that car-sharing will likely grow over time (Prettenthaler and Steininger 1999, 450-452). Besides offering the largest potential economic benefits to households, ride-sharing and car-sharing reduce traffic congestion and demand for parking (Gorenflo and Eskandari-Qajar 2013).

The average U.S. household spends $9,090 a year on shareable goods that some people already borrow and lend using online platforms. This figure provides a rough upper bound on the

potential savings from decentralized sharing, and it leads me to conclude that peer-to-peer sharing could reasonably provide over one thousand dollars in value for the typical American household. While my analysis is limited to the U.S., the potential benefit of sharing goods on online platforms is probably on the same order of magnitude in other affluent countries with large stocks of shareable goods. The economic gains from sharing are not limitless, as some proponents suggest, but they are significant – particularly in the context of stagnating household incomes.

2.4 Economic growth and the future of sharing

Even if the potential value of decentralized sharing is large, economic development is historically associated with reductions in many forms of sharing. To some extent economic growth may reflect the escape from the Tragedy of the Commons and the triumph of individual self-interest. People with greater buying power may also have less of an incentive to share quasi-public goods. Recall that Salcedo *et al.* (2012) argue that the reduction in average household size over the last 150 years is explained partly by the fact that higher wages increased the opportunity cost of managing relationships with "roommates". Economic growth may similarly lead to reduction in other forms of sharing, if the cost of sharing a good with one more person or engaging in one more transaction increases in income.

A simple argument for why people with higher incomes are less likely to share emerges from Gary Becker's 1965 "Theory on the Allocation of Time". In his model, households are "small factories" that combine labor and intermediate goods, such as time, food, and furniture, to produce final commodities, such as meals, bicycle rides, and sleep. Everything else equal, individuals with higher wages will use production methods that are more goods-intensive and less time-intensive (Becker 1965, 513). Becker uses his theory to explain American lifestyles in the 1960s:

> Americans are supposed to be much more wasteful of food and other goods than persons in poorer countries, and much more conscious of time: they keep track of it continuously, make (and keep) appointments for specific minutes, rush about more, cook steaks and chops rather than time-consuming stews and so forth. They are simultaneously supposed to be wasteful of material goods and overly economical of immaterial time. Yet both allegations may be correct and not simply indicative of a strange American temperament because the market value of time is higher relative to the price of goods there than elsewhere. That is, the tendency to be economical about time and lavish about goods may be no paradox, but in part simply a reaction to a difference in relative costs (Becker 1965, 514).

One way in which individuals may substitute time for goods is by sharing items with others. However, if sharing goods is a time-intensive means of producing final commodities, Becker's argument suggests that the practice will decline with wage growth.

In empirical studies it is difficult to isolate the effect of income on the propensity to share quasi-public goods over time, because -- as I argue in Chapter 1 -- the costs of sharing vary with evolving norms and preferences. However, it is possible to identify the relationship between individual income and sharing at a given point in time. The cost of sharing will be greater for high-income people, if the practice is time-intensive or if privacy and independence are luxury goods. As a result, the affluent may share quasi-public goods with fewer people and less frequently. However, online platforms may make sharing less sensitive to income. Purchasing secondhand goods on Craigslist or travelling with Airbnb or Couchsurfing requires no long-term commitments. Although users can always convert pleasant interactions into lasting friendships, they can just as easily terminate unpleasant relationships and warn other group members. The arm's-length nature of these interactions may significantly reduce the cost of sharing with the marginal person.

This section analyzes the effect of income on individuals' use of various methods of sharing goods. Online platforms arguably reduce the amount of time it takes to coordinate sharing, so these institutions may be attractive to people with both high and low opportunity costs of time. I hypothesize that new institutions for sharing, unlike traditional institutions, are used at similar rates by people of all incomes. If the rich as well as the poor use online platforms to share

goods, then Hal Varian's simple forecasting rule suggests that these institutions may remain economically important even in the face of continued economic growth (McCafee 2015).

2.4.1 Data and methodology

This paper examines the relationship between income and various methods of sharing. I use data from the American Community Survey, my own survey of NeighborGoods users, and Center for a New American Dream Survey. Each poll provides multiple measures of how individuals share goods. I distinguish between traditional and new institutions for sharing goods. The methods I deem traditional are: carpooling, shopping at thrift stores and garage sales, living with a non-relative, living in a multi-generational household, and sharing items with relatives, friends, and neighbors. The methods I deem new are: exchanging goods on used merchandise websites like Craigslist, using peer-to-peer lodging platforms like Airbnb or Couchsurfing, making use of car-sharing services like Zipcar or RelayRides, and participating in bike-sharing programs like New York City's Citibike. Traditional forms of sharing are more time-intensive and rely on stronger social ties, while new forms are generally less time-intensive and function among loosely-connected individuals. While all the traditional institutions developed before the advent of the internet, the new institutions make heavy use of it.

My first source of data is the 2010 American Community Survey (ACS). I use the Public Use Microdata, which provides information on almost 2 million American adults. The ACS asks workers how they usually commuted to work in the previous week. As shown in Table 2.6, 10 percent of workers report carpooling to work – about twice as many as report taking mass transportation. Carpooling provides many Americans with a way to substitute time for money if they have a housemate, neighbor, or coworkers with a similar commute. The ACS also collects data on whether respondents live with non-relatives or live in multi-generational households, a

decision which may depend, in part, on economic factors. I find that 8 percent of adults live with a non-relative besides an unmarried partner. (I do not count unmarried partners as non-relatives, because the decision to live with a partner may have more to do with love than economics. That said, including unmarried partners strengthens my key results.) The ACS also reveals that 8 percent of adults live in a multi-generational households, and there is very little overlap between adults living with non-relatives and those living in multi-generational households.

My second data source is my own online survey of 298 NeighborGoods users described in Section 2.2.1, which provides data on how often people borrow and lend goods across households. This paper simply uses the NeighborGoods Survey (NGS) for information on how often people informally share goods with others off the platform. The NGS suggests that 38 percent of adults lend out at least one item a month and 33 percent of adults borrow at least one item a month.

My third source of data is a 2014 Center for a New American Dream survey (CNADS), which provides a unique look at how 1,646 Americans use one traditional institution and four new institutions for sharing goods. I use CNADS data on how often people use thrift stores and garage sales, online secondhand markets like Craigslist, peer-to-peer lodging platforms like Airbnb and Couchsurfing, car-sharing services like Zipcar and RelayRides, and bike-sharing services like New York City's Citibike. Shopping at thrift stores and garage sales is quite time-intensive, and I view these as traditional institutions for sharing goods. On the other hand, the four new institutions are specifically designed to reduce the amount of time it takes to exchange used goods, find a place to spend the night, or borrow a car or bike. Whether they facilitate peer-to-peer transactions, like Craigslist, Airbnb, Couchsurfing, and RelayRides, or more centralized forms of sharing, like Zipcar and Citibike, these new platforms all work to promote cooperation among loosely-connected networks of people. (Unlike car rental companies that clean and inspect their vehicles every time they are returned, Zipcar requires its customers to follow rules,

such as keeping it clean, transporting pets in carriers, and reporting damage, a dirty car, or low fuel before borrowing a car (Zipcar 2015).)

Table 2.6 lists my ten dependent variables and the percent of adults who report using each form of sharing goods. The ACS asks all respondents who they live with, and it asks workers how they usually commuted work in the previous week. The NGS and CNADS ask respondents how frequently they use a given method of sharing goods. I construct binary variables specifying whether a given individual reports using a method of sharing at least once a month or at least once a year, depending on how commonplace it is. For example, I analyze how income affects the probability that someone uses Craigslist at least monthly, but I analyze how income affects the probability that someone uses Airbnb or Couchsurfing at least yearly.

The ACS and CNADS are nationally representative surveys, which I analyze using the appropriate population weights, but the NGS is not. Table 2.7 shows that the sample in the NGS is somewhat more male and somewhat younger than the adult American population as a whole. Despite these discrepancies, respondents report lending items to strangers at levels very similar to those found in the General Social Survey (Fremstad 2014, 18), so the levels of sharing reported in the NGS are probably representative of the American population.

The exact measure of household income varies across surveys. The ACS asks individuals to report their household income, though the Public Use Microdata is top-coded for very high earners. The NGS and CNADS ask respondents to select their household income from a list of categories. NGS respondents were given five categories, and CNADS respondents were given seven categories. I assume each person's household income is equal to their category midpoint. As Table 2.7 shows, the ACS and NGS find very similar income levels. For unknown reasons, reported household income is significantly lower in the CNADS. Since I focus on the relationship between income and sharing within each sample, differences across samples do not pose a large problem for my analysis.

This section compares relationship between income and sharing using traditional institutions to using new institutions. I begin this analysis by simply calculating the fraction of American adults who regularly engage in each form of sharing across household income categories. While these comparisons are informative, I will also use multivariate regressions to test my hypothesis that people with higher incomes are less likely to use traditional methods of sharing goods, but no less likely to use new methods. For ease in interpretation, I present ordinary least squares estimates from a linear probability model, but my qualitative results are the same when I estimate a multivariate probit model. I estimates the effect of household income on and individuals' propensity to share goods after controlling for household size, age, gender, and race.

$$\Pr(\text{sharing}_i) = \beta_0 + \beta_1 ln(hh.\ income_i) + \beta_2 ln(hh.\ size_i) + \beta_3 age_i + \beta_4 female_i + \beta_5 white_i + \varepsilon_i \quad (1)$$

Of crucial interest is the magnitude and precision of my estimate of β_1, or the effect of income on the probability that an individual engages in a particular form of sharing at given level.

2.4.2 Results

I first analyze how the proportion of Americans who use each method of sharing varies across income categories. While these comparisons do not control for other variables, they illustrate the magnitude of income's impact and allow for non-linear effects. Figure 2.2 shows the relationship between income and six traditional methods of sharing. There is clear evidence that adults with higher household incomes are less likely to carpool to work. Workers in the poorest households are nearly 40 percent more likely to carpool to work than those in the richest households. People with higher incomes are also less likely shop at thrift stores or garage sales. This is consistent with Becker's (1965) model if sharing goods is time-intensive.

It is less clear how household income affects the probability that someone is living with a non-relative or living in a multi-generational household. There is evidence that households with incomes exceeding $150,000 are less likely to include unrelated members (besides unmarried partners). However, the probability of living in a house with multiple generations increases substantially with household income. Since multi-generation households are generally larger than typical households, this does not necessarily mean that the standard of living is actually higher in multi-generational households. My regression analysis will test this relationship by controlling for household size.

There is also some evidence that people with higher household incomes are less likely to share items with others. Americans with the lowest incomes report borrowing items much more often than lending items, perhaps because they have little to offer. Still, people with household incomes above $100,000 are the least likely to both borrow and lend items on a monthly basis.

Next, I turn to four new methods of sharing goods: online secondhand markets like Craigslist, peer-to-peer lodging platforms like Airbnb and Couchsurfing, car-sharing services like Zipcar and RelayRides, and bike-sharing programs. Figure 2.3 shows little correlation between income and the use in these new methods of sharing goods. The reason for this could be that these new methods are not very time-intensive, making them attractive to both low- and high-income people, as Becker's (1965) model suggests. Sharing goods among fluid networks of loosely-connected individuals might be also be attractive to a wider-range of people, as Benkler (2004) argues.

Figure 2.2 presents preliminary evidence that traditional institutions for sharing goods are disproportionately used by the poor, whereas Figure 2.3 suggests that new institutions are used at similarly by people with all incomes. My next step is to use a multivariate probit regression to estimate the impact of household income on an individual's propensity to use a given method of sharing controlling for household size, age, gender, and race.

Table 2.8 presents my estimates of the determinants of traditional methods of sharing. Column (1) shows that the inverse relationship between carpooling and household income is highly statistically significant. For the average worker, a one-unit increase in log household income reduces the probability that she will carpool to work by about 18 percent. Column (2) shows that affluent are significantly less likely to shop at thrift stores or garage sales.

My regression analysis finds strong evidence that people with higher incomes are less likely to live with non-relatives (besides unmarried partners) or with multiple generations. For the average household, a one-unit increase in log income reduces the probability of living with non-relative by about 18 percent and it reduces the probability of living in a multiple generational household by only about 17 percent. These results are consistent with Salcedo *et al.*'s (2012) theory that people with higher incomes will tend to avoid living with "roommates".

Finally, multivariate regressions provide some evidence that people with higher incomes are less likely to informally share goods across households. The inverse relationship between household income and lending is not statistically significant, but the inverse relationship between household income and borrowing is statistically significant at the 10 percent level. In both cases the point estimates are large. The results suggest that for the average person a one-unit increase in log household income reduces the probability of borrowing items at least monthly by 15 percent and lending items at least monthly by 21 percent.

My next task is to more carefully analyze the relationship between income and the use of new institutions for sharing goods. Table 2.9 shows that there is no statistically significant relationship between income and the use of services like Craigslist, Airbnb and Couchsurfing, Zipcar and RelayRides, or Citibike. The point estimates are also very small. In the case of Craigslist -- the most popular of these new institutions -- a one unit increase in log income is associated with less than a 1 percent reduction in the probability of using Craigslist's for sale section at least monthly.

As predicted, I find strong evidence that the propensity to rely on traditional institutions for sharing goods – from households, to carpools, to neighborhoods – declines with household income. However, I find no evidence that the use of new institutions for sharing goods, including Craigslist, to Airbnb, and Zipcar, similarly declines with income. My results are consistent with Becker's (1965) model if traditional methods of sharing are time-intensive, but new institutions are not. The multivariate analysis may also fit Benkler's (2004) claim that many people may prefer to share goods on fluid and loosely-connected networks than to share them within closely-knit communities.

Before discussing my main results in greater detail, it is worthwhile to reflect on the impact of other variables on individuals' propensity to share and a few robustness checks. First, consider the effect of household size. My preferred specification controls separately for household income and household size, which allows me to avoid making arbitrary assumptions about household economies of scale. My estimates of the effect of household size fit my interpretation of the results. Holding household income constant, I find strong evidence that increases in household size (and decreases in household members' standard of living) are associated with greater use of traditional institutions for sharing goods. However, I find no evidence that household size has a statistically significant impact on individuals' use of new institutions for sharing goods. These results fit my claim that the affluent are less likely to rely on old methods of sharing goods but just as likely as the poor to use new methods of sharing goods.

As a robustness check, I calculate two further measures of individual's income: (1) per capita household income and (2) equivalent household income using the square root scale. I arrive at the same results when I regress sharing on either of these adjusted income measures, instead of controlling household income and household size separately. People with a higher standard of living are less likely to use traditional institutions for sharing goods, but no less likely to use new institutions for sharing goods.

There is no indication in my results that either gender or race have consistent effects on individuals' propensities to share, which provides an after-the-fact justification for my focus on income. I do find some evidence that young people are more likely than their older counterparts to use new institutions for sharing goods. For example, my estimates suggest that, on average, an extra 10 years in age reduces the probability of using Craigslist at least monthly by 15 percent. This does not contradict my hypotheses about the relationship between income and sharing, but it does suggest that the sharing economy will increase in importance if young people today continue to use online platforms at similar rates in the years to come.

Finally, given the effect of age on the likelihood that a person practices some forms of sharing, I estimate a more flexible specification as another robustness check. Instead of controlling for age linearly, I include dummy variables for five-year age cohorts. My main results are qualitatively identical in this alternative specification. In short, I find robust evidence for an inverse relationship between income and traditional methods of sharing, but no evidence of a relationship between income and new methods of sharing.

My estimates suggest there is indeed an inverse relationship between income and six traditional methods of sharing. However, not all forms of sharing decline with income. I show that Americans with higher incomes are no less likely to use new services like Craigslist, Airbnb, Zipcar, or Citibike. The reason for this may be that these forms of sharing less time-intensive than more traditional forms of sharing. My results also suggest that the sharing economy may succeed in substantially increasing sharing levels over the long run, even in the face of steady economic growth.

There are alternative explanations for the patterns documented in this paper. A rival interpretation of my results is that low-income people are more amenable to all methods of sharing goods, but since they also have worse access to the internet, they are no more likely to use online platforms than their high-income counterparts. The digital divide may be an important part of the story, but I am unable to control for internet access in my multivariate analysis. If

inequality in internet access hides the inverse relationship between income and new sharing practices, it would cast some doubt on Benkler's claim that cooperation on fluid networks is appealing to a wider range of people than cooperation within stable communities (Benkler 2004, 343). However, this interpretation would not necessarily conflict with my ultimate conclusion, that sharing levels are likely to increase over time. After all, creating a role for internet access means that new institutions for sharing will continue to grow in importance as low-income Americans get connected to the internet.

2.5 Conclusion

The empirical evidence reviewed here supports the hypothesis that levels of sharing are likely to increase in the years to come. First, using data on how often people borrow and lend goods across households, I estimate that this form of sharing is already worth at least $179 a year for 30 percent of Americans and at least $774 for 8 percent of Americans. While informal sharing between households is not nearly as valuable as sharing within households, I show it is an important component of inter-household cooperation. Second, I show that the Consumer Expenditure Survey finds that households spend an average of $9,090 a year on shareable goods, which suggests that the potential savings from greater decentralized sharing may be substantially larger. My analysis concludes that the largest gains from sharing will probably come from increasing the utilization of privately-owned vehicles. Third, I address the claim that sharing is passé in a world of continued economic growth. While I do find evidence that high-income individuals are less likely to make use of traditional institutions for sharing, I find no evidence that they are less likely to use new institutions of sharing, like Craigslist, Couchsurfing, or Zipcar. Taken together, I conclude that the future of sharing on fluid networks of loosely-connected individuals is bright.

The sharing economy is fertile ground for further research. Others could improve upon my estimates of the current and future value of sharing by conducting nationally-representative surveys of sharing activities. More detailed surveys might ask subjects to list the items they share with relatives, friends, and neighbors. Studies could separately estimate the current value of carpooling and hosting, which I ignore in Section 2.2. Qualitative research might also shed light on the social costs and benefits of sharing goods.

This chapter highlights the differences between traditional institutions for sharing goods, like households and thrift stores, and new institutions for sharing goods, like Craigslist and Airbnb. In doing so it ignores the role of public institutions for sharing goods, such as libraries, parks, and mass transportation. Unlike sharing economy platforms, which often charge users to access goods, public institutions often make goods available for free or at subsidized rates. It may be surprising, then, that high-income people make greater use of libraries, parks, and mass transit than their low-income counterparts. Appendix C suggests that this is because public institutions focus on serving high-income areas. Further work could investigate the political economy of sharing quasi-public goods.

Research is also needed on the environmental benefits of sharing. My survey indicates that "reducing waste" is the most common motivation for participating on NeighborGoods. Data from the EPA shows that US per-capita municipal solid waste grew steadily until 2000, when it peaked at 4.7 pounds per person per day before beginning a slow decline (Environmental Protection Agency 2011, Figure ES-1). Careful analysis might reveal whether online platforms played a role in this reduction in waste. I examine the effect of Craigslist's market for secondhand goods on waste in Chapter 3.

Finally, the sharing economy is generating new data to test hypotheses from behavioral economics in real-world settings. The growth of online platforms will allow researchers to observe how people actually share goods. Future studies may leverage big data to address fundamental questions about why people cooperate, when members contribute to groups, and

how reputations influence behavior. In the years to come, researchers will not only evaluate the economic, social, and ecological impacts of the sharing economy, but also use data from the sharing economy to improve our understanding of human behavior.

2.6 Appendix A: Online survey of NeighborGoods users

1. During the last 12 months, how often have you done each of the following things ON or OFF NeighborGoods?

	More than once a week	Once a week	Once a month	At least 2 to 3 times in the past year	Once in the past year	Not at all in the past year
Let someone you DIDN'T KNOW WELL borrow an item of some value	○	○	○	○	○	○
Let someone you KNEW WELL borrow an item of some value	○	○	○	○	○	○
Borrowed an item of some value from someone you DIDN'T KNOW WELL	○	○	○	○	○	○
Borrowed an item of some value from someone you KNEW WELL	○	○	○	○	○	○

2. How important are the following motivations for participating on NeighborGoods?

	Very important	Somewhat important	Not important
Helping others	○	○	○
Reducing waste	○	○	○
Saving money	○	○	○
Meeting new people	○	○	○
Building community	○	○	○

3. What are your main reasons for not borrowing more items on NeighborGoods?
Check all that apply.
There are not many NeighborGoods users in my area.
There are not many items I want to borrow on NeighborGoods.
It is more convenient for me to borrow items from people I know outside of NeighborGoods.
I forget to check NeighborGoods' inventory when I need something.
I am uncomfortable borrowing items from people I don't know.
Other:

4. Would you consider sharing more expensive items if you were protected in case of damage?
○ Yes
○ No

5. Would you consider sharing more expensive items on NeighborGoods if lenders could charge a fee?
- Yes
- No

6. Can you list one item that you would be willing to lend to others on NeighborGoods for a fee?
Item:
Estimated price of the item:
Fee you would charge:

7. Can you list one item that you would be willing to borrow from someone on NeighborGoods for a fee?
Item:
Estimated price of the item:
Fee you would pay:

8. What is your preferred place to pick up and drop off goods?
- At the lender's home
- At the lender's office
- In an open public place
- Other:

9. What would be the easiest way for you to communicate and manage sharing requests on NeighborGoods?
- Website
- Text messages
- Mobile app

10. Is NeighborGoods valuable enough that you would be willing to pay $1 a month for the service?
- Yes
- No

We always appreciate your feedback, but you may skip this question if you like.
11. How do you think NeighborGoods could be improved?

12. What is your age?

13. What is your gender?
- Male
- Female

14. How many people, including yourself, live in your household?
- 1
- 2
- 3
- 4
- 5 or more

15. What was your total household income last year?
- Under $20,000
- $20,000 to $39,999
- $40,000 to $59,999
- $60,000 to $99,999
- $100,000 or more

16. How many years have you lived in your current neighborhood?
- Less than 1 year
- 1 - 3 years
- 3 - 5 years
- More than 5 years

17. Taken all together, how would you say things are these days - would you say that you are very happy, pretty happy, or not too happy?
- Very happy
- Pretty happy
- Not too happy

18. What is your email address?
Winners of Amazon gift cards will be informed via email. After the raffle, all email addresses will be deleted.

2.7 Appendix B: Shareable goods in the Consumer Expenditure Survey

UCC	UCC description	Category of shareable good	Percent of total expen-ditures
470111	Gasoline	Private vehicles (variable costs)	6.675
500110	Vehicle insurance	Private vehicles (fixed costs)	2.432
450210	New trucks or vans (net outlay)	Private vehicles (fixed costs)	1.952
460110	Used cars (net outlay)	Private vehicles (fixed costs)	1.795
460901	Used trucks or vans (net outlay)	Private vehicles (fixed costs)	1.759
450110	New cars (net outlay)	Private vehicles (fixed costs)	1.747
210210	Lodging away from home away from home on trips	Lodging away from home	0.833
480110	Tires (new, used or recapped); replacement and mounting of tires, including tube replacement	Private vehicles (variable costs)	0.402
610320	Pets, pet supplies and medicine for Pets	Pets	0.398
220212	Same as 220211 - owned vacation home, vacation coops	Vacation homes	0.357
470113	Gasoline on out-of-town trips	Private vehicles (variable costs)	0.350
610110	Toys, games, arts, crafts, tricycles, and battery powered riders	Tools, media, gear, etc.	0.331
510901	Truck or van finance charges	Private vehicles (variable costs)	0.315
520110	Vehicle registration state/local	Private vehicles (variable costs)	0.304
620420	Veterinarian expenses for Pets	Pets	0.299
450310	Basic lease charge (car lease)	Private vehicles (fixed costs)	0.265
510110	Automobile finance charges	Private vehicles (fixed costs)	0.265
220312	Same as 220311 - owned vacation home; vacation coops	Vacation homes	0.241
490312	Lubrication and oil changes	Private vehicles (variable costs)	0.212
490413	Motor repair and replacement	Private vehicles (variable costs)	0.183
660110	School books, supplies, and equipment for college	Tools, media, gear, etc.	0.177
490221	Brake work	Private vehicles (variable costs)	0.169
450410	Basic lease charge (truck/van lease)	Private vehicles (variable costs)	0.162
490311	Motor tune-up	Private vehicles (variable costs)	0.147
490318	Repair tires and miscellaneous repair work, such as battery charge, wash, wax, repair and replacement of windshield wiper, wiper motor, heater, air conditioner, radio and antenna	Private vehicles (variable costs)	0.142
590230	Books not through book clubs	Tools, media, gear, etc.	0.128
480213	Vehicle parts, equipment, and accessories	Private vehicles (variable costs)	0.125
470112	Diesel fuel	Private vehicles (variable costs)	0.125
320410	Lawn mowing equipment and other yard machinery	Tools, media, gear, etc.	0.124

590310	Magazine or newspaper subscription	Tools, media, gear, etc.	0.117
670902	Rentals of books and equipment, and other school-related expenses	Tools, media, gear, etc.	0.108
600122	Trailer-type or other attachable-type camper (net outlay)	Tools, media, gear, etc.	0.101
490211	Clutch and transmission repair	Private vehicles (variable costs)	0.099
620410	Pet services	Pets	0.097
520531	Parking fees at garages, meters, and lots excl. fees that are costs of property ownership	Private vehicles (fixed costs)	0.095
490412	Electrical system repair	Private vehicles (variable costs)	0.084
230152	Repair and remodeling services (owned vacation)	Vacation homes	0.080
610230	Photographic equipment	Tools, media, gear, etc.	0.080
490110	Body work, painting, repair and replacement of upholstery, vinyl/convertible top, and glass, installation of carpet	Private vehicles (variable costs)	0.075
310220	Video cassettes, tapes, and discs	Tools, media, gear, etc.	0.073
320521	Small electrical kitchen appliances	Tools, media, gear, etc.	0.073
460902	Used motorcycles, motor scooters, or mopeds (net outlay)	Private vehicles (fixed costs)	0.070
600420	Hunting and fishing equipment	Tools, media, gear, etc.	0.069
490231	Steering or front end repair	Private vehicles (variable costs)	0.063
450220	New motorcycles, motor scooters, or mopeds (net outlay)	Private vehicles (fixed costs)	0.063
490232	Cooling system repair	Private vehicles (variable costs)	0.061
520512	Auto rental on out-of-town trips	Rental vehicles	0.059
490313	Front end alignment, wheel balance and rotation	Private vehicles (variable costs)	0.054
600310	Bicycles	Tools, media, gear, etc.	0.053
620912	Rental of video cassettes, tapes, and discs	Tools, media, gear, etc.	0.051
310231	Video game software	Tools, media, gear, etc.	0.051
320420	Power tools	Tools, media, gear, etc.	0.044
320511	Electric floor cleaning equipment	Tools, media, gear, etc.	0.044
310232	Video game hardware/accessories	Tools, media, gear, etc.	0.044
310230	Video and computer game hardware and software	Tools, media, gear, etc.	0.043
260113	Same as 260112 - owned vacation home; vacation condos and coops	Vacation homes	0.040
490900	Auto repair service policy	Private vehicles (variable costs)	0.039
230902	Same as 230901 - owned vacation home; vacation condos and coops	Vacation homes	0.037
490411	Exhaust system repair	Private vehicles (variable costs)	0.036
310314	Digital audio players	Tools, media, gear, etc.	0.036
590410	Magazine or newspaper, single copy	Tools, media, gear, etc.	0.035
490319	Vehicle air conditioner repair	Private vehicles (variable costs)	0.035
220122	Same as 220121 - owned vacation home, vacation coops	Vacation homes	0.035
310340	Records, CDs, audio tapes	Tools, media, gear, etc.	0.034

520410	Vehicle inspection	Private vehicles (variable costs)	0.033
320150	Barbeque grills and outdoor equipment	Tools, media, gear, etc.	0.033
600132	Boat with motor (net outlay)	Tools, media, gear, etc.	0.030
470211	Motor oil	Private vehicles (variable costs)	0.029
310210	VCR"s and video disc players	Tools, media, gear, etc.	0.028
310320	Sound components, component systems, and compact disc sound systems	Tools, media, gear, etc.	0.028
320522	Portable heating and cooling equipment	Tools, media, gear, etc.	0.027
320370	Non-electric cookware	Tools, media, gear, etc.	0.027
520310	Driver’s license	Private vehicles (fixed costs)	0.025
480212	Vehicle products and services	Private vehicles (variable costs)	0.024
340901	Rental or repair of equipment and other yard machinery, power and non-power tools	Tools, media, gear, etc.	0.023
490212	Drive shaft and rear-end repair	Private vehicles (variable costs)	0.023
450313	Cash down payment (car lease)	Private vehicles (fixed costs)	0.021
520511	Auto rental, excl. trips	Rental vehicles	0.020
430130	Travel items, including luggage, and luggage carriers	Tools, media, gear, etc.	0.019
320320	China and other dinnerware	Tools, media, gear, etc.	0.018
520532	Parking fees on out-of-town trips	Private vehicles (variable costs)	0.017
320130	Infants? equipment	Tools, media, gear, etc.	0.017
600410	Camping equipment	Tools, media, gear, etc.	0.017
600430	Winter sports equipment	Tools, media, gear, etc.	0.017
600121	Boat without motor or non camper-type trailer, such as for boat or cycle (net outlay)	Tools, media, gear, etc.	0.016
600902	Other sports equipment	Tools, media, gear, etc.	0.015
450413	Cash down payment (truck/van lease)	Private vehicles (fixed costs)	0.015
320902	Non-power tools	Tools, media, gear, etc.	0.015
490314	Shock absorber replacement	Private vehicles (variable costs)	0.015
210902	Ground rent - owned vacation home	Vacation homes	0.014
250213	Gas, bottled or tank - owned vacation home	Vacation homes	0.014
620919	Rental of other vehicles on out-of-town trips	Tools, media, gear, etc.	0.013
470220	Coolant/antifreeze, brake - transmission fluids, additives, and radiator/cooling system protectant (not purchased with tune-up)	Private vehicles (variable costs)	0.013
520550	Towing charges (excl. contracted or pre-paid)	Private vehicles (variable costs)	0.012
600901	Water sports equipment	Tools, media, gear, etc.	0.012
270413	Same as 270412 - owned vacation home; vacation condos and coops	Vacation homes	0.012
520542	Tolls on out-of-town trips	Private vehicles (variable costs)	0.012
270213	Same as 270212 - owned vacation home; vacation condos and coops	Vacation homes	0.011

450414	Termination fee (truck/van lease)	Private vehicles (variable costs)	0.009
260213	Same as 260212 - owned vacation home; vacation condos and coops	Vacation homes	0.009
590220	Books through book clubs	Tools, media, gear, etc.	0.009
520522	Truck or van rental on out-of-town trips	Rental vehicles	0.009
260114	Electricity - rented vacation property	Vacation homes	0.008
510902	Motorcycle finance charges	Private vehicles (variable costs)	0.008
320310	Plastic dinnerware	Tools, media, gear, etc.	0.007
320340	Glassware	Tools, media, gear, etc.	0.007
320512	Sewing machines	Tools, media, gear, etc.	0.007
310311	Radio	Tools, media, gear, etc.	0.007
480214	Vehicle audio equipment excluding labor	Private vehicles (variable costs)	0.006
520521	Truck or van rental, excl. trips	Rental vehicles	0.006
230142	Same as 230141 - owned home and vacation home	Vacation homes	0.005
620904	Rental and repair of musical instruments, supplies, and accessories (now includes pianos)	Tools, media, gear, etc.	0.005
880310	Interest on line of credit home equity loan - owned vacation home	Vacation homes	0.005
340907	Rental and installation of household equipment - see 300111-300332	Tools, media, gear, etc.	0.005
520560	Global positioning services	Tools, media, gear, etc.	0.005
320360	Serving pieces other than silver	Tools, media, gear, etc.	0.004
440140	Clothing rental	Tools, media, gear, etc.	0.004
390902	Girls' other clothing, incl. costumes	Tools, media, gear, etc.	0.004
380903	Women's other clothing, incl. costumes	Tools, media, gear, etc.	0.004
450314	Termination fee (car lease)	Private vehicles (fixed costs)	0.004
480215	Vehicle video equipment	Private vehicles (variable costs)	0.004
470212	Motor oil on out-of-town trips	Private vehicles (variable costs)	0.004
250113	Same as 250112 - owned vacation home; vacation condos and coops	Vacation homes	0.003
420120	Sewing notions, patterns	Tools, media, gear, etc.	0.003
370902	Boys? other clothing, incl. costumes	Tools, media, gear, etc.	0.003
340908	Rental of office equipment for non-business use - see 320232, 690111, 690119, 690120, 690210-690230	Tools, media, gear, etc.	0.003
230123	Same as 230122 - owned vacation home; vacation condos and coops	Vacation homes	0.003
660310	Encyclopedia and other sets of reference books	Tools, media, gear, etc.	0.002
660410	School books, supplies, and equipment for vocational or technical school	Tools, media, gear, etc.	0.002
360902	Men's other clothing, incl. costumes	Tools, media, gear, etc.	0.002
620905	Rental and repair of photographic equipment	Tools, media, gear, etc.	0.002

520907	Rental of boat or non camper-type trailer, such as for boat or cycle on out-of-town trips	Tools, media, gear, etc.	0.002
310313	Tape recorder and player	Tools, media, gear, etc.	0.001
220314	Interest on home equity loan - owned vacation home	Vacation homes	0.001
660901	School books, supplies, and equipment for day care centers and nursery schools	Tools, media, gear, etc.	0.001
600110	Outboard motor	Tools, media, gear, etc.	0.001
340902	Rental of televisions	Tools, media, gear, etc.	0.001
240323	Same as 240322 - owned vacation home	Vacation homes	0.001
240313	Same as 240312 - owned vacation home	Vacation homes	0.001
220902	Parking at owned vacation home, vacation condos and coops	Vacation homes	0.001
340905	Rental of VCR, radio, and sound equipment - see 310210, 310311-310330	Tools, media, gear, etc.	0.001
320350	Silver serving pieces	Tools, media, gear, etc.	0.001
270414	Trash and garbage collection - rented vacation property	Vacation homes	0.001
620918	Rental of video software	Tools, media, gear, etc.	0.000
620917	Rental of video hardware/accessories	Tools, media, gear, etc.	0.000
240113	Same as 240112 - owned vacation home	Vacation homes	0.000
620916	Rental of video or computer hardware or software	Tools, media, gear, etc.	0.000
620906	Rental of all boats and outboard motors	Tools, media, gear, etc.	0.000
520904	Rental of non camper-type trailer, such as for boat or cycle	Tools, media, gear, etc.	0.000
320623	Same as 320622 - owned vacation home	Vacation homes	0.000
270903	Septic tank cleaning - owned vacation home	Vacation homes	0.000
240123	Same as 240122 - owned vacation home	Vacation homes	0.000
240223	Same as 240222 - owned vacation home	Vacation homes	0.000
--	337 UCCs that are not shareable	Uncategorized	74.566

2.8 Appendix C: Political economy of public institutions for sharing

This chapter compares traditional institutions for sharing goods with new institutions for sharing goods. In doing so, it ignores the role of public institutions. Public transportation, libraries, and parks are three important ways in which people share valuable goods. Using data from the ACS and CNADS, it is possible to analyze the impact of income on the use of these public institutions just as I do for traditional institutions and new institutions. There is good reason to think that low-income people are more likely to use mass transit, libraries, and parks than high-income people. After all, these services tend to require a significant amount of time. Moreover, public institutions are typically funded in part by government, which should make them especially attractive to the poor.

Surprisingly, then, a first glance at the data suggests that the use of public institutions increases with income. Figure 2.4 shows that people the affluent are disproportionately likely to use public libraries and public parks and playgrounds. The case of mass transit is more complex. Mass-transit use appears to be U-shaped, so that workers living in the poorest and richest households are much more likely to use mass transportation than workers living in middle-income households. Controlling for household size, age, gender, and ethnicity sharpens the positive relationship between income and public methods of sharing. Table 2.10 shows strong evidence that people with higher incomes are more likely to use mass transit, libraries, and parks. For example, I estimate that a one unit increase in log household income is associated with a 16 percent increase in the likelihood that individuals use public parks at least once a month.

At first these results may seem counter-intuitive, but I hypothesize that poor people are less likely to use public institutions for sharing goods because people living in poor neighborhoods and cities tend to have limited access to public goods. For example, public transportation systems may be designed primarily to serve high-income neighborhoods, and neighborhoods with easy access to mass transit may become unaffordable for low-income people.

In either case, the amount of time it takes to use mass transit may be higher for low-income people than high-income people, which could explain why they are less likely to use it, despite their low wages.

I can test my hypothesis by focusing my analysis on the correlation between income and mass transit use within Public Use Microdata Areas (PUMAs). Table 2.11 presents the results of OLS regressions estimating the determinants of mass transit use. Column (1) replicates my original finding: nationwide American workers with higher incomes are more likely to take mass transit. However, Column (2) shows that within PUMAs the relationship reverses. In other words, the positive correlation between income and mass transit is driven entirely by the fact that workers in wealthier PUMAs are more likely to take mass transportation than workers in poorer PUMAs. Within any given PUMA, where the availability of mass transportation is relatively constant, low-income Americans are disproportionately likely to make use of it. As a robustness check, consider the case of carpooling. Columns (3) and (4) of Table 2.11 show that the negative relationship between income and carpooling is not impacted by including PUMA fixed effects, which is consistent with my interpretation of the results, if all Americans have similar access to roads.

Note that if it were possible to run these regressions within even smaller geographical areas, the inverse relationship between income and mass transit use may be even greater. After all the average PUMA contains almost half a million people, and some PUMAs have millions of people, so access to mass transit within PUMAs may still vary substantially with neighborhood wealth.

Given the smaller size of the CNADS, it is impossible to test whether the positive relationship between income and the use of libraries and parks holds true within smaller geographical areas that have similar access to libraries and parks. Nevertheless, the results from mass transportation suggest that people in affluent cities and neighborhoods may have systematically better access to public goods, which could explain why nationwide the rich are

disproportionately likely to use these public methods of sharing goods. These findings highlight the role of political economy in determining how people distribute the costs and the benefits of sharing goods, although the issue falls beyond the scope of this paper.

2.9 Tables and figures

Table 2.1: Descriptive statistics for GSS and NeighborGoods samples

	GSS sample				NeighborGoods sample			
	n	**Mean**	**Min**	**Max**	**n**	**Mean**	**Min**	**Max**
Female	2,712	0.51	0	1	324	0.45	0	1
Age	2,700	44.7	18	89	319	41.6	20	81
Household size	2,712	2.74	1	11	323	2.60	1	5
Household income	2,398	59,243	449	204,320	306	84,412	10,000	150,000
Happiness	2,706	2.22	1	3	325	2.22	1	3

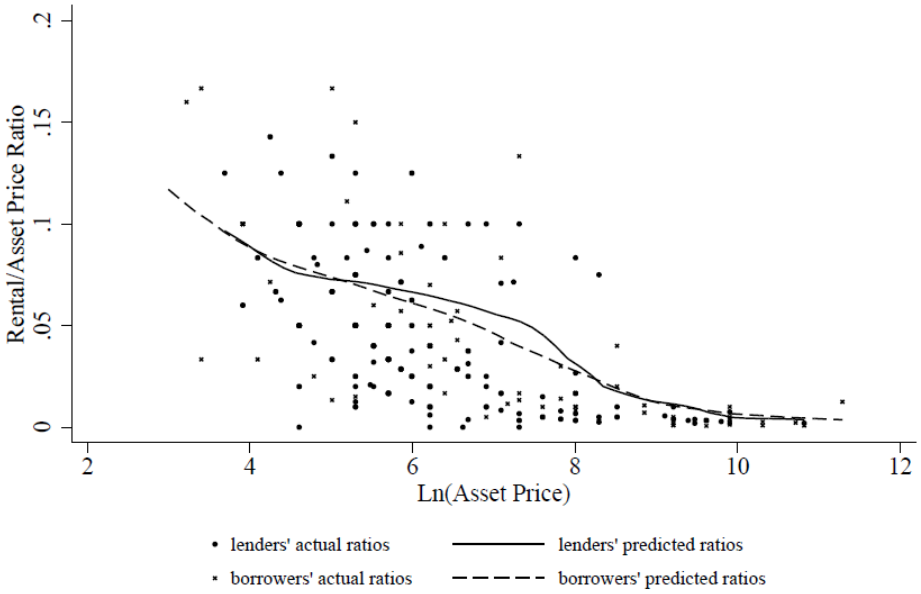
Note: Variables definitions are as follows: female (male = 0, female = 1), household size ("5 or more" = 5 for NG sample), household income (based on midpoints, in 2013 dollars), happiness (1 = "not too happy", 2 = "pretty happy", 3 = "very happy"). GSS means are weighted using sampling weights, NeighborGoods means are unweighted.

Table 2.2: Value of items on NeighborGoods

	n	**Median value**	**Mean value**
Posted goods	14,863	$60	$214
Shared goods	1,243	$75	$466

Notes: Author's calculations using anonymous data from NeighborGoods.

Figure 2.1: Actual and predicted rental/asset price ratios



Note: Actual rental/asset price ratios are from author's survey of NeighborGoods users. I estimate predicted price ratios using a local polynomial estimator.

Table 2.3: Current frequencies of sharing

	GSS Sample	**NeighborGoods Sample**			
	lend to someone you didn't know well	lend to someone you didn't know well	lend to someone you knew well	borrow from someone you didn't know well	borrow from someone you knew well
More than once a week	1%	1%	5%	0%	2%
Once a week	1%	2%	8%	1%	5%
Once a month	5%	5%	22%	4%	22%
At least 2 to 3 times in the past year	18%	12%	33%	9%	28%
Once in the past year	17%	20%	9%	19%	16%
Not at all in the past year	58%	60%	22%	67%	27%
Total	100%	100%	100%	100%	100%

Notes: Calculations use data from the General Social Survey and the author's survey of NeighborGoods users.

Table 2.4: The value of various forms of inter-household cooperation

	mean incidents per year	mean minutes per day	annual value*
borrowing goods	9.5		$141
lending goods	14.3		$213
helping non-hh kids		4.5	$272
helping non-hh adults		5.2	$316
formal volunteering		9.7	$588

Note: Data is from my survey and ATUS 2003-2012 sample means using person/day weights. I assume that the mean value of sharing a good is $14.88 and that non-market work is worth $10 an hour.

Table 2.5: Household expenditures on shareable goods

Categories of spending	Mean annual expenditures	Examples of non-market platforms	Examples of market platforms
Tools, media, gear, etc.	$820	NeighborGoods	Sharetribe
Pets	$286		Rover
Vacation homes	$289	HomeExchange	Airbnb
Lodging away from home	$298	CouchSurfing	Airbnb
Private vehicles (fixed costs)	$3,994		RelayRides,
Private vehicles (variable costs)	$3,403		BlaBlaCar
All shareable goods	$9,089		

Source: Consumer Expenditure Public Use Microdata 2011. For more information on these platforms see Neighborgoods.net, Sharetribe.com, Rover.com, HomeExchange.com, Airbnb.com, Couchsurfing.com, Relayrides.com, and Blablacar.com.

Table 2.6: Use of various institutions for sharing goods

Dependent variables:	**Type**	**Source**	**Mean**	**Std. Dev.**
Usually carpooled to work last week (among workers)	Traditional	ACS	0.10	0.30
Uses thrift stores or garage sales at least monthly	Traditional	CNAD	0.43	0.50
Lives with a non-relative (besides an unmarried partner)	Traditional	ACS	0.08	0.28
Lives in a multi-generational household	Traditional	ACS	0.08	0.26
Lends item to anyone at least monthly	Traditional	NG	0.38	0.49
Borrows item from anyone at least monthly	Traditional	NG	0.33	0.47
Uses used merchandise website like Craigslist at least monthly	New	CNAD	0.31	0.46
Uses peer-to-peer lodging services like Airbnb or Craigslist at least annually	New	CNAD	0.10	0.30
Uses car-sharing service like Zipcar or RelayRides at least monthly	New	CNAD	0.06	0.24
Uses bicycle sharing services at least annually	New	CNAD	0.09	0.28

Note: All summary statistics use population weights, except NG survey.

Table 2.7: Comparisons of common variables

	ACS	**NGS**	**CNADS**
Female	0.52	0.43	0.52
	(0.50)	(0.50)	(0.50)
Age	45.74	41.01	45.95
	(17.10)	(12.13)	(16.60)
White	0.76	NA	0.77
	(0.43)	NA	(0.42)
Household size	3.45	2.60	2.67
	(1.59)	(1.18)	(1.25)
Household income	83,992	84,463	57,258
	(75,907)	(49,256)	(45,835)
Equivalent hh income	47,566	54,560	36,492
(using sqrt. scale)	(44,320)	(32,390)	(28,596)
Observations	1,820,352	298	1,646
Population weights?	Yes	No	Yes
Survey year	2010	2013	2014
Notes on construction of income data	Household income with topcoding.	Household income based on midpoints from 5 income brackets	Household based on midpoints from 7 income brackets.

Notes: Population means with standard deviations in parentheses. All statistics use population weights, except the NGS, which is not nationally representative.

Figure 2.2: Household income and traditional methods of sharing

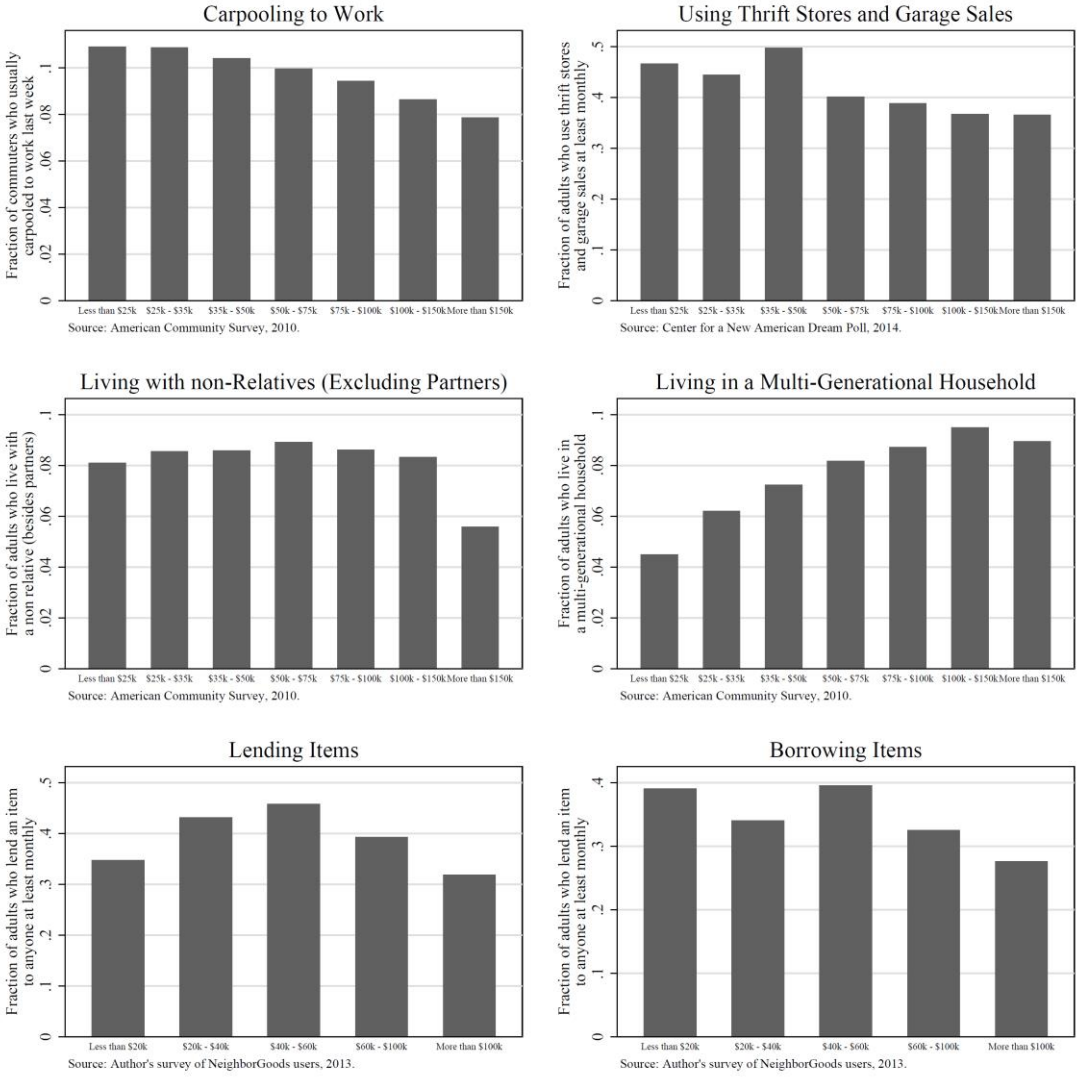


Figure 2.3: Household income and new methods of sharing

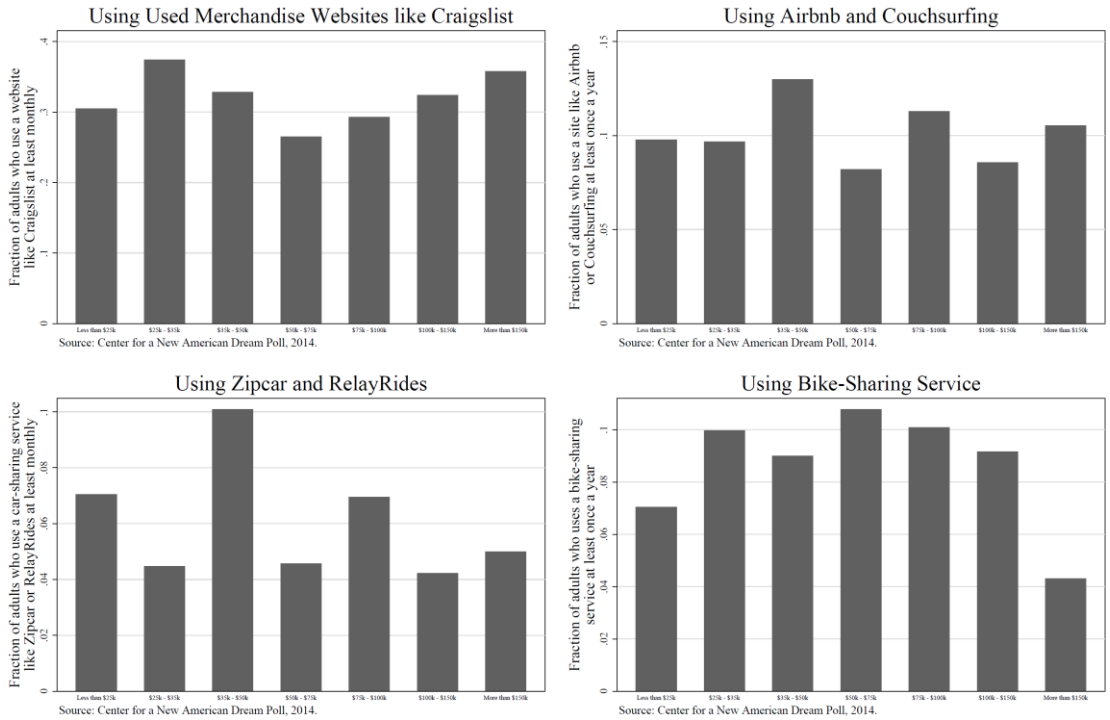


Table 2.8: Inverse relationship between income and traditional methods of sharing

	Usually carpooled to work last week	Uses thrift store or garage sale at least monthly	Lives with non-relatives (besides partners)	Lives in a multi-generational household	Lends item to anyone at least monthly	Borrows item from anyone at least monthly
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(hh income)	-0.0178***	-0.0551***	-0.0148***	-0.0127***	-0.0587	-0.0684*
	(0.000415)	(0.0179)	(0.000286)	(0.000217)	(0.0378)	(0.0366)
Ln(hh size)	0.0558***	0.0811***	0.0643***	0.203***	0.134**	0.124**
	(0.000640)	(0.0307)	(0.000514)	(0.000581)	(0.0615)	(0.0570)
Age	-0.000468***	0.000766	-0.00184***	0.00179***	0.00340	0.00220
	(2.38e-05)	(0.00100)	(1.58e-05)	(1.32e-05)	(0.00233)	(0.00228)
Female	-0.00465***	0.0435	-0.0187***	0.0233***	-0.0759	-0.0248
	(0.000620)	(0.0282)	(0.000497)	(0.000411)	(0.0567)	(0.0549)
White	-0.0228***	0.133***	0.00114*	-0.0434***		
	(0.000832)	(0.0345)	(0.000651)	(0.000588)		
Constant	0.276***	0.791***	0.277***	-0.0452***	0.814*	0.904**
	(0.00451)	(0.192)	(0.00319)	(0.00233)	(0.428)	(0.413)
Observations	1,319,635	1,646	2,273,619	2,273,619	298	298
R-squared	0.014	0.025	0.041	0.154	0.032	0.023
Population weights	Yes	Yes	No	No	Yes	Yes

Note: Estimates from Linear Probability Model with robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2.9: No Relationship between income and new methods of sharing

	Uses Craigslist at least monthly	Uses Airbnb or Couchsurfing at least monthly	Uses Zipcar or RelayRides at least monthly	Uses bike-sharing at least monthly
	(1)	(2)	(3)	(4)
Ln(hh income)	-0.00187	0.00681	-0.00760	0.00997
	(0.0168)	(0.0113)	(0.00923)	(0.00908)
Ln(hh size)	0.0374	-0.0191	0.00939	-0.0120
	(0.0296)	(0.0226)	(0.0156)	(0.0182)
Age	-0.00470***	-0.00276***	-0.000572	-0.00192***
	(0.000956)	(0.000812)	(0.000520)	(0.000605)
Female	-0.0110	-0.0127	-0.00775	-0.0436***
	(0.0263)	(0.0190)	(0.0151)	(0.0162)
White	-0.0105	-0.0218	-0.0355*	-0.0262
	(0.0344)	(0.0259)	(0.0208)	(0.0227)
Constant	0.532***	0.196	0.193*	0.125
	(0.176)	(0.128)	(0.101)	(0.107)
Observations	1,646	1,646	1,646	1,646
R-squared	0.035	0.024	0.008	0.022
Population weights	Yes	Yes	Yes	Yes

Note: Estimates from Linear Probability Model with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 2.4: Household income and public methods of sharing

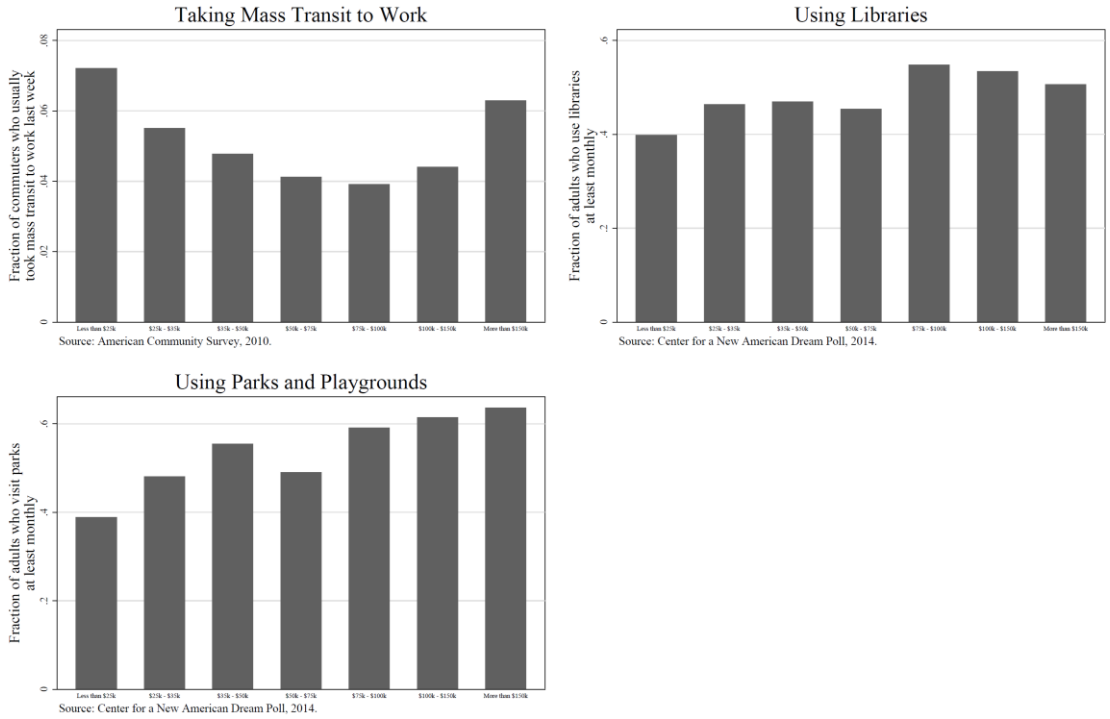


Table 2.10: Direct relationship between income and public methods of sharing

	Usually took mass transit to work last week	Uses library at least monthly	Uses parks at least monthly
	(1)	(2)	(3)
Ln(hh income)	0.00353***	0.0449**	0.0869***
	(0.000357)	(0.0176)	(0.0172)
Ln(hh size)	-0.0137***	0.0581**	0.0655**
	(0.000542)	(0.0296)	(0.0298)
Age	-0.000610***	3.84e-05	-0.00339***
	(1.89e-05)	(0.00100)	(0.000993)
Female	0.00548***	0.0839***	0.0176
	(0.000473)	(0.0282)	(0.0283)
White	-0.0713***	-0.00711	0.0306
	(0.000757)	(0.0353)	(0.0361)
Constant	0.102***	-0.106	-0.355*
	(0.00385)	(0.185)	(0.183)
Observations	1,319,635	1,646	1,646
R-squared	0.021	0.019	0.043
Population weights	Yes	Yes	Yes

Note: Estimates from Linear Probability Model with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2.11: Household and area determinants of mass transit use and carpooling

	Usually took mass transit to work last week	Usually took mass transit to work last week	Usually carpooled to work last week	Usually carpooled to work last week
	(1)	(2)	(3)	(4)
Ln(hh income)	0.00353***	-0.000809**	-0.0178***	-0.0162***
	(0.000357)	(0.000338)	(0.000415)	(0.000424)
Ln(hh size)	-0.0137***	-0.00912***	0.0558***	0.0539***
	(0.000542)	(0.000504)	(0.000640)	(0.000649)
Age	-0.000610***	-0.000491***	-0.000468***	-0.000473***
	(1.89e-05)	(1.74e-05)	(2.38e-05)	(2.39e-05)
Female	0.00548***	0.00485***	-0.00465***	-0.00421***
	(0.000473)	(0.000443)	(0.000620)	(0.000619)
White	-0.0713***	-0.0449***	-0.0228***	-0.0255***
	(0.000757)	(0.000701)	(0.000832)	(0.000884)
Constant	0.102***	0.120***	0.276***	0.263***
	(0.00385)	(0.00367)	(0.00451)	(0.00459)
PUMA fixed effects	No	Yes	No	Yes
Observations	1,319,635	1,319,635	1,319,635	1,319,635
Population weights	Yes	Yes	Yes	Yes
R-squared	0.021	0.135	0.014	0.018

Note: Estimates from OLS model with standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

CHAPTER 3

DOES CRAIGSLIST REDUCE WASTE?
EVIDENCE FROM CALIFORNIA AND FLORIDA

3.1 Introduction

A number of online platforms have emerged in recent years to improve the allocation of durable goods. Since the 1990s, Craigslist, eBay, and Freecycle have reduced the cost of buying, selling, and giving away secondhand items. More recently, platforms like Airbnb and RelayRides have facilitated peer-to-peer rental of lodging and vehicles. Some researchers stress the environmental benefits of increasing the utilization of consumer goods (Botsman and Rogers 2010; Schor 2010, 137-143). Most Americans agree that sharing goods reduces waste and environmental burdens (Center for a New American Dream 2014; Fremstad 2014, 23). However, little research has attempted to measure the environmental benefits of these online platforms.

This paper analyzes the impact of Craigslist on solid waste generation. The platform has sharply reduced transaction costs in the market for secondhand goods. Craigslist makes it easy for individuals to post items they would like to sell and search for items they would like to buy, and the website has attracted large numbers of users. In 2014, 54 percent of Americans reported using "used merchandise websites such as Craigslist", and 11 percent reported using such websites once a week or more (Center for a New American Dream 2014). Economic theory suggests that a reduction in transaction costs in secondhand markets will increase the number of transactions and divert some goods from the solid waste stream. Unlike eBay, Craigslist facilitates local exchange, so its gradual expansion in California and Florida from 1996 to 2009 provides an opportunity to identify the platform's impact on waste. This paper exploits sharp

variation in when the platform entered various counties to estimate Craigslist's impact on the solid waste disposal.

Some recent studies have addressed how the internet has affected various markets. There are clear theoretical arguments for why more efficient markets for consumer durables may reduce material throughput. Valerie Thomas (2003) provides a simple model in which lower transaction costs in secondhand markets can lead to less waste, by raising incentives for owners to sell used goods rather than discard them. In her model, the environmental benefit of falling transaction costs declines as the value of used goods increases, because consumers know they can resell new goods in the future. However, this price effect is small when prices for used goods are low, as they are for many categories of secondhand goods (Thomas 2003, 75). In related work, Thomas (2011) evaluates the environmental impact of the online market for secondhand books. Her calculations suggest that buying a used book online saves twice as much energy as buying a new book printed on recycled paper. Thomas' theoretical and empirical work sheds light on the understudied relationship between secondhand markets, transaction costs, and waste.

While economists have not addressed the internet's impact on waste, they have studied how online markets affect the utilization of economic resources. Kroft and Pope (2014) estimate the impact of Craigslist on local unemployment rates and apartment vacancy rates as the platform expanded across the United States. Using data on the number of housing, job, personal, and for-sale posts in 35 Metropolitan Statistical Areas (MSAs) in 2005 and 162 MSAs in 2007, Kroft and Pope perform difference-in-difference regressions of unemployment and apartment vacancy rates on the growth of Craigslist posts. While they find no evidence that Craigslist impacted unemployment rates, they show that Craigslist reduced apartment vacancies by approximately 10 percent over this time period (Kroft and Pope 2014, 289). Their explanation is that Craigslist provides a better means of advertising housing than newspapers, because the website is searchable, posts are immediately accessible, and landlords can provide prospective renters with much more information about apartments (Kroft and Pope 2014, 297-298). Kroft and Pope

conclude that Craigslist increased the utilization of rental housing by better matching landlords and tenants. Although the paper does not consider the potential environmental benefits, it suggests that Craigslist increased the utilization of rental housing by roughly 1 percent, which may have reduced demand for new housing.

Rapson and Schiraldi (2013) address the impact of the internet on the market for used cars in California. They calculate the percent of households with internet at home in Californian counties using the Consumer Population Survey (CPS). Using a difference-in-difference methodology, the authors estimate how internet penetration affects the quantity of used car registrations. Rapson and Schiraldi conclude that, between 1997 and 2007, growing access to the internet increased the resale ratio by 7 percent. The authors "remain intentionally agnostic" about why the internet caused this effect, but they note that "three channels stand out as plausible explanations: search costs, match quality, and asymmetric information" (Rapson and Schiraldi, 2013: 234). They argue that this reduction in transaction costs has private as well as public benefits. Online markets for vehicles increase consumer surplus by better allocating used cars, and increasing the turnover of the vehicle fleet may also reduce carbon emissions (Rapson and Schiraldi, 2013: 234). However, Rapson and Schiraldi do not attempt to directly measure the environmental impacts of the online market for cars.

To my knowledge, no papers have estimated the impact of online markets on solid waste. A handful of papers do explain cross-sectional variations in solid waste generation. Hockett *et al.* (1995) use county-level data from North Carolina, which is "relatively consistent with respect to collection and reporting methods" (216) to estimate the determinants of per capita solid waste. They find that retail sales and waste disposal fees are statistically significant cross-sectional determinants of waste generation, while demographic factors are insignificant.

Much of the research on solid waste is conducted by government agencies. Local governments do not report to the federal government how much solid waste they generate, but since the 1960s the Environmental Protection Agency (EPA) has estimated the solid waste

generation for the United States as a whole using a material flows methodology (Environmental Protection Agency 2011, 24). The EPA estimates waste using data on the production, net import, and the lifetime of goods. As Figure 3.1 illustrates, The EPA's estimates of Municipal Solid Waste (MSW) suggest that the growth of pre-recycling waste slowed in the 1990s and declined slightly in the 2000s.

It is not clear what accounts for this decline in pre-recycling waste, but the EPA highlights the potential role of "source reduction activities", which include sharing and reusing durable goods (Environmental Protection Agency 2011, 128):

> Although source reduction has been an increasingly important aspect of municipal solid waste programs since the late 1980s, the goal of actually measuring how much source reduction has taken place – how much waste prevention there has been – has proved elusive… Unlike recycling, where there are actual materials to weigh all through the process, measuring source reduction means trying to measure something that no longer exists (Environmental Protection Agency 2011, 132).

This paper exploits variation in how Craigslist expanded in California and Florida to estimate its contribution to source reduction by better matching consumers to secondhand goods. I then test the plausibility of my estimates by examining a sample of goods posted for sale on Craigslist.

The EPA's data does suggest that extending the life of durable goods could significantly reduce solid waste. The EPA defines durable goods as products that last three years of more, including "large and small appliances, furniture and furnishings, carpets and rugs, rubber tires, lead-acid automotive batteries, consumer electronics, and other miscellaneous durable goods (e.g., luggage, sporting goods, miscellaneous household goods)" (Environmental Protection Agency 2011, 62). The EPA estimates that durable goods constitute 24.6 percent of post-recycling waste by weight (Environmental Protection Agency 2011, 10). If Craigslist leads people to sell or give away goods instead of simply discarding them, the platform may cause a measurable decline in solid waste.

Next, I provide some historical background on Craigslist's expansion in California and Florida. Section 2.3 describes my data and empirical strategy. In the following section, I present econometric evidence that Craigslist significantly reduces waste. I test the robustness of my findings in Section 2.5, by estimating the platform's impact on pre-recycling waste in Florida, allowing for county-specific trends in waste, and investigating the timing of Craigslist's effect. My plausibility analysis uses data on the number and type of posts in the for-sale section of Craigslist to show that these posts can reasonably explain my econometric results. My conclusion summarizes my argument and provides some avenues for further research.

3.2 Background on Craigslist

Craig Newmark created Craigslist in 1995 by establishing an email list for friends and acquaintances living in San Francisco. Craigslist launched a public website for the San Francisco Bay Area in 1996. The website provided a simple, searchable platform for people to post goods, jobs, housing, services, and personals, and Craigslist quickly attracted users. In 2000, the platform launched lists for eight more American cities, including Los Angeles, San Diego, and Sacramento. By 2009, Craigslist had hundreds of lists worldwide including 46 lists in California and Florida (Craigslist "Expansion" 2015).

The largest section on Craigslist is devoted items for sale. For-sale posts are generally free. Craigslist earns revenue by charging users for a few types of posts; for example it charges employers $25 and $75 to advertise jobs in some cities and $10 for brokered apartment rentals in New York City. However, with the exception of automobile dealers, who pay $5 to post cars and trucks on the site, individuals and businesses can post items for sale on Craigslist at no cost (Craigslist "Posting Fees" 2015). Unlike traditional newspaper classifieds, sellers may also provide detailed descriptions and pictures of goods.

Craigslist was not the first platform for exchanging used goods. For example, the California Materials Exchange (CalMAX) was created in 1991 with the explicit goal of diverting waste from landfills. The government-run exchange originally printed catalogs to match firms, agencies, and individuals with materials that would otherwise flow into the solid waste stream. CalMAX went online in 1994, and California claims that the platform diverted hundreds of thousands of tons of materials from landfills in the 1990s. However, the public platform was gradually crowded out by popular, private platforms. Today CalMAX directs its online visitors to Craigslist, Freecycle, and eBay (CalMAX 2014). Freecycle is a smaller local network in which owners give items away for free, whereas eBay provides a national and international market for secondhand goods, in which sellers generally ship items to buyers. However, Craigslist is the largest online market for local, secondhand goods in most U.S. cities.

3.3 Data and methodology

My empirical strategy exploits variation in how Craigslist expanded across the states of California and Florida from 1996 to 2009. I combine annual data on post-recycling solid waste generation and information on when Craigslist launched lists in California and Florida. Unlike most states, California and Florida have consistently collected county-level solid waste data for nearly two decades. California's electronic Disposal Reporting System (eDRS) recorded how many tons of solid waste originated in 57 Californian counties every quarter from 1995 to 2013.[3] Florida's Solid Waste Annual Reports provide annual county-level data on post-recycling waste

[3] The eDRS provides no solid waste data for Sutter County, which had a population of 95,000 in 2010.

from 1995 to 2013 as well as data on pre-recycling waste from 1996 to 1999 and from 2001 to 2013.

This rich panel data allows me to identify the effect of Craigslist on solid waste generation using difference-in-difference methods. I use solid waste to measure the utilization of durable goods in much the same way that Kroft and Pope use apartment vacancy rates and unemployment to measure the utilization of housing and labor. The dependent variable for my analysis is daily per capita waste generation. Over this period, mean post-recycling waste was about 5.6 pounds per person per day in both states, although the variation in waste disposal within counties is about twice as large in Florida as in California.

There are several limitations to available waste data. Ideally, I would analyze the impact of Craigslist on the disposal of durable goods, the category of waste most likely to be affected by the secondhand market. To my knowledge, no state collects panel data with this level of detail. I would also prefer to examine the impact of Craigslist on pre-recycling waste rather than post-recycling waste, since Craigslist is unlikely to affect recycling rates. While Florida does track both pre- and post-recycling waste in its counties, California only collects post-recycling data. This paper focuses on the determinants of post-recycling waste and uses Florida's pre-recycling waste as a robustness check. Table 3.2 shows that over this period Floridians generated about 7.6 pounds per person per day, which implies a recycling rate of about 25 percent. The shortcomings in my data are mitigated by the fact that California and Florida provide consistent data for 124 counties over 19 years, allowing me to control for county and year fixed effects throughout my analysis.

The key independent variable in my analysis is whether Craigslist was available to residents of a given county for the entire year. I use data on when Craigslist launched each of its

46 lists in California, including 13 lists that were launched after Kroft and Pope's study.[4] Although Craigslist does not generally name its lists after the counties it serves, I map each of its lists onto the main counties that use the list as shown in Table 3.1. This allows me to estimate how Craigslist's entry into a county affects that county's per capita waste, after controlling for changes in waste in California and Florida. My mapping is necessarily imperfect: some counties that "get Craigslist" may not generate many secondhand market transactions, while other counties that "do not get Craigslist" may make use of a nearby list. Any error in my mapping leads to attenuation bias, reducing the magnitude and the statistical significance of my estimates of Craigslist's effect on waste.

Other online platforms may also have increased the utilization of goods and reduced waste. I control for these possible effects using county-level data on the percentage of people with home internet access. Following Rapson and Schiraldi, I collect county-level internet penetration data from the Current Population Survey (CPS). The CPS asked respondents whether they had internet in their homes in October 1997, August 2000, September 2001, October 2003, October 2007, October 2009, October 2010, July 2011, and October 2012. County-level internet penetration data is available for 60 counties for an average of 7.65 years. Most of the variation in internet penetration occurs over time, rather than across counties, and I use the raw data to estimate internet penetration rates for missing county-years. I do so in two steps. First, I linearly interpolate internet penetration data for counties with original data, which provides me with 775 observations and may also mitigate any measurement error in the CPS data. Second, I impute internet penetration rates for all missing observations using predictive mean matching. County-year observations are matched with similar county-year observations based on their year, state,

[4] I exclude the Reno/Tahoe list from my analysis, because it overwhelmingly serves Reno, Nevada.

population, population density, employment, and wages. Table 3.2 presents the original CPS internet penetration data for 459 county-years as well as my imputed internet penetration data for the 2,275 county-years.

Economic variables may also have a significant impact on solid waste generation. The housing boom and the Great Recession may explain part of the trend in California and Florida's daily per capita waste. In my analysis, year fixed affects will control for general economic trends, but these events affected some counties more than others. I use data from the Quarterly Census of Employment and Wages (QCEW) to control for total wages and employment. I also include data on wages and employment in the construction industry, which is an important source of solid waste. Table 3.2 presents descriptive statistics for total wages per capita and construction wages per capita.

I use standard two-way fixed effects models to estimate the impact of Craigslist on daily per capita waste in California. My specification simply exploits variation in whether and when Craigslist entered each county.

$$W_{c,t} = \alpha CL_{c,t} + \delta X_{c,t} + \eta_c + \lambda_t + \varepsilon_{c,t} \quad (1)$$

This equation estimates the impact of Craigslist, *CL*, on daily per capita waste, *W*, while controlling for other variables, *X*, county fixed effects, η_c, and year fixed effects, λ_t. $CL_{c,t}$ takes on a value of 1 if Craigslist was available in county, *c*, for the entire year, *t*. This specification estimates the average effect of Craigslist on waste in all counties it entered. I present my results in the following section.

3.4 Results

Between 1995 and 2013, solid waste generation declined in counties that Craigslist entered relative to those that it did not enter. Figure 3.2 illustrates the trends in mean daily per

capita waste using population weights for counties in California and Florida that did and did not get Craigslist between 1996 and 2009. According to my data, per capita waste peaked in 2005 and has declined substantially since then.

On average, counties that Craigslist entered over this period generated more waste per person than counties that did not get Craigslist, but they also achieved larger waste reductions over this period. Indeed, daily per capita waste declined by over half a pound in counties that got Craigslist relative to those that did not get Craigslist between 1995 and 2013. Figure 3.3 shows that this relative reduction in waste occurred as the fraction of residents living in counties with Craigslist grew. My regression analysis tests whether Craigslist is responsible for all or part of the relative decline in waste illustrated in Figure 3.3.

My econometric results are shown in Table 3.3. All regressions include year and county fixed effects. Column (2) adds controls for wages and column (3) adds controls for employment. Of my four economic variables, only total wages and total jobs are consistent and statistically significant determinants of waste, although they have opposite effects. In column (4), I control for log population density and imputed internet penetration, neither of which is a statistically significant determinant of waste.

The estimated coefficients in all four regressions are large, and they suggest that Craigslist reduced daily per capita waste about one-third of a pound. Although the point estimates imply that Craigslist is responsible for about half of the relative decline in waste illustrated in Figure 3.3, they are not very precise. Nevertheless, my estimates of Craigslist impact on waste are statistically significant at the 5% level in regressions (1), (2), and (3) and they are statistically significant at the 10% level in regression (4).

In addition to choosing control variables based on economic intuition, I follow Belloni, Chernozhukov and Hansen's (2014) data-driven procedure to select the best control variables from a set that includes all my variables from Table 3.3 as well as log population, county linear trends, and dummy variables for each county-year observation. This double-selection LASSO

method selects different control variables from those I intuitively chose, but it generates a very similar estimate of Craigslist's impact on waste. In column (5) of Table 3.3 I show my post-LASS0 regression produces a point estimate of -0.35 and a t-statistic of -1.81. Again this suggests that my estimates of Craigslist's impact on waste do not depend heavily on my selection of control variables in Specification (1).

I also subject my point estimate in column (4) of Table 3.3 to a simple placebo test. First I purge the waste data of the platform's effect on waste, adding 0.35 pounds to daily per capita waste in county-years with Craigslist. Then, instead of using information about when Craigslist actually launched lists in 78 counties, I randomly select 78 of my 124 to be treated with a placebo on a year uniformly distributed between 1996 and 2009. I create 10,000 such placebo treatments. Finally, I estimate the effect of each of these placebo treatments on waste. Figure 3.4 illustrates the distribution of my estimates of the placebo effect, which fit a normal distribution centered on 0. My actual point estimate from Table 3.3 is represented by the dotted line. Only 193 (or 1.9%) of my placebo treatments are expected to reduce waste by as much as my estimate of Craigslist's actual effect. This exercise suggests that my results are unlikely to be generated by chance, and it provides additional support for my finding that Craigslist's impact is both large and statistically significant.

3.5 Robustness

In this section, I test the robustness of my estimates. First, I consider other explanations for why Craigslist may be correlated with waste reductions. Specifically, I test whether my estimates could be driven by changes in recycling or other county-level policies to reduce waste generation. Second, I conduct a double-selection post-LASSO estimation technique to choose the

most important control variables. Third, I investigate the timing of Craigslist's effect on waste to test whether it is consistent with my claim that Craigslist led to reductions in waste.

3.5.1 Other explanations for waste reduction

Between 1995 and 2013, other factors may have led to changes in counties' waste disposal. For example, some counties may have more vigorously pursued strategies to reduce waste, such as increasing recycling rates, establishing composting programs, or regulating construction and demolition waste. It is also possible that one or more of these factors is correlated with Craigslist's entry. I test these possibilities in two ways. First, I use Florida's data on pre-recycling waste generation. If my estimates in Table 3.3 are driven partly by changes in recycling, then Craigslist should have a smaller impact on pre-recycling waste than post-recycling waste. Second, I test my specifications by allowing for linear county-specific trends in waste. In these regressions, I allow for the possibility that – for whatever reason – some counties made faster progress than others in waste reduction.

Table 3.4 compares my main result with an estimate using pre-recycling waste and another allowing for county-specific trends. Column (2) suggests that Craigslist probably generated larger reductions in pre-recycling waste than post-recycling waste. My point estimate implies that the platform reduced pre-recycling waste by 0.61 pounds per person per day, though the effect of Craigslist is not statistically significant. It does not appear that different trends in recycling rates in treated and untreated counties are driving my results. At least Florida, accounting for county-level changes in recycling would increase my estimate of Craigslist's effect on waste.

Column (3) presents my results when I include county-specific linear trends in my baseline specification and estimate the following equation:

$$W_{c,t} = \alpha CL_{c,t} + \delta X_{c,t} + \eta_c + \lambda_t + t\times\eta_c + \varepsilon_{c,t} \quad (2)$$

Specification (2) estimates the impact of Craigslist on waste, controlling for other variables, *X*, county and year fixed effects, η_c and λ_t, as well as county-specific linear trends, $t\times\eta_c$. My estimates suggest that the online marketplace diverted a large amount of waste from landfills, and the effect remains statistically significant at the 10% level. This further suggests that Craigslist reduced waste in counties it entered, and that it did not merely enter counties that made greater progress towards waste reduction between 1995 and 2013.

3.5.2 Timing

My interpretation of my estimates in Table 3.3 is that Craigslist caused a decrease in waste disposal, probably by making it easier for people to sell items they would otherwise discard. In this section I interrogate this claim by examining the timing of Craigslist's supposed effect. If my story is correct, then the effect should not precede the platform's entry. Moreover, the impact of Craigslist should probably grow over time, as more people adopt the platform, enabling it to better match secondhand goods with new owners.

To examine the timing of Craigslist's effect, I create indicator variables for the two years leading up to Craigslist's entry, the first two years with Craigslist, and years three and on with Craigslist. I interact each of these variables with internet density and estimate the following model:

$$W_{c,t} = \sum_{k=-1}^{1} \alpha CL_{c,t+k} + \beta X_{c,t} + \eta_c + \lambda_t + \varepsilon_{c,t} \quad (3)$$

Specification (3) estimates the effect of Craigslist over time, after controlling for other variables, *X*, and county and year fixed effects, η_c and λ_t. I estimate this model for those counties that are

not observed at least three years before Craigslist's entry, which excludes data from the San Francisco Bay Area.

Table 3.5 presents my results for Specification (3). I find little evidence of reductions in waste prior to Craigslist's entry. Recall that I do not consider a county treated unless it is available in a county for the entire year, so the average county is actually treated for about a quarter of the period "two years before CL". More importantly, this regression suggests that the platform's effect increases over time. Indeed, this analysis suggests that, on average, Craigslist reduced daily per capita waste by about half a pound in years three and on, an effect that is statistically significant at the 10% level.

My results from Specification (1) appear to be robust. Craigslist seems to reduce pre-recycling waste as much as post-recycling waste and the platform's effect on post-recycling waste is robust to the inclusion of county-specific trends. Finally, the timing of the effect suggests Craigslist is responsible for the decline in waste.

3.6 Plausibility

This paper finds statistically significant evidence that Craigslist reduced solid waste generation as it expanded in California and Florida. The point estimates from my preferred specification suggest that in California and Florida Craigslist reduced daily per capita waste by about 0.35 pounds in 2013 or 5.6 percent relative to 1995 levels. However, my estimates are not very precise, and the 95% confidence interval suggests that Craigslist may have reduced waste by 0.72 pounds or increased it by 0.01 pounds.

To gauge the plausibility of my estimates, I examine the number and type of secondhand items posted for sale on Craigslist. My analysis suggests that Californians and Floridians created roughly 140 million posts in the for-sale section of Craigslist in 2014. For Craigslist to reduce

waste by as much as my point estimate, each post would need to divert 53 pounds from the solid waste stream. Similarly, my 95% confidence intervals imply that each post reduced waste by 108 pounds or increased waste by 2 pounds.

I test the plausibility of this analysis by analyzing a proportional stratified random sample of 1,000 items posted on Craigslist's 28 websites in California. All posts in the for-sale section of Craigslist are listed within one of 39 categories, the largest of which are furniture, cars & trucks, auto parts, electronics, and appliances. However, not all these posts represent attempts by owners or dealers to sell (or give away) secondhand goods. In my sample of 1,000 posts, 71 posts advertise new goods sold in bulk by businesses. Another 131 posts are advertisements for large inventories, services, wanted items, businesses, property, or garage sales. Finally, there are 10 posts for pets, plants, or organic goods that are not exactly secondhand goods. Still, most of the posts in my sample – 788 out of 1,000 posts – are advertisements for specific secondhand goods that Craigslist may divert from the solid waste stream. Table 3.6 shows the largest categories of goods within Craigslist's for-sale section, as well as the percent of posts within each category that I classify as advertisements for secondhand goods.

The next step is to calculate the weight of the secondhand goods in my sample. This is a difficult and time-consuming process. Few advertisements state how much items weigh. Some specify the model of the good, which allows me to find its exact weight online. I estimate the weight of most goods based on descriptions, pictures, and the weight of similar items. Some posts advertise multiple goods, such as a stroller and a car seat posted together in "baby & kid stuff" category. In these cases, I sum the weights and prices of all items within the post. (Recall, however, that I assign no weight to items being sold in garage sales.) Although my estimates are approximate, they provide clear evidence on the relative weights of posts in different category of Craigslist. For example, cars and trucks weigh tend to weight twenty times as much as furniture and appliances, which weigh ten times as much as clothing and computers, which weigh over ten times as much as cell phones and jewelry. As a result, the mean weight of secondhand goods on

Craigslist depends largely on the proportion of posts within each of these categories, rather than the exact weight of goods within each category.

Table 3.7 lists the mean asking price and the mean weight of secondhand goods advertised within each category of Craigslist. For the sample as a whole, the mean weight is 717 pounds. In other words, my sample of 1,000 for-sale posts includes 788 ads for 282 tons of secondhand goods. Clearly, not all of the items would enter the solid waste stream in the absence of Craigslist. Consider the posts in the "cars & trucks" category, which comprise 14 percent of all posts for secondhand goods, and which weigh much more than most secondhand goods. Before Craigslist, the used car market depended largely on classified ads in newspapers, and the transaction costs in this market were significantly higher than they are today. However, transaction costs were probably not so high that used vehicles were regularly salvaged rather than sold. Rapson and

Schiraldi (2013) do find that rising internet access substantially increased used vehicle sales in California, but more efficient used car markets did not necessarily increase the lifetime utilization of vehicles or reduce the flow of automobile waste. Even if Craigslist did reduce on the disposal of vehicles, the average car and truck posted certainly did not reduce waste by 3,737 pounds. Similar arguments can be made for goods in other high-value categories.

For my plausibility analysis, I assume that the Craigslist had *no* impact on the disposal of secondhand goods in the following six categories: Cars & trucks; Motorcycles/scooters; Heavy equipment; RVs; ATVs, UTVs, & snowmobiles; and Boats. In my sample of 1,000 posts, 629 are secondhand goods in the remaining categories and weigh a total of approximately 56,000 pounds. Not all items posted for-sale on Craigslist find a buyer. Willer *et al.* (2012) conduct an online survey of Craigslist users, which suggests that 69 percent of posts are successful (Willer *et al.* 2012, Table 1). Also, not all secondhand goods exchanged on Craigslist would otherwise have ended up in a landfill. Craigslist has probably crowded out traditional methods of redistributing secondhand goods, such as thrift stores and garage sales, in the same way it

crowded out CalMAX, the materials exchange catalog and online platform established by the state of California. Assuming that 50 percent of Craigslist transactions crowd out other methods for reallocating secondhand goods, the average post in the for-sale section of Craigslist reduces waste by 19 pounds. If the actual rate of crowding is 90 percent, then the average for-sale post reduces waste by 4 pounds; if it is 10 percent, then the average post reduces waste by 35 pounds.

My analysis of 1,000 random Craigslist posts suggests that the average post in the for-sale section could reasonably reduce waste by 19 pounds. Given the number of posts in California and Florida, Craigslist's secondhand market could have reduced daily per capita waste by about 0.10 pounds in 2013 – less than my point estimate but well within my confidence intervals.

I see two potential reasons for why my point estimates suggest Craigslist had a larger effect on waste than can be justified by the number and type of for-sale posts. First, my plausibility analysis is built on the conservative assumption that the platform had no impact on the disposal of the heaviest categories of goods, and even small effects in these categories could lead to much larger waste reductions. Second, my analysis ignores how other sections of Craigslist might impact solid waste. Kroft and Pope (2014) find that Craigslist increased the utilization of rental housing by about 1 percent between 2005 and 2007. If they are correct, the platform may have also reduced demand for new housing and prevented the associated construction and demolition waste. However, an examination of all the channels through which Craigslist could affect waste generation is beyond the scope of this paper. Posts for secondhand goods in the for-sale section of Craigslist could have plausibly reduced waste by a magnitude consistent with my results.

3.7 Conclusion

The expansion of Craigslist in California and Florida provides some early evidence that its market for secondhand goods diverted a significant amount of solid waste from landfills. These results are fairly robust to the inclusion of county trends in waste, and the timing of Craigslist's effect is consistent with my claim that the platform caused the reduction in waste. A plausibility analysis suggests that Craigslist's for-sale posts could be responsible for waste reductions within the confidence intervals of my estimates.

My results are consistent with other recent research, including Kroft and Pope's (2014) finding that Craigslist decreased apartment vacancy rates, and Rapson and Schiraldi's (2013) report that online markets increased used vehicle sales. However, this paper is unique in its attempt to directly estimate the environmental benefit of online markets for secondhand goods. My results suggest that Craigslist diverted hundreds of thousands of tons from the solid waste streams, saving the states hundreds of millions of dollars in waste collection and disposal costs. The environmental benefits of preventing the disposal of functional durable goods may be even larger in magnitude.

Craigslist may have mitigated waste generation by the same magnitude as California's glass bottle recycling programs without any public support or planning. By making it easier for people to buy and sell used goods the online platform improved the matching of people with secondhand goods. The success of Craigslist in changing the way people consume durable goods illustrates the power of online platforms to improve wellbeing while protecting environmental resources. This does not delegitimize waste reduction strategies that require government action. On the contrary, it is possible that platforms like Craigslist would facilitate more transactions and divert more waste if they operated in conjunction with public campaigns to encourage people to buy and sell secondhand goods, similar to public campaigns to promote recycling.

There are many avenues for further research into the environmental benefits of online markets. Economists could build on the model developed by Thomas (2003) to improve our understanding of the relationship between transaction costs, material throughput, and waste. As Thomas's model highlights, the ability to easily resell a durable good decreases the effective cost of purchasing it new. However, her model does not include a budget constrain, so it does not address how people allocate their savings from participating in the secondhand market (as both buyers and sellers) towards new goods, services, or leisure. More complete models may allow us predict the economic and environmental consequences of more efficient secondhand markets as well as new rental markets for durable goods.

This paper warrants further empirical research on the relationship between online platforms and waste. High-quality waste data is in short supply, but it may be possible to apply my methodology to some other states. Historical data describing Craigslist's market for secondhand goods is sparse, but researchers could begin to collect information about online markets for used goods in the same way they collect data about the online market for jobs.

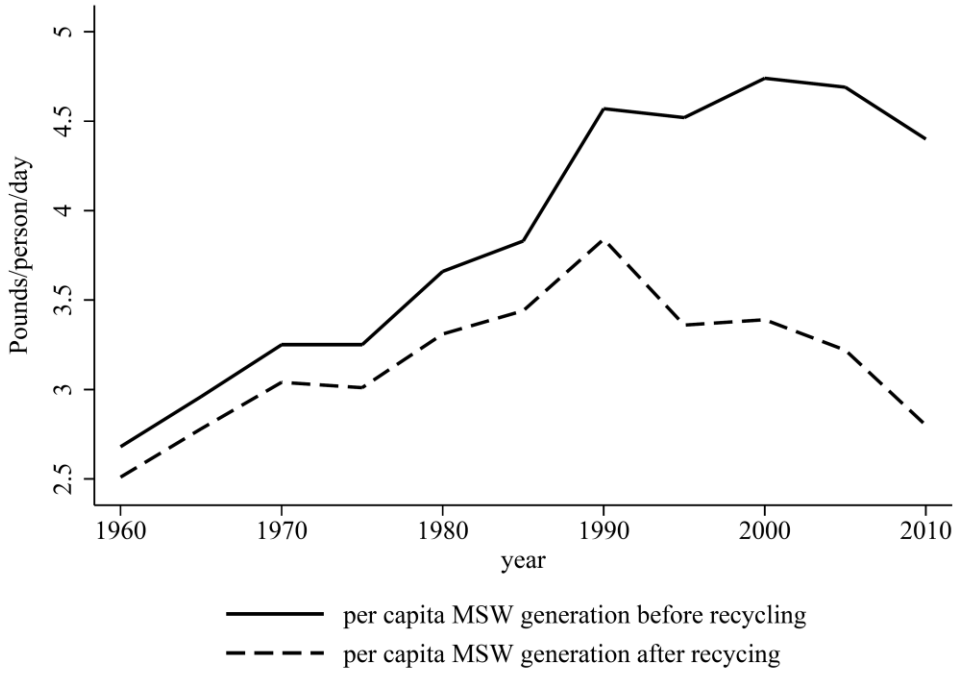
Another avenue for studying Craigslist may be to survey users who post items for sale. An online survey could collect information on whether, when, and at what price a particular item was sold. Respondents could also report what they would have done with the item they posted if it had not sold on Craigslist. Researchers might also study secondhand markets by focusing on their impact on markets for new goods. If my results are correct, then it seems possible that Craigslist reduced demand for some categories of new goods, such as furniture.

I hope that this paper encourages environmentalists, policymakers, and social entrepreneurs to think more about how we can harness the internet to increase the use and reuse of durable goods. Craigslist's success should provide some inspiration to the founders and users of smaller online platforms for sharing goods. A decade ago, most Americans did not expect that they would be regularly using an anonymous website to find jobs, housing, and secondhand goods, but today most Americans do. In another ten years, Americans may be using an array of

platforms that allow us substantially increase the utilization of consumer durables – from lodging and vehicles to tools and gear. My analysis of Craigslist provides some reason to think that these online platforms may simultaneously raise living standards and mitigate environmental burdens.

3.8 Tables and figures

Figure 3.1: Trends in per capita solid waste generation in the United States



Notes: The Environmental Protection Agency (EPA) regularly estimates per capita municipal solid waste (MSW) generation. This data comes from the EPA (2012) Figures ES-1 and ES-2. The EPA's definition of MSW, 'otherwise known as trash or garbage', includes product packaging, grass clippings, furniture, clothing, bottles, food waste, newspapers, appliances, and batteries, but not construction and demolition materials, municipal treatment sludges, or non-hazardous industrial wastes (EPA 2012, 4).

Table 3.1: Craigslist's expansion in California and Florida

Yr. entry	Craigslist	Counties served	State
1996	SF Bay Area	Alameda, Contra Costa, Marin, San Francisco, San Mateo, Santa Clara	CA
2000	Los Angeles	Los Angeles	CA
2000	San Diego	San Diego	CA
2000	Sacramento	Sacramento, Yolo	CA
2002	South Florida	Broward, Miami-Dade, Palm Beach	FL
2003	Tampa Bay Area	Hernando, Hillsborough, Pasco, Pinellas	FL
2004	Fresno	Fresno, Madera	CA
2004	Orlando	Lake, Orange, Osceola, Seminole	FL
2004	Santa Barbara	Santa Barbara	CA
2005	Bakersfield	Kern	CA
2005	Jacksonville	Baker, Clay, Duval, Nassau, St. Johns	FL
2005	Stockton	San Joaquin	CA
2005	Modesto	Stanislaus	CA
2005	Chico	Butte	CA
2005	Ft. Myers / SW Florida	Lee	FL
2005	Redding	Shasta	CA
2005	San Luis Obispo	San Luis Obispo	CA
2005	Tallahassee	Gadsden, Jefferson, Leon, Wakulla	FL
2005	Pensacola	Escambia, Santa Rosa	FL
2006	Gainesville	Alachua, Gilchrist	FL
2006	Panama City	Bay, Gulf	FL
2006	Ventura	Ventura	CA
2006	Treasure Coast	Martin, St. Lucie	FL
2006	Daytona Beach	Flagler, Volusia	FL
2006	Merced	Merced	CA
2006	Sarasota-Bradenton	Manatee, Sarasota	FL
2006	Ocala	Marion	FL
2006	Gold Country	Amador, Calaveras, Tuolumne	CA
2006	Inland Empire	Riverside, San Bernardino	CA
2006	Orange County	Orange	CA
2006	Visalia-Tulare	Tulare	CA
2006	Space Coast	Brevard	FL
2006	Lakeland	Polk	FL
2008	Imperial County	Imperial	CA
2008	Mendocino County	Mendocino	CA
2008	Monterey Bay	Monterey	CA
2008	Yuba-Sutter	Yuba	CA
2008	SF Bay Area	Santa Cruz	CA
2008	Florida Keys	Monroe	FL
2009	Hanford-Corcoran	Kings	CA
2009	Humboldt County	Humboldt	CA
2009	Siskiyou County	Siskiyou	CA
2009	Susanville	Lassen	CA
2009	North Central FL	Columbia	FL
2009	Okaloosa / Walton	Okaloosa, Walton	FL
2009	Heartland Florida	Highlands	FL

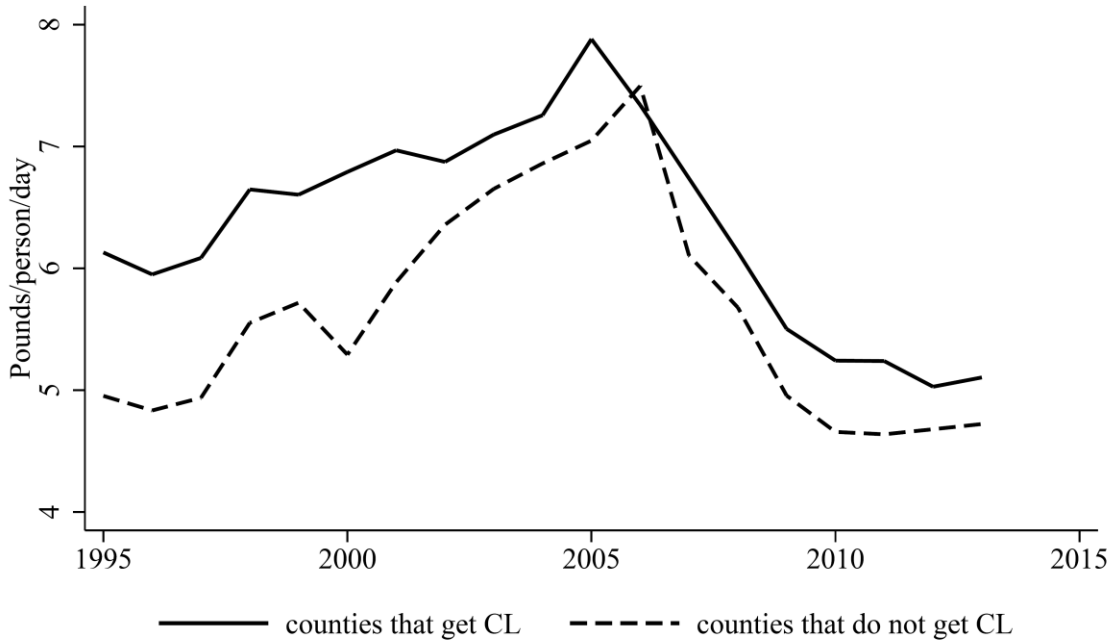
Source: Craigslist https://www.craigslist.org/about/expansion

Table 3.2: Descriptive statistics for key variables

Variable		Mean	Std. Dev.	Min	Max	Observations
Daily waste, post recycling in pounds/person/day	overall	5.64	2.78	0.20	65.89	N = 2356
	between		2.02	1.94	15.13	n = 124
	within		1.92	-6.78	56.39	T = 19
Daily waste, pre recycling in pounds/person/day (Florida only)	overall	7.56	4.04	1.12	72.58	N = 1139
	between		3.07	2.25	19.62	n = 67
	within		2.65	-7.13	60.52	T = 17
Internet penetration (raw)	overall	0.64	0.21	0.00	0.99	N = 459
	between		0.09	0.38	0.82	n = 60
	within		0.19	0.03	0.97	T = 7.65
Int. pen. (imputed)	overall	0.56	0.24	0.00	0.99	N = 2275
	between		0.06	0.35	0.72	n = 124
	within		0.23	-0.05	1.03	T-bar = 18.3
Log population density	overall	4.69	1.69	0.40	9.78	N = 2356
	between		1.69	0.48	9.72	n = 124
	within		0.10	4.10	5.15	T = 19
Log internet density	overall	2.71	1.60	0.00	8.99	N = 2275
	between		1.10	0.27	6.07	n = 124
	within		1.18	-2.09	5.63	T-bar = 18.3
Total wages per capita	overall	2,786	1,636	548	15,798	N = 2356
	between		1,534	805	11,343	n = 124
	within		582	-1,461	7,345	T = 19
Con. wages per capita	overall	166	108	8	811	N = 2275
	between		90	21	424	n = 124
	within		60	-58	553	T-bar = 18.3
Total jobs per 1000 pop.	overall	336	108	97	981	N = 2356
	between		105	115	720	n = 124
	within		26	96	597	T = 19
Con. jobs per 1000 pop.	overall	19	10	2	75	N = 2275
	between		8	4	45	n = 124
	within		5	-5	59	T-bar = 18.3

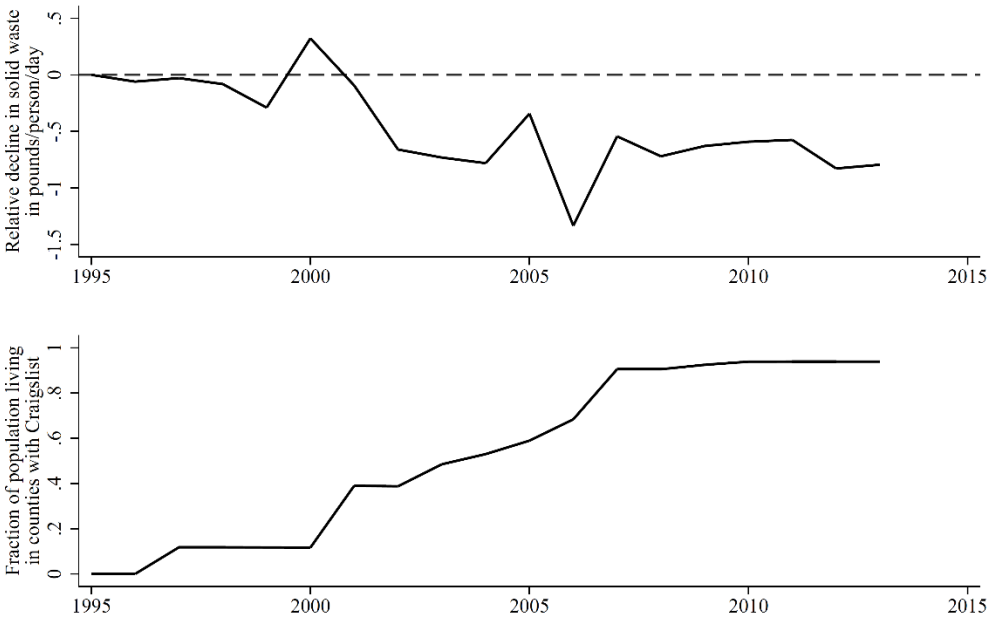
Notes: This table lists unweighted means and standard deviations for key variables. Some data are available for limited county-quarters. Waste data is from California's eDRS and Florida's Annual Waste Reports, internet data is from the CPS, and employment and wage data are from the QCEW.

Figure 3.2: Relative decline in post-recycling solid waste
in CA and FL counties that get Craigslist



Notes: Data for California comes from the state's electronic Disposal Reporting System (eDRS). Data for Florida comes from the state's Solid Waste Annual Reports. All Florida data is from Table 2A except for the years 1995 and 2000. For these years I use the historical data in Table 1B from the 2001 Annual Report.

Figure 3.3: Relative decline in waste and the expansion of Craigslist in CA and FL



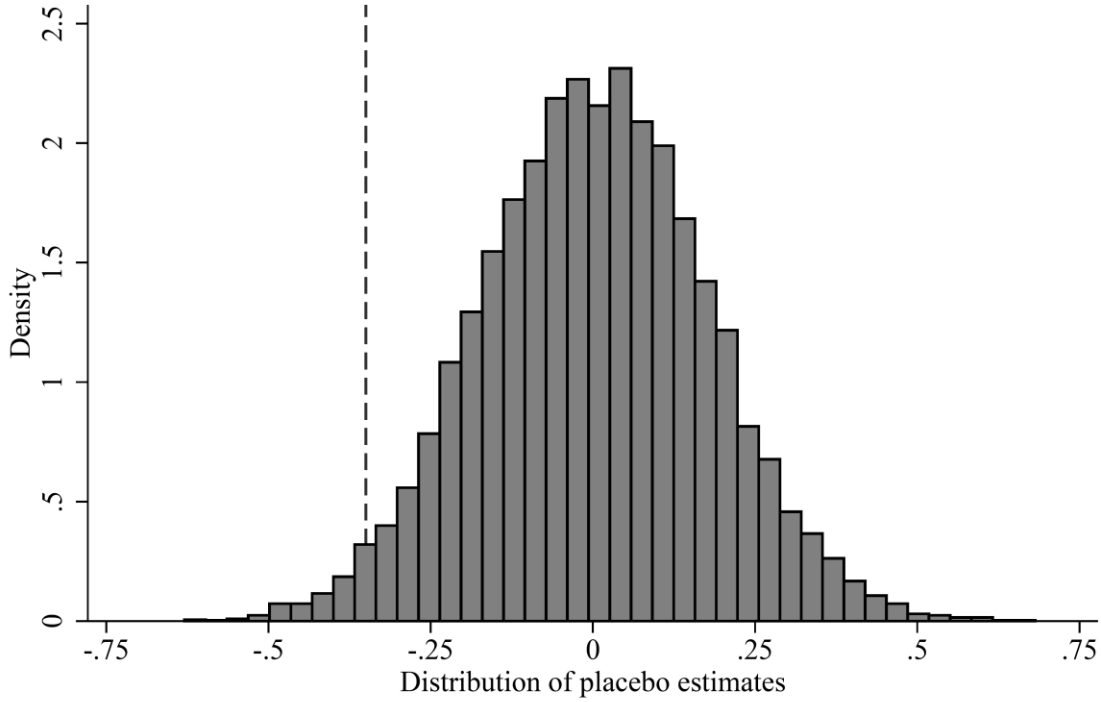
Note: Top panel shows relative deline in waste in counties with Craigslist from Figure 2.2. Bottom panel shows the percentage of Californians and Floridians living in counties with Craigslist over time.

Table 3.3: Effect of Craigslist on daily per capita waste

	(1)	(2)	(3)	(4)	(5)
Craigslist	-0.568***	-0.374**	-0.362**	-0.356*	-0.350*
	(0.215)	(0.176)	(0.178)	(0.186)	(0.194)
Con. wages per capita		0.00546***	0.00395	0.00415	.
		(0.00154)	(0.00269)	(0.00262)	.
Total wages per capita		-0.000417***	-0.000475***	-0.000494***	.
		(0.000102)	(0.000101)	(9.62e-05)	.
Con. jobs per 1000 pop			0.00548	0.00239	.
			(0.0250)	(0.0244)	.
Total jobs per 1000 pop			0.00691**	0.00693**	.
			(0.00305)	(0.00299)	.
Log population density				-0.210	.
				(0.690)	.
Imputed Internet penetration				0.519	.
				(0.381)	.
Years used	All	All	All	All	All
Year fixed effects	Y	Y	Y	Y	Y
County fixed effects	Y	Y	Y	Y	Y
Observations	2,356	2,275	2,275	2,275	2,275
R-squared	0.598	0.676	0.678	0.678	0.675

Notes: OLS regressions of daily per capita waste on Craigslist and control variables. Columns (2) through (4) report estimates of intuitive control variables. Column (5) reports double-selection post-LASSO estimates. This procedure chose a set of control variables from my intuitive controls as well as ln(population), ln(pop density)*internet penetration, 124 county-specific linear trends, and 2,275 observation dummies. County-cluster-robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 3.4: Placebo tests



Note: This histogram shows the distribution of estimates from 10,000 placebo tests in which 78 of 12 counties are randomly treated between 1996 and 2009. My actual point estimate of Craigslist's effect on waste is shown by the dashed line.

Table 3.4: Robustness of Craigslist's impact on waste			
	Post-recycling waste	Pre-recycling waste	Post-recycling waste
	(1)	(2)	(3)
Craigslist	-0.356*	-0.614	-0.397*
	(0.186)	(0.402)	(0.229)
Con. wages per capita	0.00415	0.0104*	0.00604
	(0.00262)	(0.00547)	(0.00369)
Total wages per capita	-0.000494***	-0.000472	8.66e-06
	(9.62e-05)	(0.000595)	(0.000192)
Con. jobs per 1000 pop	0.00239	-0.0658	-0.0141
	(0.0244)	(0.0460)	(0.0369)
Total jobs per 1000 pop	0.00693**	0.00729	-8.47e-05
	(0.00299)	(0.00572)	(0.00411)
Log population density	-0.210	-1.043	3.852
	(0.690)	(1.119)	(3.828)
Imputed Internet penetration	0.519	0.427	0.367
	(0.381)	(0.943)	(0.387)
Year fixed effects	Y	Y	Y
County fixed effects	Y	Y	Y
County linear trends	N	N	Y
Data used	All	Florida	All
Observations	2,275	1,097	2,275
R-squared	0.678	0.695	0.714
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1			

Table 3.5: Timing Craigslist's effect on waste	
	(1)
Two years before CL	-0.0709
	(0.236)
First two years with CL	-0.336
	(0.230)
Years three and on with CL	-0.508*
	(0.258)
Controls	Y
Quarter fixed effects	Y
County fixed effects	Y
Observations	2,142
R-squared	0.679

Notes: These OLS regressions excludes counties that are not observed at least 3 years prior to Craigslist's entry. Control variables are total wages and employment, construction wages and employment, population density, and internet penetration. County-cluster-robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: For-sale posts on Craigslist in California

CL for-sale categories	**Percent of all for-sale posts**	**Percent of posts in category advertising secondhand goods**
Furniture	14%	65%
Cars & trucks	11%	98%
Auto parts	9%	85%
Electronics	6%	88%
General	5%	79%
Appliances	5%	76%
Baby & kid stuff	4%	95%
Sporting goods	4%	76%
Computers	4%	69%
Household items	3%	82%
Clothing & accessories	3%	93%
Other	34%	74%

Note: Based on author's proportionate stratified random sample of 1,000 postings across 28 lists in California.

Table 3.7: Secondhand goods posted for sale on Craigslist in CA

Category	Percent of all posts for secondhand goods	Mean asking price	St. dev. asking price	Mean weight (in lbs.)	St. dev. weight (in lbs.)
Cars & trucks	14.1%	$8,307	$9,005	3,737	1,105
Furniture	12.3%	$348	$1,052	155	211
Auto parts	9.5%	$327	$628	103	165
Electronics	7.4%	$248	$617	45	111
Baby & kid stuff	4.8%	$57	$83	71	322
Appliances	4.6%	$342	$540	173	116
Sporting goods	3.7%	$179	$207	77	193
General	3.6%	$574	$1,609	297	646
Clothing & accessories	3.3%	$88	$79	8	10
Tools	3.2%	$190	$483	57	110
Household items	3.0%	$77	$83	33	43
Computers	2.9%	$213	$301	10	9
Collectibles	2.7%	$156	$234	9	8
Musical instruments	2.4%	$427	$510	96	127
Motorcycles/scooters	2.0%	$4,579	$3,926	417	228
Bicycles	1.9%	$374	$564	38	15
Books & magazines	1.6%	$31	$32	7	7
Tickets	1.4%	$161	$123	0	0
Antiques	1.4%	$353	$610	55	65
Materials	1.3%	$354	$286	167	149
Cell phones	1.3%	$199	$153	1	0
Motorcycle parts & accs.	1.3%	$184	$297	21	30
Jewelry	1.3%	$258	$384	0	0
Video gaming	1.1%	$78	$54	7	5
Toys & games	1.1%	$229	$233	17	21
Farm & garden	1.0%	$454	$593	137	198
Arts & crafts	1.0%	$119	$197	16	10
Business/commercial	0.9%	$1,015	$2,062	173	225
Heavy equipment	0.9%	$9,093	$12,455	5,219	7,783
CDs/DVDs/VHS	0.8%	$49	$34	21	39
Photo/video	0.6%	$191	$234	16	18
RVs	0.5%	$6,617	$6,178	12,250	5,560
ATVs, UTVs, snowmobiles	0.4%	$708	$711	287	220
Boats	0.4%	$3,908	$5,248	523	846
Health & beauty	0.4%	$288	$443	108	166
All secondhand goods	**100.0%**	**$1,549**	**$4,597**	**717**	**1805**

Notes: Based on author's proportionate stratified random sample of 1,000 postings across 28 lists in California. These figures are for the 788 posts that I classify as secondhand goods.

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