NHH

Share the spare

Modelling consumer behaviour in the sharing economy

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Abstract

The sharing economy allows consumers to share spare goods and resources through online platforms, using technology to reduce the transaction costs and efficiently match supply with demand on a global scale. Reflecting a change in consumption patterns, the sharing economy is disrupting existing industries, steadily replacing ownership with access.

To explain observed consumer behaviour in the sharing economy, we develop an economic model that describes consumers' choice of providing and receiving access to underutilised goods. The model is applied to the market for ridesharing, where owners with empty seats are connected with passengers looking for a ride.

Modelling the purchase decision, we find that the number of consumers who purchase a car increases when 1) the price of sharing increases, 2) the price of owning decreases, 3) the owner's transaction cost decreases and 4) the passenger's transaction cost increases. On the supply side, the number of consumers offering a lift in their car to others increases when 1) the revenue generated from sharing increases, 2) the owner's transaction cost decreases and 3) the passenger's transaction cost increases. On the demand side, the number of consumers riding with others increases when 1) the price of sharing decreases, 2) the owner's transaction cost increases and 3) the passenger's transaction cost decreases.

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This thesis concludes my Master of Science in Economics at the Norwegian School of Economics. The model of consumer behaviour is based on knowledge I have attained through five years at NHH, and my own experience with collaborative consumption. I hope it sparks discussion, sharing of spare resources and a swarm of future research.

Being a passionate user of the sharing economy, I have long been eager to explore the phenomenon more closely. Thus, I was lucky to find a supervisor who shared my academic enthusiasm and inspired me to pursue my idea. First and foremost I would like to thank Lars Mathiesen for his support and insightful advices, encouraging me to go forth and model. Building a model has been a demanding, yet rewarding learning experience.

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Table of contents

1.   Introduction

Over the last decade, access has emerged as a viable substitute for ownership in many sectors of the economy. The rise of the sharing economy, in which consumers share excess assets, time and skills directly with each other, is enabled by digital platforms that reduce transaction costs and efficiently match supply with demand. Ensuring cost efficiency, the sharing economy generates a more efficient use of resources, which in turn entails extensive economic and environmental benefits. Involving deeper human interactions than regular market transactions, social sharing re-emerges the community, creating a culture of what is mine is yours. Or more precisely: what is mine is yours, for a fee.

To explain the consumer behaviour evolving with the rise of the sharing economy, we develop an economic model that describes the decisions to purchase and use shareable goods. Addressing the underlying mechanisms of consumer decision-making, the model seeks to answer the following research question: *How does peer-to-peer sharing influence consumer behaviour?* As opposed to prior research, our model considers both the supply and demand side of the sharing economy, providing theoretical explanations for consumers' choice of both providing and receiving access to underutilised goods and resources.

Considering the demand for shared goods, empirical evidence suggests that sharing may be preferred to ownership as it allows access to goods at lower cost. On the supply side, an owner has the opportunity to benefit if she can enjoy any positive utility from sharing goods that exhibit idle capacity. In correspondence with rational utility models, Benkler (2004) provides a transactional framework for understanding the decision to share goods with others. Following his work, we encompass the utility obtained from sharing in our model of consumer behaviour. The utility may have a monetary value, but can also take the form of social or psychological gains that arise through sharing. More recently, Müller (2014) develops a model explaining consumer decision-making in the context of online sharing systems. We employ an adapted version of his segmentation of consumers to the market for ridesharing, and modify the corresponding expressions for the net utility achieved from sharing. Based on the set of alternatives associated with the decisions to purchase and use a car, we divide the market into four consumers groups. Explaining the allocation of consumers to the various segments, the model may be used to make predictions on how behaviour is affected by a change in the costs related to ownership and sharing of private goods. As the number of consumers in each segment is given outside our model, we only observe the endogenous changes in consumer allocation,

and cannot predict the effect on aggregated demand. Providing a methodology applicable to other markets of shareable goods, the model fills a gap in the literature on the sharing economy and lays the groundwork for future empirical research.

Modelling the purchase decision, we assume that for given prices, a consumer will be indifferent between purchasing and not purchasing a car when the two options provide equal utility. The number of consumers who purchase a car increases when 1) the price of sharing increases, 2) the price of owning decreases, 3) the owner's transaction cost decreases and 4) the passenger's transaction cost increases. Given that a car is purchased, a consumer will be indifferent between riding alone and sharing the ride when the utility generated from both options is the same. On the supply side, the number of consumers offering a lift in their car to others increases when 1) the revenue generated from sharing increases, 2) the owner's transaction cost decreases and 3) the passenger's transaction cost increases. If not purchasing a car, a consumer will be indifferent between riding with others and using public transport if the utility generated from these alternatives is the same. Considering the demand side, the number of consumers riding with others increases when 1) the price of sharing decreases, 2) the owner's transaction cost increases and 3) the passenger's transaction cost decreases. By affecting consumption patterns, the sharing of spare resources has implications on consumer and producer surplus, and subsequently social welfare. Illustrating this disruption, our results are relevant for organisations in the sharing economy, established firms responding to peer-to-peer entrants and policy makers promoting sharing or regulating permeated sectors.

The remainder of this paper is structured as follows. First, a brief introduction to the sharing economy is provided in section two. Subsequently, section three gives an overview of the theoretical and empirical literature relevant to our research. In particular, we elaborate on the impacts of the sharing economy on existing industries and consumption patterns. Based on theoretical as well as empirical insight, we establish the model of consumer behaviour and apply it to the market for ridesharing in section four. Modelling both the purchase and usage decision of a car, we put a particular emphasis on the determinants of supply and demand in the sharing economy. On the demand side, sharing enables individuals to get access to a vehicle without purchasing a car through a traditional provider. On the supply side, consumers can provide access to spare seats in their car that would otherwise be unused. To increase the understanding of consumer behaviour, we assess the sensitivity of consumers' choice of strategy to a change in prices, in section five. In section six, we proceed by a broader discussion of results and applications of the model. Section seven contains some concluding remarks.

2.   The sharing economy

Even though sharing is one of the most elemental forms of economic distribution (Belk, 2010), the Internet is "redefining its scope, meaning and possibility", permitting decentralised sharing of goods and services (Botsman & Rogers, 2011). Social sharing platforms enable a nearly instantaneous synchronisation of borrowers and lenders, buyers and sellers – efficiently matching supply with demand on a global scale. Guests wanting accommodation may search for locals renting out extra space. Passengers who need to travel may connect with drivers who have available seats. Similarly, individuals may share clothes, meals, toys, tools and even pets online. Intangible assets such as time and skills may also be transferred through sharing.

Often referred to as collaborative consumption, a distinction is made between the "peer provider" who supplies access to shareable goods or services, and the "peer user" who demands access to the available goods and services (Botsman & Rogers, 2011). Bardhi and Eckhardt (2012) describe the phenomenon as "access-based consumption", indicating that consumers prefer access to ownership, valuing the option to pay for temporary access rather than buying and owning goods.

The rise of the sharing economy occurs as persistent environmental concerns and cost consciousness are creating a shift away from hyper individualistic consumer behaviour towards a revived belief in the importance of the community (Botsman & Rogers, 2011). Collaborative consumption challenges the traditional relationship between consumer and producer, disrupting the practice of keeping up with, or even outpacing, the Joneses. Online networks bring people together again to save time and money, be more environmental-friendly and create relations. Consumers strive for simplicity and seek for participation, both enabled by social sharing systems. At the same time, traceability and transparency have become increasingly important as consumers want to know what and from whom they are buying.

Studying a myriad of examples of sharing practices, Botsman and Rogers (2011) identify four fundamental principles of collaborative consumption: critical mass, idling capacity, belief in the commons and trust between strangers. First, critical mass describes the "existence of enough momentum in a system to make it become self-sustaining" (Botsman & Rogers, 2011). In order to be a relevant alternative to buying through a regular market, the selection of shared goods and services must be sufficient. As the number of consumers joining a sharing community increases, more goods are likely to be shared, thus people are more likely to find what they are

looking for. Critical mass further refers to the social influence that is required to change attitudes towards sharing.

The basic idea of idling capacity is simple. Why own a power drill you barely use, if you could save money and space by sharing it with your neighbours or borrowing it from a local sharing platform. By definition, goods that can be shared are underutilised (Fremstad, 2014). Through sharing platforms, consumers may increase the utilisation rate of their goods by redistributing the slack capacity. When joining a sharing community, a consumer is also creating value for other consumers, as the system works better when more users are joining. Sharing communities rely on this network effect, referred to as belief in the commons.

Lastly, trust between strangers is required as sharing platforms enable self-managed exchanges between peers without an intermediary that governs the transactions (Botsman & Rogers, 2011). To reinforce trust between loosely connected individuals, most sharing platforms operate with limited regulatory controls and provide feedback mechanisms to encourage collaborative behaviour (Fremstad, 2014). The evaluation of others' trustworthiness is particularly relevant when online transactions result in offline exchanges of goods or services, such as sharing your home or car with a stranger (Lauterbach, Truong, Shah & Adamic, 2009). Transparent systems for user history and ratings further provide an incentive for honesty and hospitality, as having a good reputation is likely to increase the possibility of being chosen as a host or driver by others in the future.

Over the next decade, peer-to-peer business models are predicted to overtake ownership as the primary way of consumption in some sectors, while remaining a niche in others (PwC, 2015). Primarily disrupting the transportation industry, we study the phenomenon ridesharing, in which car owners offer lifts in their car to other individuals. For the purpose of the analysis, it is important to distinguish between this form of sharing and carsharing, where companies or individuals rent out cars for shorter periods or distances. In a ridesharing platform, car owners post where they are going and how many seats they have available in their car. Owners may also specify the conditions for travelling, such as the size of luggage, tolerance for pets or smoking, or preference for music or silence. Individuals without a car search for drivers going in the same direction, offering a lift in their car. If a passenger requests a seat, and the owner agrees, the pair then arranges the time and place of the pick-up. The passenger pays the agreed contribution during the journey. After travelling together, both users are asked to leave a rating and comment for the other user, taking anonymity out of the transaction.

3.   Related literature

The model of consumer behaviour is built on theoretical literature on sharing and consumer behaviour as well as empirical research on the sharing economy. The related studies delineate the change in consumer choice that comes with the introduction of peer-to-peer sharing, affecting owners, borrowers and the community.

3.1   Theoretical literature

As defined by Belk (2007), sharing is "the act and process of distributing what is ours to others for their use and/or the act and process of receiving or taking something from others for our use." Benkler (2004) provides a more concise definition, regarding sharing as "nonreciprocal pro-social behaviour."

3.1.1   The decision to share

According to Benkler (2004), an individual will invest in ownership of an asset if the utility achieved over the lifetime of the asset is greater than the price of the asset over its lifetime. By comparing the utility with the cost of the unit, the decision is detached from the fact that an asset may produce more utility over its lifetime than the owner actually needs. Because consumers do not require or cannot use the entire capacity of their goods, many resources will usually exhibit slack capacity. As an example, Benkler classifies a single trip in a car as a rapidly decaying, underutilised asset, indicating that the empty seats in a car going from A to B are wasted unless others use the capacity. While secondary markets or management in general may solve excess capacity, a more appropriate way of reallocating empty seats would be through ridesharing, transferring excess capacity from owners to non-owners. Studying only the supply of shareable goods, the author disregards the fact that riding with others may give consumers more utility than owning a car. Thus, we extend the model to also include consumers who do not own a car but choose to ride with others.

Considering social sharing systems as transactional frameworks, the gain from sharing an asset is dependent on its utilisation over its entire lifetime, not just over any particular period (Fremstad, 2014). Thus, perfectly efficient sharing will eliminate the deadweight loss created by slack capacity (Benkler, 2004). This is consistent with the economic law of disintermediation, suggesting that peer-to-peer markets are more efficient as intermediaries are removed (Botsman & Rogers, 2011).

According to Benkler (2004), the decision to share involves a series of choices related to the inclusion and exclusion of other individuals. Ranging from no exclusion to perfect exclusion, an individual considering transferring her goods to others must assess the transaction and opportunity cost related to each alternative. While leaving the asset open to anyone's use entails the lowest transaction cost, this alternative is likely to include the highest opportunity cost, restricting the owner's own use of the asset. Perfect exclusion, on the other hand, involves the opportunity cost of partial exclusion. As shareable goods provide more capacity over its lifetime than the individual requires, the owner will benefit if she can earn any positive utility from transferring the capacity to others through sharing. The utility may be monetary measurable, but can also take the form of social or psychological gains, being altruistic and environmentally responsible. Permitting others to access your goods also involves transaction costs: the search and localisation of the goods, the arrangement of the sharing, picking up and dropping off the goods (Fremstad, 2014). Moreover, the cost of sharing entails social costs, such as the definition of social norms or monitoring and enforcement of the terms of social sharing (Benkler, 2004). As pointed out by Fremstad (2014), the social costs are highly dependent on the level of trust between the owner of an asset and the borrower.

The most elementary form of partial exclusion is nonselective, implying sharing on a first come, first served basis (Benkler, 2004). However, sharing may also be based on market or social selection, limiting the set of permitted users on the basis of market prices or social criteria, respectively. Comparing the various strategies, Benkler suggests that sharing will occur when the cost of exclusion is higher than the cost of permitting others to use the goods or resources they own. The condition indicates that the excess capacity of perfectly private goods that are more valuable than the cost of exclusion, will be transferred, and thus shared with others. Correspondingly, Fremstad (2014) argues that there are gains from sharing goods or resources when the benefit of the borrower exceeds the cost of the lender.

Transferring the framework to ridesharing, a car is only likely to be shared, if at all, on a partial exclusion basis, as nonexclusive sharing may lead to overuse and depletion. Sharing available seats on a nonselective basis, the primary perceived cost will be the personal security fear associated with picking up hitchhikers. Otherwise, comparing the costs of nonselective and selective partial exclusion is more inconclusive. While selectively admitting some users involve greater information costs, the monitoring and enforcement costs may be higher for nonselective sharing. Either way, the low utilisation rate of an average privately owned vehicle suggests that there are considerable economic gains from sharing (Fremstad, 2014).

14

3.1.2 The propensity to share

According to Belk (2010), an individual's willingness to share is strongly affected by the attachment to the asset, making people more reluctant to share if they possess a strong attachment to their belongings. Sharing may also be constrained as people seek to avoid interdependence. To account for this in our model, we assume that some car owners achieve a higher utility from sharing their car than others do. On the demand side, however, pragmatic economic motives suggest an increased propensity to share, as sharing may provide access to expensive goods at lower cost. In this way, collaborative consumption enables people to afford goods that they could not have afforded on their own.

Further, Fremstad (2014) argues that norms and preferences are important determinants of the level of sharing. Even though the transaction costs of sharing have been reduced, sticky norms and endogenous preferences may prevent people from participating in peer-to-peer sharing, leaving the potential gains from sharing unexploited. Over time, Fremstad argues that online networks will contribute to a substantial increase in sharing by providing structures for building trust between strangers, shifting preferences towards peer-to-peer transactions. The more adopters or peers, the larger is the individual utility derived from adoption of sharing (Rochelandet & Le Guel, 2005).

3.1.3 Consumer segmentation

Ghose et al. (2006) examine the degree of product cannibalisation on new-product sales for books when used-products markets are introduced. The insight from the secondary market is important as we observe the same tendencies for sharing platforms, both markets featuring a wider selection of available goods, lower search costs and lower prices compared to traditional first-hand markets. Conducting a theoretical analysis, the authors develop a model to study the implications of second-hand markets on consumer and producer welfare.

The existence of used-books markets makes it possible, but not mandatory, for consumers to buy new books and sell them later. As not all consumers may be aware of the presence of the secondary markets, or have the incentives to engage in these markets, not all consumers will chose the option of reselling their used books. To account for this characteristic, Ghose et al. distinguish between three types of buyers: consumers buying and reselling new goods, consumers only buying used goods and consumers who not buy anything.

Müller (2014), who in an ongoing study explores the economic implications of online sharing systems on social welfare, further expands this distinction. The author develops a theoretical model explaining consumer decision-making and usage behaviour in the context of online sharing systems, where the consumers are given the opportunity to either grant or gain access to infrequent-used goods or spaces. Based on the consumer segmentation of Ghose et al. (2006), Müller (2014) differentiates between four consumer groups: "(a) consumers that do not buy and do not share, (b) consumers that do not buy but share, (c) consumers that buy and share, and (d) consumers that buy but do not share an infrequent-use good or space."

Deriving expressions for the net utility for consumers who buy and share, and consumers who only share, Müller finds that the number of uses of infrequent-used goods or spaces increases for both consumer groups if the individual's monetary utility per use increases. Preliminary results further indicate that the number of private uses for consumers who buy and share will increase if the price of sharing decreases as a result of increase in the aggregate sharing supply. Oppositely, if the price of sharing increases, an owner is likely to increase the number of shares, causing a decrease in the number of private uses of the goods or spaces. For consumers who only share, the number of uses increases with a decrease in the price of sharing, and decreases with a price increase.

This paper shares methodological traits with the abovementioned study, although we also consider the implications on consumer behaviour of a price change in buying infrequent-use goods or spaces, overcoming a limitation in Müller's model. In order to provide a more precise description of the net utility for consumers who buy and share, we modify the model by adding operative costs of using infrequent-used goods to the net utility expressions.

In his research agenda, Müller presents three steps towards a deeper understanding of consumer behaviour and welfare effects in the sharing economy. Specifically, the author announces research on the various upper and lower bounds of the utility gained per use of infrequent-used goods or spaces, including the utility where consumers convert from one segment to another. Our model provides a method for deriving these indifference points and explaining the allocation of consumers to the different market segments.

16

3.2   Empirical literature

To accurately describe consumer behaviour and welfare in the sharing economy, a review of empirical literature on various forms of sharing has been conducted. These studies illustrate the power of the sharing economy to change behaviour, and emphasise the economic and decision-making implications of peer-to-peer sharing.

A recent stream of empirical work examines the adoption and impacts of sharing in the transportation sector. Disruptively changing the transportation landscape, carsharing systems enable members to drive cars on demand – by the hour or day. Having access to a car reduces the demand for private vehicles to complete a trip, providing both monetary and environmental benefits.

Considering carsharing's impact on household vehicle holdings, Martin et al. (2010) find that every shared vehicle in North America has replaced between 9 and 13 privately owned vehicles on the roads. The reduction in vehicles held by members is mainly driven by households with one car selling their car to attend carsharing. A large number of members join carsharing as their car reaches the age of discarding, suggesting that members postpone a planned purchase. However, if a household would consider buying a car in the second-hand market, the potential cost saving of carsharing decreases (Duncan, 2011). The cost competitiveness of carsharing further depends on driving habits such as frequency and average distance and duration of trips.

As the number of privately owned cars is reduced, a considerable decrease in the demand for parking (Engel-Yan & Passmore, 2013) and fuel consumption (Cervero, Golub & Nee, 2007) is observed among carsharing members. Public benefits are also generated through reduction in average travel distance and greenhouse gas emissions, as well as through increased average occupancy level. Being aware of the accumulative costs of driving, consumers seem to be more conscious in choosing when and where to drive when the car is shared.

Studying the carsharing service Bilkollektivet, Hald et al. (2011) find that the main reasons for joining carsharing are the hassle and fixed costs related to owning a car, and environmental concerns. Other studies highlight the lack of parking possibilities, low or moderate income or high costs related to purchase as factors increasing the probability of joining carsharing (Ruud & Ellis, 2008). Benkler (2004) recognises similar motivations for ridesharing, spanning from instrumental motives, such as taking advantage of carsharing lanes and reducing the costs of driving, to non-instrumental motives, such as having company and thinking green.

The propensity towards carsharing decreases as the weekly trip frequency and travel distance increase, and increases with augmented familiarity with the system (Luca & Pace, 2014). As consumption is rivalry, high demand by some individuals may prevent access to cars for others. Consumers' concern regarding vehicle supply meeting demand is thus an important determinant of sharing propensity, even when technical cost, various sources of utility, sharing knowledge and perceived degree of substitutability are accounted for (Lamberton & Rose, 2012).

A similar adaption pattern is observed in the market for travel accommodation. By lowering the barriers to entry for providers, the social sharing platform Airbnb enables individuals to profitably list their spare room or entire home, offering accommodation to other individuals. Estimating the impact of Airbnb on the hotel industry, Zervas et al. (2014) find that a one-percent increase in Airbnb listings in Texas is related to a 0.05 percent decrease in quarterly hotel revenues. The impacts range across the industry, with lower-end hotels and hotels not serving business travellers being most prone to competition. Observing the patterns of substitution, the authors suggest that Airbnb accommodation serves as a feasible, but imperfect, substitute for traditional hotel stays. As the impacts are unevenly distributed across the industry, stays in short-term apartments and home rentals are most likely to displace stays in lower-end hotels not catering to business travellers.

For the market to be efficient, accommodation services and other sharing systems rely on reciprocity between members (Lauterbach et al., 2009). If all users receive access, but not enough users are able or willing to give access to their goods and spaces, the systems could support far fewer transactions. Bearing this in mind, Lauterbach et al. (2009) study the frequency of direct reciprocity between travellers and hosts on the accommodation platform Couchsurfing. Their analysis reveals that 12 to 18 percent of the reported stays were directly reciprocated, demonstrating that meaningful relationships are created through sharing. In order to encourage reciprocity, sharing platforms like Couchsurfing provide reputation and rating systems where users may comment on other users' behaviour. As users know that their behaviour today influences the likelihood of future transactions, they are likely to behave well in order to protect their reputation (Botsman & Rogers, 2011).

In an ongoing study, Fremstad (2014) assesses the economic benefits of decentralised sharing, measured as the gap between the rental/asset price ratio of rental companies and the ratio consumers are willing to pay to borrow an asset of the same value. Using data from NeighborGoods, a platform for lending and borrowing goods among friends and neighbours, the author finds that the current value of peer-to-peer sharing is at least $179 a year for 30

percent of Americans and at least $774 a year for eight percent of Americans. Potential gains may be left unexploited, as people tend to forget checking the sharing networks' inventory when they need something, suggesting low awareness of online sharing systems. Respondents further thought there were too few users in their area. This is in line with the findings of Botsman and Rogers (2011), suggesting that building a critical mass is a prerequisite for peer-to-peer sharing.

However, if online platforms facilitate a higher degree of acceptancy towards decentralised sharing, Fremstad (2014) suggests that the average household would gain at least one thousand dollars a year from sharing. The author uses the current expenditures on shareable goods as an upper bound for the potential value of sharing, but ignores the social costs and benefits of sharing, making the estimate imperfect.

In order to address this gap, we include the social costs and benefits in the utility achieved from sharing in the following theoretical analysis. As argued in prior work (Zervas et al., 2014), studies on social welfare are demanded to fully understand the benefits of the sharing economy. Our work contributes to this by describing consumer preferences in the sharing economy, modelling consumers' choice of providing and receiving access to spare resources.

4.   Model of consumer behaviour

Based on the theoretical insight of Benkler (2004) and Müller (2014), we develop a model to explain consumer behaviour in the context of peer-to-peer sharing. The model considers sharing practices among loosely connected individuals, and seeks to explain sharing of private economic goods, initially owned by individuals for their own use. Considering private goods, consumption is rivalry - sharing an asset with one individual may prevent simultaneous consumption by other individuals.

To simplify the theoretical analysis, we apply the model to the market for ridesharing, where owners with empty seats are connected with passengers looking for a ride, through some form of sharing platform. Associated with car owners permitting other passengers to ride along in the same car to the same destination, this type of sharing is different from carsharing, in which a fleet of cars, owned by a community or a company, is made available to consumers through short-term rental. In the latter case, the consumer has the entire car at her disposal and may ride alone from A to B.

Addressing the gap between supply and demand for mobility, ridesharing provides a context to study behaviour in the sharing economy. Consistent with the theoretical model of Benkler (2004), a car is only likely to be shared on a partial exclusion basis. Through online sharing systems, car owners may offer a ride to other passengers, suggesting sharing based on both market and social selection. Correspondingly, consumers who need to travel but do not have a car can find a trusted driver. These options, to give or get a ride, describe the meaning of sharing in the ridesharing context, and define the frames of consumer behaviour in the sharing economy.

Through online sharing systems, consumers who did not own a car initially may now improve their mobility without needing to purchase a vehicle. Consistent with empirical research (Cervero et al., 2007; Martin et al., 2010), consumers who used to own a car might trade their cars in for a ridesharing membership, suggesting a decrease in demand for privately owned vehicles. In accordance with Benkler (2004), the more efficient the sharing market, the less incentive there will be for the marginal consumer to purchase a new vehicle, because she will be able to obtain functionality from sharing. For others, the opportunity to share may be the deciding factor for buying a car, indicating that the opportunity to share affects both the purchase and usage decision.

Enabling generalised reciprocity, online sharing systems allow users to either provide or obtain access to a car. Accordingly, individual A may offer a ride to individual B, but B does not need to reciprocate directly by offering a ride to A. If owning a car, individual B may give rides to other members of the sharing system or choose not to share her car with others. Otherwise, B may decide only to ride with others or not to ride at all. Thus, given the nature of ridesharing systems, the following four consumer segments[1] can be identified:

1. Consumers who own a car but do not share the ride with others ($O \wedge \bar{S}$)

2. Consumers who own a car and share the ride with others ($O \wedge S$)

3. Consumers who do not own a car, but ride with others ($\bar{O} \wedge S$)

4. Consumers who neither own nor share a car ($\bar{O} \wedge \bar{S}$)

To structure the decision making process, we consider a two-stage model. In the first stage, the consumer decides whether to purchase a car or not. Given that a car is purchased, the consumer act as a supplier in the second stage, facing the decision of riding alone or offering a ride to others. If not purchasing a car, the consumer has the option to ride with others or choose other modes of transport. For simplicity, we assume that the competing mode of transport is public transport. Depending on the decisions made by the individual, there are four outcomes, corresponding to the strategies of the four consumer segments. The set of outcomes are jointly exhaustive and mutually exclusive, meaning that only one of the alternatives can be chosen. Modelling a sequential decision problem, optimal consumer choice is determined by backwards induction. Consistent with rational utility models, we assume that the consumer will choose the strategy yielding the highest net utility. Consumer decisions and the corresponding segments are described graphically in Figure 4.1.

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[1] The consumer segmentation is an extended version of Ghose et al.'s (2006) market segmentation for selling used books in the secondary market, referred to in Müller (2014).
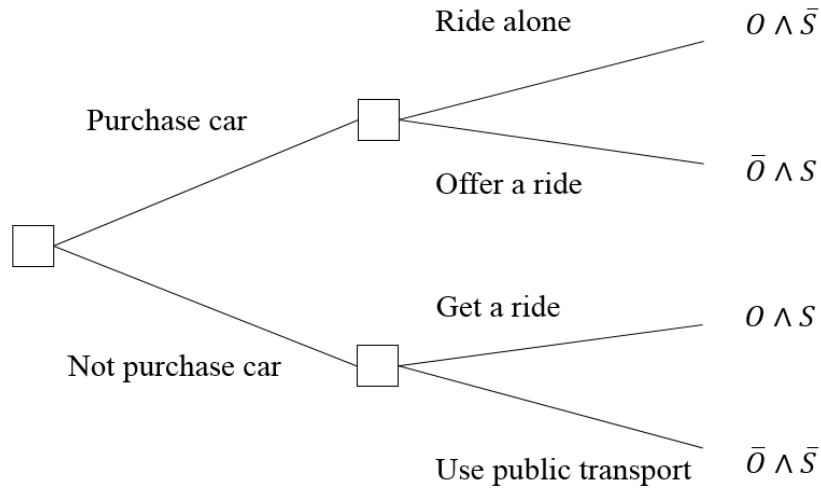
Figure 4.1. Decision tree and corresponding segments in the market for ridesharing

Assuming that the number of trips (x) is the same regardless of the mode of transport, we consider a single trip from A to B and evaluate the benefits and costs of each option. The utility per trip is monetarily measurable and depends upon the individual valuation of owning and/or sharing a car.

Let θ be the consumer's valuation of owning a car. A consumer with a higher θ attaches a higher monetary utility to the ownership of a car than one with a lower θ. Further, let γ denote the utility achieved from ridesharing, either as owner or as passenger. Consistent with Benkler (2004), the benefits from sharing may be instrumental, such as being able to use carsharing lanes, and non-instrumental, like having company and protecting the environment. For simplicity, we assume that a consumer who neither owns nor shares achieves the utility δ from using public transport.

Competing decisions in the market for ridesharing entail different costs per trip. Let p_O denote the price of owning a car, mirroring the operational costs per trip including fuel costs, maintenance costs and insurance. Further, let p_S be the price of sharing a given trip, reflecting a part of the price of owning. Here, the passenger's cost is the owner's revenue. Assuming that the price of sharing is used to discharge the owner's operational costs rather than to generate profit, $p_S < p_O$. In addition to the direct expenditure, transaction costs p_{TO} and p_{TS} arise, for the owner and passenger respectively, as they need to search for a trustworthy travelling companion and physically arrange the sharing. Finally, p_B denotes the price of public transport.

4.1 The supply of shareable goods

We begin by modelling the upper terminal node of the tree, corresponding to the decision of riding alone or offering a ride to others. Considering a single trip in a car going from A to B, we draw on the theoretical model of Benkler (2004) to explain the supply side of the sharing economy. For a consumer who owns a car and rides alone $(O \wedge \bar{S})$, the net utility per trip is given by the difference between the utility of ownership and the price of owning.

$$U_{O \wedge \bar{S}} = \theta - p_O \qquad (4.1)$$

Once a consumer decides to ride alone, idle capacity is created in the form of four empty seats. Duly, as noted by Benkler (2004), the owner has the opportunity to benefit if she can earn any positive utility from increasing the utilisation rate through sharing. This is so whether the opportunity cost takes the form of revenue generated by sharing, social and psychological gains or environmental benefits. To account for this fact, it is assumed that the car owner achieves the added utility γ and the revenue p_S from sharing her car. Thus, for a consumer who owns a car and shares the ride $(O \wedge S)$, the net utility per trip is given by the sum of the utility of ownership, the utility of sharing, the price of owning, the revenue generated from sharing the trip and the transaction cost.

$$U_{O \wedge S} = \theta + \gamma - p_O + p_S - p_{TO} \qquad (4.2)$$

An evaluation of the competing approaches of usage requires a comparison of the net utility achieved from the two alternatives. For given prices, the consumer will be indifferent between riding alone and sharing the ride when the two choices provide equal utility. That is, when

$$U_{O \wedge \bar{S}} = U_{O \wedge S}$$

Substituting equations (4.1) and (4.2) into the expression above gives

$$\theta - p_O = \theta + \gamma - p_O + p_S - p_{TO}$$

Rearranging the equation, we obtain an expression for the indifferent consumer's valuation of offering a ride, $\bar{\gamma}$

$$\bar{\gamma} = p_{TO} - p_S \qquad (4.3)$$

Note from equation (4.3) that the cost of owning is eliminated, as it is incurred regardless of whether the ride is shared with others or not. Thus, consistent with prior literature, an owner

will choose to share her ride with others if the benefit of sharing is greater than the cost. Put differently, if

$$\gamma > p_{TO} - p_S$$

From the expression above, we note that the decision to offer a ride is dependent on the owner's transaction cost and revenue associated with sharing.

4.2 The demand of shareable goods

Turning to the lower terminal node of the tree, we consider the demand side of the sharing economy, in which the consumer decides to either ride with others or use public transport to get from A to B. For a consumer who does not own a car, but get access to one through ridesharing ($\bar{O} \wedge S$), the net utility is given by the difference between the utility achieved from sharing, the price of sharing and the transaction cost.

$$U_{\bar{O} \wedge S} = \gamma - p_S - p_{TS} \tag{4.4}$$

Similarly, for a consumer who neither owns nor shares a car ($\bar{O} \wedge \bar{S}$), the net utility is given by the difference between the utility and cost of public transport.

$$U_{\bar{O} \wedge \bar{S}} = \delta - p_B \tag{4.5}$$

For given prices, the consumer will be indifferent between getting a ride and using public transport when the two options provide equal utility. That is, when

$$U_{\bar{O} \wedge S} = U_{\bar{O} \wedge \bar{S}}$$

Inserting the utility expressions from (4.4) and (4.5) into the expression above gives

$$\gamma - p_S - p_{TS} = \delta - p_B$$

At this point, the net utility achieved from public transport defines the minimum net utility that must be achieved in order to be willing to rideshare. Rearranging the equation, we obtain an expression for the indifferent consumer's valuation of getting a ride, $\bar{\gamma}$

$$\bar{\gamma} = (p_S + p_{TS}) + (\delta - p_B) \tag{4.6}$$

As we consider the demand for ridesharing, this expression for $\bar{\gamma}$ is substantially different from equation (4.3) where the price of sharing signifies the owner's revenue. Accordingly, a consumer will choose to ride with others if

$$\gamma > (p_S + p_{TS}) + (\delta - p_B)$$

That is, when the utility generated from ridesharing exceeds the total cost of getting a ride and the net utility obtained from using public transport. The net utility of using public transport represents the opportunity cost of getting a ride, arising as the consumer loses the potential gains from public transport when choosing to ride with others. Although social and environmental motivations may trigger both options, ridesharing is likely to be a faster, more flexible and efficient way of travelling than public transport. In most cases, ridesharing also emerges as a more economical alternative than public transit, indicating that $(p_S + p_{TS}) < p_B$. Although we mainly study consumers where this condition holds, it is important to note that the total cost of sharing may exceed the cost of public transit in other cases, as, for instance, consumers live in remote areas or face a weak supply of rides.

4.3 The purchase decision

Conditioned on the decisions being made in the terminal nodes, we work backward to predict behaviour at the initial node, corresponding to the decision to purchase or not to purchase a car. Consistent with prior literature (Lamberton & Rose, 2012), the purchase decision is depending on the perceived utility, and thus the perceived degree of substitutability between ridesharing and ownership. We use the contingent solutions from the terminal nodes to determine the optimal course of action available at this point.

Supposing the consumer places a high value on ridesharing, $(\gamma > \bar{\gamma})$, we determine the optimal initial decision by comparing the decisions to offer and get a ride. Conditioned on these decisions being made, the consumer will be indifferent between purchasing and not purchasing a car when the two options provide equal utility. For given prices, that is when

$$U_{O \wedge S} = U_{\bar{O} \wedge S}$$

Inserting (4.2) and (4.4) into the equation above, we get

$$\theta + \gamma - p_O + p_S - p_{TO} = \gamma - p_S - p_{TS}$$

Rewriting the equation, we obtain an expression for the indifferent consumer's valuation of owning a car, $\bar{\theta}$

$$\bar{\theta} = p_O - 2p_S + p_{TO} - p_{TS} \tag{4.7}$$

Consequently, a consumer will choose to purchase a car when

$$\theta > p_O - 2p_S + p_{TO} - p_{TS}$$

From the equation above, we note that the decision to purchase a car is dependent on the price of owning, the price of sharing and the transaction costs of the owner and passenger. Thus, in order for car purchase to be the optimal decision, the utility derived from ownership must be greater than the cost of ownership incurred after the cost contribution has been accounted for, and the owner's transaction cost subtracted by the passenger's transaction cost. Both the passenger's direct expenditure (p_S) and transaction cost are subtracted in the equation, as they are not incurred when purchasing a car.

The comparison of the lower-valuation segments ($\gamma < \bar{\gamma}$) is handled analogously. Now we assume that the optimal decisions in the upper and lower terminal node are respectively to ride alone and use public transport. When prices are fixed, the consumer will be indifferent between purchasing and not purchasing a car when these decisions generate equal utility. Namely, when

$$U_{O \wedge \bar{S}} = U_{\bar{O} \wedge \bar{S}}$$

Inserting the utility functions (4.1) and (4.5) into the expression above, we obtain

$$\theta - p_O = \delta - p_B$$

Again, the indifferent consumer's valuation of owning a car, $\bar{\theta}$, follows by rearrangement:

$$\bar{\theta} = p_O + \delta - p_B \qquad (4.8)$$

At this point, car purchase will be the optimal decision as long as

$$\theta > p_O + \delta - p_B$$

Because the optimal decision at the first stage is contingent on the decisions being made in the second stage, this expression for $\bar{\theta}$ is substantially different from the one in (4.7). Since the decision in question is conditioned on the decisions not to share, neither own nor others car, the utility and cost of sharing a ride are left out of the equation. Now, a consumer will choose to purchase a car if the utility obtained from ownership exceeds the cost of ownership and the net utility of using public transport. The net utility of using public transport represents the opportunity cost of purchasing a car.

5. Sensitivity analysis

With an established theoretical foundation for determining the sequence of optimal decisions, we can evaluate the sensitivity of consumer behaviour to a change in parameter values. By studying how the segmentation of consumers is affected by a change in costs, the model may be used to predict changes in demand for ownership and ridesharing. Recall from chapter 4 that the net utility derived from the strategies of the four consumer segments is dependent on the individual utility achieved from owning and sharing a car, and the various cost parameters. As different strategies are associated with different costs and utility, net utility will differ depending on the consumer's choice of strategy.

To simplify the analysis, we normalise the net utility achieved from public transport to zero, $\delta - p_B = 0$. For given prices[2], the choice of strategy corresponding to the four consumer segments can then be expressed as a function of θ and γ. This provides the basis for a two-dimensional division of consumers, in which the indifference points $\bar{\theta}$ and $\bar{\gamma}$ mark the partition of consumers into the four segments, as illustrated in Figure 5.1. Both partition lines are kinked, as there are two expressions for each indifference point, depending on which strategies that are being compared.
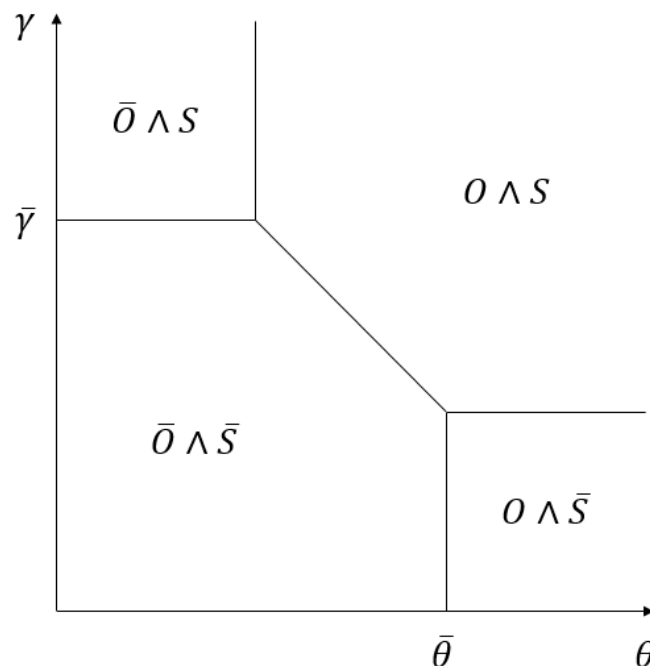

Figure 5.1. Optimal decisions expressed as a function of θ and γ

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[2] As a starting point, we assume that the following costs arise per trip: $p_O = 20$, $p_S = 6$, $p_{TO} = 5$ and $p_{TS} = 3$.

Whereas the consumer located at the left part of $\bar{\gamma}$ will be indifferent between riding with others and using public transport, the consumer located at the right part of $\bar{\gamma}$ will be indifferent between sharing her car with others and riding alone. Similarly, the consumer located at the upper part of $\bar{\theta}$ will be indifferent between getting a ride and offering a ride, and the consumer located at the lower part of $\bar{\theta}$ will be indifferent between using public transport and riding alone in her own car. As the distribution of consumers spanned by θ and γ is exogenously given, the number of consumers in each segment cannot be predicted by the model.

Calculus allows us to obtain the changes in $\bar{\theta}$ and $\bar{\gamma}$ for a change in a given price, holding other factors fixed. The actual impact on consumer behaviour will depend on the actual distribution of consumers and the prices observed in the market.

5.1 Changing the price of sharing

We begin by testing how a change in the price of sharing will influence consumer allocation. From the expressions for $\bar{\theta}$ (4.7) and $\bar{\gamma}$, (4.3) and (4.6), we note that the price of sharing affects both the initial purchase decision and the subsequent choices. Considering first the decision to purchase or not to purchase a car for a consumer who shares, the corresponding change in $\bar{\theta}$ with respect to the price of sharing is given by

$$\frac{\partial \bar{\theta}}{\partial p_S} = -2 \tag{5.1}$$

Holding other prices fixed, a decrease in the price of sharing is associated with an increase in $\bar{\theta}$, indicating that the indifference point shifts to the right. When the price of sharing declines, ridesharing emerges as a more attractive alternative from a passenger's point of view, and the consumer must therefore attach a higher utility to ownership to be willing to purchase a car. As revenue decreases for owners offering a ride to others, more consumers will choose not to purchase a car, and ride with others instead. Separately, this leads to an increase in the segment of consumers who do not own a car but ride with others, represented by the movement in the upper part of the vertical dividing line in Figure 5.2.

Assessing the subsequent choice of usage for those who decide to purchase a car, we use equation (4.3) to derive the partial derivative of $\bar{\gamma}$ with respect to the price of sharing:

$$\frac{\partial \bar{\gamma}}{\partial p_S} = -1 \tag{5.2}$$

The derivative tells us that a decrease in the price of sharing is associated with an increase in $\bar{\gamma}$, indicating that the point of indifference between riding alone and sharing the ride shifts upwards. Since the financial benefits of sharing has been reduced, consumers must attach a higher utility to sharing to be willing to share the ride with others. The isolated effect is an increase in the segment of car owners who ride alone, illustrated by the movement in the right part of the horizontal dividing line in Figure 5.2.

Examining the subsequent choice for consumers who decide not to purchase a car, we derive the change in $\bar{\gamma}$ with respect to the price of sharing from equation (4.6):

$$\frac{\partial \bar{\gamma}}{\partial p_S} = 1 \qquad (5.3)$$

As the derivative is positive, a decrease in the price of sharing will cause the point of indifference between getting a ride and using public transport to shift downwards. When the price of sharing drops, getting a ride appears relatively cheaper compared to using public transport. Consequently, more consumers will choose to ride with others, translating into a drop in the left part of the horizontal dividing line in Figure 5.2.
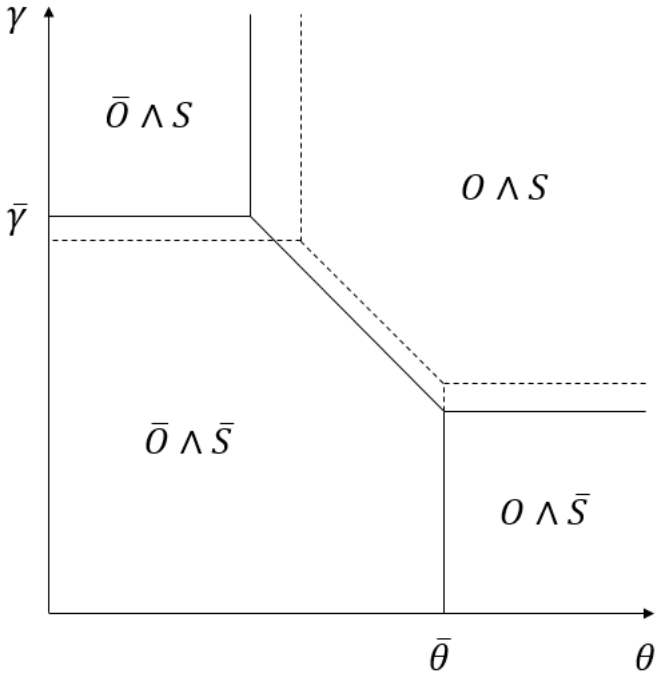

Figure 5.2. Effect of a decrease in the price of sharing

Marked by the dotted lines, the movement in the two dividing lines illustrates the net effect on consumer allocation caused by the lower price of sharing. As $\left|\frac{\partial \bar{\bar{\theta}}}{\partial p_S}\right| > \left|\frac{\partial \bar{\gamma}}{\partial p_S}\right|$, the shift in $\bar{\theta}$ will be larger than the shifts in $\bar{\gamma}$. From Figure 5.2 we observe that more consumers will choose not to purchase a car and ride with others ($\bar{O} \wedge S$) when the price of sharing declines. This substitution effect, in which ownership is replaced with access, is observed both in the market for carsharing (Cervero et al., 2007; Martin et al., 2010) and within travel accommodation (Zervas et al., 2014). Because sharing a car is now cheaper, consumers also enjoy an increase in purchase power, known as the income effect.

As getting a ride appears relatively cheaper than using public transport, the segment of consumers who neither own nor share a car ($\bar{O} \wedge \bar{S}$) is likely to experience a decline. As shown in Figure 5.2, fewer consumers will choose the strategy of purchasing and sharing a car ($O \wedge S$), as revenue declines for this consumer segment. While car owners placing a lower value on ownership will be embedded in the segment of consumers who ride with others, car owners placing a lower value on sharing will choose to ride alone, implying an increase in the segment $O \wedge \bar{S}$.

It is interesting to view the results in light of empirical findings. Although the majority of ridesharing schemes are not associated with owners making profit, but rather subsidising the owner's operational costs, there are circumstances where the car is shared without generating any revenue, such as sharing with friends and family. Additionally, ridesharing platforms give owners the opportunity to offer free rides. Transferring this to our model, setting p_S equal to zero would suggest a decline in the segment of car owners offering a lift to others. However, while the economic returns are eliminated in this case, Benkler (2004) argues that the social rewards may be larger as we are likely to prefer acquaintances to strangers when deciding whom to share a ride with. As this type of sharing is ubiquitous, it may indicate that motives for social sharing go beyond financial gains.

In addition to the direct expenditure, the cost of sharing a ride may comprise a membership or usage fee. For instance, the ridesharing platform GoMore charges a service fee that amounts to ten percent of the driver's revenue generated through sharing (GoMore, 2015). While the passenger's cost in this instance is kept constant, a usage fee directly reduces the owner's revenue (p_S), suggesting a decline in the number of owners who share their ride.

In accordance with empirical research (Fremstad, 2014; Ruud & Ellis, 2008), regulatory obstacles and social barriers inhibit consumers to choose access over ownership. In line with our results, supportive policies and regulations are thus proposed to reduce the price of sharing, promoting ridesharing as an equitable alternative to owning a car. When parking is scarce, ridesharing emerges as a relatively more attractive option to car ownership (Ruud & Ellis, 2008). Accordingly, several carsharing operators provide free membership for individuals or cooperatives offering their private parking space to carsharing (Hertz BilPool, 2015). In our model, membership subsidies would lower the passenger's cost of sharing, suggesting that more consumers will choose to ride with others. Reduced costs of membership has also enabled low-income households to join carsharing (Transportation Research Board, 2005), indicating a shift from consumer segment $\bar{O} \wedge \bar{S}$ to $\bar{O} \wedge S$.

5.2   Changing the price of owning

In the same manner, we turn to the expressions for $\bar{\theta}$, (4.7) and (4.8), to analyse how a change in the price of owning affects consumer allocation. Affecting the purchase decision for both consumers who share and consumers who do not share, the change in $\bar{\theta}$ with respect to the price of sharing may generically be written as

$$\frac{\partial \bar{\theta}}{\partial p_O} = 1 \qquad (5.4)$$

If the price of owning falls, we note from equation (5.4) that $\bar{\theta}$ will decrease. The lower price of owning encourages consumers who place a lower value on ownership to purchase a car, indicating that a lower θ is required for car purchase to be the optimal decision. As owning a car becomes relatively cheaper, more consumers will choose to purchase a car, shifting $\bar{\theta}$ to the left. The shift is equally large for consumers who share and consumers who do not share, illustrated by the movement in both the upper and lower part of the vertical dividing line in Figure 5.3. As illustrated in the figure, the segments of owners ($O \wedge S$ and $O \wedge \bar{S}$) will expand at the expense of the segments of non-owners ($\bar{O} \wedge S$ and $\bar{O} \wedge \bar{S}$) when the price of owning declines. The distribution of consumers between the segment of car owners who share and the segment of car owners who do not share remains the same, as the price of owning does not affect the subsequent decision to share the ride with others.
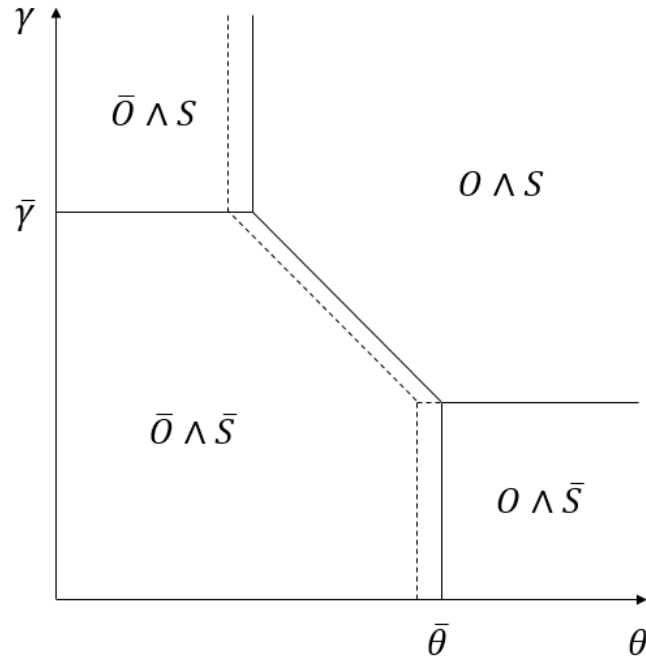
Figure 5.3. Effect of a decrease in the price of owning

On the other hand, if the price of owning rises, consumers will substitute away from ownership, as this option now is relatively more expensive. The result is in line with the findings of Hald et al. (2011) who argue that the hassle and costs of ownership are the main reasons for switching to a shared car. As sharing gives access to costly goods at a lower price, a price increase reinforces the economic motives of sharing. This prediction is corresponding with the arguments of Duncan (2011), who highly promotes the cost saving potential of sharing. Comparing the costs of owning and sharing may however be difficult, as consumers do not take into account operational costs that are not encountered daily, such as insurance, maintenance and license, when using a privately owned vehicle (Transportation Research Board, 2005). If this is the case, consumers may underestimate the costs of owning, suggesting that more consumers will choose to purchase a car.

In line with the findings of Ruud and Ellis (2008), the Transportation Research Board (2005) argues that reserved parking is one of the most advantageous actions local authorities can take in order to build a critical mass of consumers offering rides to others. In order to promote ridesharing, several local governments are therefore providing and financing parking spaces for shared vehicles. Such an initiative translates into a decline in the price of owning for car owners who share their ride with others ($O \wedge S$), indicating that more consumers will choose this strategy.

Holding the price of owning constant for consumers who ride alone, there is also evidence that tax-related solutions help ridesharing get a stronghold in communities (Transportation Research Board, 2005). By lowering the operative costs of ownership, a tax incentive scheme will benefit consumers who own a car and share the ride ($O \wedge S$), and create an incentive to share for the consumer segment $O \wedge \bar{S}$. Accordingly, the City Council of Bergen recently suggested road tax exemptions for vehicles used for ridesharing (Bergen kommune, 2015), translating into a decline in p_O for the consumer segment $O \wedge S$ in our model. In line with the theory of Benkler (2004), the City Council further proposes carsharing lanes to exploit the excess capacity in private vehicles. Reducing the capacity for the consumer segment $O \wedge \bar{S}$, this initiative emphasises access to carsharing lanes as a benefit of ridesharing, making single-occupancy car use less attractive.

5.3   Changing the transaction costs

A key to understanding consumer behaviour in the sharing economy is to study how alterations in transaction costs affect consumers' willingness to share. As the presence of a market for ridesharing enables car owners to share their empty seats, rational consumers consider this in their utility function in the buying process. When assessing the owner's transaction costs, we therefore use equation (4.7) to derive the effect on $\bar{\theta}$ of a change in the transaction costs for consumers who share:

$$\frac{\partial \bar{\theta}}{\partial p_{TO}} = 1 \tag{5.5}$$

From the expression above, we note that a decrease in the owner's transaction costs is associated with a decrease in $\bar{\theta}$. Analogous to the analysis of p_O in section 5.2, owning a car becomes more attractive for consumers placing a lower value on ownership when the transaction costs decline. As a lower θ is required for car purchase to be the optimal decision, more consumers among those who share will choose to purchase a car. Isolated, this effect is shown by the leftwards movement in the upper part of the vertical dividing line in Figure 5.4.

Turning to the usage decision of car owners, the corresponding change in $\bar{\gamma}$ with respect to the transaction costs can be derived by differentiating equation (4.3) with respect to p_{TO}:

$$\frac{\partial \bar{\gamma}}{\partial p_{TO}} = 1 \qquad (5.6)$$

The derivative tells us that a decrease in the transaction costs is associated with a decrease in $\bar{\gamma}$. With lower transaction costs, offering a ride emerges as a relatively cheaper alternative, and the consumer must therefore attach a lower utility to sharing to be willing to offer a ride to others. Consequently, more owners will choose to share the ride instead of riding alone, causing a downwards shift in the right part of the horizontal dividing line in Figure 5.4.

Combining the shifts in $\bar{\theta}$ and $\bar{\gamma}$, we observe from Figure 5.4 that the total effect of a decrease in the owner's transaction costs is an increase in the segment of consumers who own a car and share the ride with others $(O \wedge S)$, at the expense of the other strategies.
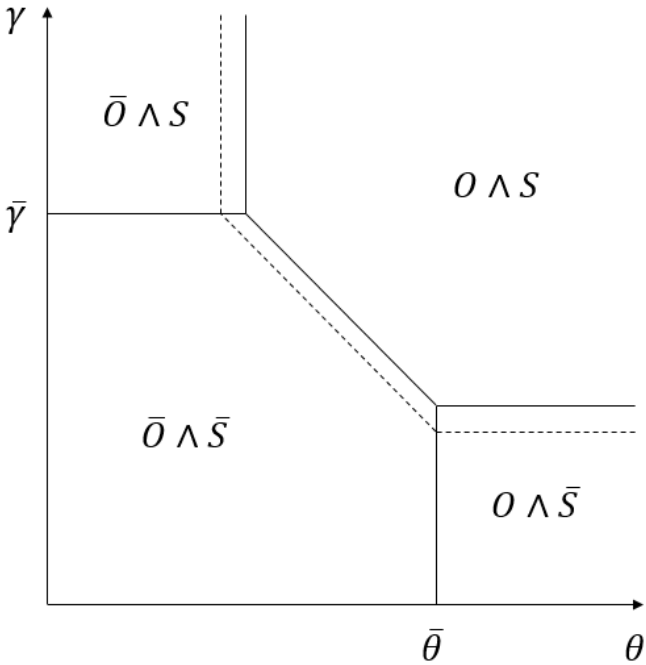

Figure 5.4. Effect of a decrease in the owner's transaction cost

In the same vein, we can analyse the impact on consumer choice of a change in the passenger's transaction costs. As this cost parameter affects the initial purchase decision for consumers who share, we use equation (4.7) to derive the partial derivative of $\bar{\theta}$ with respect to the passenger's transaction costs:

$$\frac{\partial \bar{\theta}}{\partial p_{TS}} = -1 \tag{5.7}$$

From equation (5.7), we note that a decrease in the transaction costs leads to an increase in $\bar{\theta}$. When transaction costs decline, ridesharing emerges as a relatively cheaper alternative from a passenger's perspective, thus the utility obtained from ownership must be even higher to be willing to purchase a car. More consumers will thus choose not to purchase a car, shifting the upper part of the vertical dividing line in Figure 5.5 to the right.

Supposing a car is not purchased, the passenger's transaction costs affect the subsequent choice between getting a ride and using public transport. Using equation (4.6), we derive the change in $\bar{\gamma}$ with respect to the passenger's transaction costs:

$$\frac{\partial \bar{\gamma}}{\partial p_{TS}} = 1 \tag{5.8}$$

The derivative tells us that a decrease in the transaction costs is associated with a decrease in $\bar{\gamma}$, indicating that the indifference point shifts downwards. With lower transaction costs, ridesharing appears relatively cheaper compared to using public transport. Thus, more consumers will substitute towards this alternative, shifting the left part of the horizontal dividing line downwards in Figure 5.5.

From Figure 5.5, we observe that the net change in consumer allocation occurring as a result of the decrease in the passenger's transaction costs is an increase in the segment of consumers who do not own a car, but ride with others ($\bar{O} \wedge S$). As this segment expands, the adjacent segments ($O \wedge S$ and $\bar{O} \wedge \bar{S}$) will experience a decline. The segment of car owners who ride alone ($O \wedge \bar{S}$) remains unaffected, as the passenger's transaction costs do not affect the usage decision once a car is purchased.
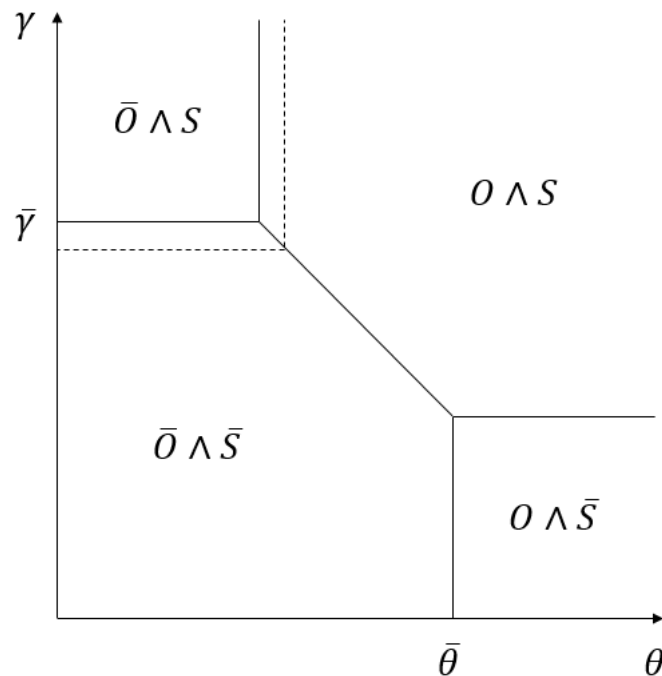
Figure 5.5. Effect of a decrease in the passenger's transaction cost

Consistent with prior literature, the drop in transaction costs may explain the observed upsurge of consumers involved in ridesharing, either offering or getting a ride. This is supported by Fremstad (2014), arguing that the rise of online sharing platforms has enabled peer-to-peer transactions at considerably lower cost. First, the search and information costs associated with locating an available seat are declining. Consumers get access to a larger selection and a greater variety of cars and rides than in a regular market, noted as an important feature positively affecting the propensity to share (Ruud & Ellis, 2008). By reducing the steps and time taken to place an order, and increasing the number of ways to order, sharing platforms facilitate a quick and easy transaction. As a passenger, you simply indicate your points and time of departure and arrival, and subsequently choose a driver who matches your search criteria. Similarly, drivers publish their pick-up and drop-off points, date and time, and can accept or decline requests from passengers. To facilitate sharing, the ridesharing platforms automatically suggest potential passengers and a reasonable price per passenger, reducing both the search and bargaining costs.

Consistent with the findings of Lauterbach et al. (2009), visible information about users' recent activity and public ratings simplifies the choice of travelling companions, lowering both the information and decision costs. Transparent feedback mechanisms further reduce the policing and enforcement costs, as dishonesty about price and condition of what is being shared will be publicly displayed to other members. Users are encouraged and rewarded for openness, trust

and reciprocity. As noted by Benkler (2004), sharing communities self-moderate, using social norms and ridesharing rules to regulate the transactions and punish users who do not comply the collaborative conduct. In addition to feedback mechanisms, ridesharing platforms enhance safety through verification of member identities, online payment and confidentiality in regards to member data (GoMore, 2015). Translating into a drop in p_{TO} and p_{TS}, these features are likely to increase the number of consumers who rideshare, as owners and passengers respectively. Summing up the effect, the actual distribution between the segments $\bar{O} \wedge S$ and $O \wedge S$ will depend on the relative change in transaction costs, as the costs are likely to drop simultaneously.

5.4   Changing the utility achieved from sharing

Although the distribution of consumers spanned by θ and γ is considered given in the model, it may evolve over time as preferences and attitudes toward sharing and ownership change. This is supported by research by Luca and Pace (2014), suggesting that the propensity to share increases with augmented knowledge of the system. Rochelandet and Le Guel (2005) also argue that the individual utility achieved from sharing increases with the number of members in a peer-to-peer sharing system.

Consistent with Benkler (2004), we suggest that the propensity to share is highly dependent on the net utility achieved from ridesharing. In order to understand the decision to share, it is therefore essential to identify the various sources of utility in a ridesharing context. As γ may be interpreted as the social-psychological gains from sharing, an improvement in psychological elements such as trust, safety and reliability is likely to increase the number who rideshares in the long term. Recent empirical work (Botsman & Rogers, 2011; Fremstad, 2014) shows that online sharing platforms are contributing to this by providing feedback and rating mechanisms, enhancing trust between strangers.

Likewise, more consumers may choose ridesharing as awareness about the environmental benefits rises. This corresponds with the findings of Hald et al. (2011), noting environmental concerns as an important motive for participating in carsharing. In general, the utility achieved from ridesharing is dependent on the degree to which a consumer perceives ridesharing as a substitute for ownership. This substitutability will always be a matter of degree, something that is likely to change over time.

6. Discussion and future work

The theoretical model of consumer behaviour is developed to explain consumers' choice of both providing and receiving access to shareable goods. Studying the case of ridesharing, which has emerged as a feasible alternative to car ownership, we identify that the possibility to share affects both the purchase and usage decision of cars. As consumers are affected differently by the introduction of peer-to-peer sharing, we differentiate between four consumer segments. Explaining the allocation of consumers to these segments, the model may be used to make predictions on how behaviour is affected by a change in the costs related to ownership and sharing of privately owned vehicles. In order to assess the actual distribution of consumers all parameters should be quantified empirically.

The introduction of two utility parameters, θ and γ, provides the basis for a two-dimensional division of consumers. Müller (2014), on the other hand, presents a one-dimensional analysis, using θ to describe the overall utility obtained by using underutilised goods and spaces. The analysis is done only for the consumer groups who buy and share and those who only share, equivalent to $O \wedge S$ and $\bar{O} \wedge S$ in our model. Ignoring the segment of consumers who buy but not share ($O \wedge \bar{S}$) reveals a limitation in his model. Although there are economic gains from sharing[3], some consumers prefer not to share their goods with others, thus there must be an added value placed on not sharing, such as increased privacy, flexibility and independence. To account for this, we assume that individuals riding alone obtain a lower utility from sharing a ride compared to consumers who share. Although Müller's model is generalised, and thus may be applied to a broad range of shared goods, the model appears too abstracted from the kind of resource that is shared. Sharing cars, bikes or lawn mowers, mentioned as examples in his paper, clearly comes at a price. By disregarding both the operational cost of personal use and the transaction cost that arises through sharing, the net utility for consumers who buy and share will be overestimated.

Because ridesharing is a recent phenomenon, precise data on the costs and value consumers place on the different aspects of sharing does not yet exist. Lamberton and Rose (2012) propose however three types of costs that are likely to have an impact on consumer choice: membership or access fees, technical costs and search costs. Like us, they highlight that transaction costs arise when both searching for and accessing goods. Their model relies on various sources of

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[3] This is supported by research conducted by Fremstad (2014) who finds that there are substantial gains from sharing underutilised goods, particularly private vehicles.

sharing utility, demonstrating that the interpretations of γ are many. Although this creates a more sophisticated model, many variables may complicate the interpretation. Interestingly, in contrast to our suggestions, they find that consumers' propensity to share does not appear to be driven by environmental benefits. Examining which actual costs and sources of utility that determine consumer choice would therefore be an interesting path for future research.

Similar to Benkler's (2004) analysis, we find that declined transaction costs, both for peer providers and peer users, may explain the increase in the number who engages in sharing. While the author only analyses decisions on the supply side of the market for ridesharing, our inclusion of the demand side allows for a more nuanced analysis of the shift between ownership and access to a car, which is often observed in the sharing economy. However, our model disregards the broad spectre of choices on the supply side related to the inclusion and exclusion of others in the car. By limiting the comparison to perfect and selective exclusion, represented by the consumer segments $O \wedge \bar{S}$ and $O \wedge S$ respectively, the model does not take into account the opportunity cost related to other alternatives of sharing. Still, as previously argued, perfect and selective exclusion seem to be the most relevant alternatives in our example. Revealing the essence of consumer behaviour in a ridesharing context, the model provides straightforward implementation and easy economical interpretations, which may be considered some of its strengths. The model is however applicable to other ridesharing contexts, such as nonselective sharing on a first come, first served basis, where drivers and passengers arrange a common pick-up place. Such an analysis should include a comparison of the costs of selective and non-selective exclusion.

6.1   Model applications

Understanding supply and demand in the market for ridesharing is further important for public policy decisions. In that manner, the model may be applied to analyse the effect of price adjustments on the demand for cars, and consequently the negative externalities related to driving. Although the effects on aggregated demand cannot be predicted, an analysis of shifts in consumer segmentation may serve as an important input to decide how demand is affected by a change in the costs related to ownership and usage of a car. The analysis is transferrable to the purchase and use of other private goods where sharing appears as a feasible alternative to ownership.

Knowledge about demand-determining variables will allow organisations and governments to predict the outcome of policy instruments to limit single-occupancy car use, or likewise

promote ridesharing. Assuming a consumer who purchases a car also uses it; congestion, carbon emissions and roadway noise from driving impose a social cost affecting the welfare of others. Because the negative externalities are not reflected in market prices, the consumer does not take into account the harms when deciding to use the car. Unless these costs are internalised, too many consumers will use the road, resulting in congestion and high levels of emissions. Consistent with the results of Martin et al. (2010), our model suggests that more consumers will choose not to purchase a car if the price of owning increases. Accordingly, remedies pointed directly towards the operational costs of owning, such as congestion pricing and gas tax, may reduce the total volume of privately owned vehicles on the road. It is however important to note that we only consider the variation in consumer allocation brought about by the change in one cost parameter at the time. Normally, an increase in the price of owning will lead to an increase in the price of sharing, as the latter is considered a contribution towards the owner's cost of the trip. To analyse the effect on behaviour when both prices change simultaneously, the derivative of $\bar{\theta}$ with respect to p_O and p_S must be calculated.

However, not purchasing a vehicle does not require a switch to ridesharing. If repairing an old car or buying a used one prove less costly than the adoption of ridesharing, a rational consumer would prefer not to rideshare. This is supported by research conducted by Duncan (2011), who finds that the cost-saving potential of carsharing declines if a household is considering buying a used car. Allowing for these alternatives requires a considerable extension of the model, including a quantification of all externalities related to driving. Only when the market prices reflect the marginal externalities imposed per trip, is the inefficiency eliminated and the consumer facing the actual social cost in the purchase decision.

More broadly, the model is applicable to sharing of idle resources beyond vehicles, such as vacation homes, commercial spaces, tools, bikes and even pets. First, a consumer weighing the option between purchasing and accessing any kind of goods must go through a decision pattern as described in chapter 4. Each decision can be regarded as a cost-benefit analysis that compares the cost and utility of the available options. Whereas the prices of owning and sharing may be generalised, the interpretation of γ is highly context specific, as the sources of utility are likely to vary depending on the asset being shared. While a power drill, for instance, is likely to be shared out of practical reasons, a shared pet can add social and psychological value for animal lovers. Along with research reporting a wide range of motivations for sharing private goods (Benkler, 2004; Fremstad, 2014), specific utility elements are also likely to affect the owner's usage decision.

7. Conclusion

To explain observed consumer behaviour in the sharing economy, we develop an economic model that describes the decisions to purchase and use shareable goods. Applying the model to the market for ridesharing, we first consider the consumer's choice between purchasing and not purchasing a car. Assuming a car is purchased, the consumer faces the decision of whether or not to share the ride with others. If not purchasing a car, the consumer may ride with others or use public transport to get from A to B. Deriving the indifference points of these decisions, we establish a theoretical framework for explaining the sequence of decisions associated with the various consumer segments in the sharing economy.

To increase the understanding of how the optimal decision, and thus the allocation of consumers, is affected by a change in the various parameters, a sensitivity analysis is performed for the various cost parameters. In accordance with prior literature, our model shows that lower transaction costs can explain the observed increase in the proportion of consumers who rideshare. Consistent with rational utility models, more consumers are likely to engage in sharing as the benefits of sharing rise.

For given prices, the consumer will be indifferent between purchasing and not purchasing a car when the two choices provide equal utility. The number of consumers who purchase a car increases when 1) the price of sharing increases, 2) the price of owning decreases, 3) the owner's transaction cost decreases and 4) the passenger's transaction cost increases. Consistent with prior literature (Benkler, 2004; Fremstad, 2014), we assume that consumers will offer a lift in their car if the utility achieved from sharing the ride outweighs the utility achieved from riding alone. The number of car owners who share their ride with others increases when 1) the revenue generated from sharing increases, 2) the owner's transaction cost decreases and 3) the passenger's transaction cost increases. Likewise, if not purchasing a car, a consumer will be indifferent between riding with others and using public transport if the utility generated from these alternatives is the same. The number of consumers riding with others increases when 1) the price of sharing decreases, 2) the owner's transaction cost increases and 3) the passenger's transaction cost decreases.

In order to fully understand consumer choice, empirical research on the various costs and sources of utility will be needed. As the sharing economy grows, disrupting traditional industries, future research should also explore adaption patterns across industries over a longer period. In that manner, our model may serve as a theoretical foundation for implementation in

other markets. Whereas prior literature mainly examines the financial and environmental impacts of peer-to-peer sharing, our model considers the impact on consumer decision-making, providing theoretical explanations for consumers' choice of both providing and receiving access to underutilised goods. Modelling supply and demand in the sharing economy allows us to show the relevance of various costs and benefits in consumer choice, giving us a useful framework for making predictions on consumer behaviour. In that regard, our model may be applied to understand the choice between access and ownership in disrupted sectors.

Predominantly affecting markets for transport and accommodation, peer-to-peer sharing is likely to be a substantial feature of the business landscape of tomorrow. Revealing the essence of consumer behaviour in the sharing economy, our results have important implications not only for firms' predictions of consumer choice, but also for welfare-enhancing policies.

8.   References

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