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# Perspectives de l'économie du partage : limite de propriété temporelle, fournisseur auto-cannibalisant, nouveaux modèles commerciaux et politique de données

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**Perspectives of the Sharing Economy :  
Temporal Ownership Boundary, Self-Cannibalizing Supplier, New  
Business Models, & Data Policy**

**Perspectives de l'économie du partage:  
Limite de propriété temporelle, fournisseur auto-  
cannibalisant, nouveaux modèles commerciaux et politique de  
données**

Thèse de Doctorat présentée en vue de l'obtention  
du grade de docteur en sciences de gestion  
par

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# Liste des publications/List of Publication

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4. Tu, Y. J., **Chi, H.**, Zhou, W., Kapoor, G., Eryarsoy, E., & Piramuthu, S. (2019, November). "Critical Evaluation of RFID Applications in Healthcare". In *International Conference on Future Network Systems and Security*, 240-248, Springer, Cham.
5. Thibaud, M., **Chi, H.**, Zhou, W., & Piramuthu, S. (2018). "Internet of Things (IoT) in high-risk Environment, Health and Safety (EHS) industries: A comprehensive review", *Decision Support Systems*, 108, 79-95
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# Introduction

Thanks to the fast development of information technology, the Internet based social networks and online marketplace, the economies of sharing, gifting, and reselling have emerged as important elements in our daily lives. The sharing economy refers to the economic activities when goods or services are arranged to be shared among a group of consumers, characterized by a discounted price and a partial income for the collaborative contributors. The Gift economy refers to the economic activities that aim to transfer goods or services freely to other individuals without an agreed method of quid pro quo. The economy of reselling represents the transfer of the remaining value of goods accompanied by a resale price.

Generally identified by the business activities where goods or services are arranged to be shared among a group of consumers, today's sharing economy is usually established on an online platform (Huihui et al., 2016). Many sharing marketplaces have emerged, for example the AirBnB and Roomorama for lodgement, SnapGoods for tools, RelayRides for cars, Wheelz for bikes, Uber and Lyft for ad hoc taxi services, etc. Services can also be shared, for example peer-to-peer lending, crowdfunding<sup>1</sup>, and couchsurfing<sup>2</sup>, coworking, knowledge and talent-sharing, etc. The sharing economy is characterized by market niche advantages, such as low costs, extra revenues, and new social-networked communities, and group consumption, which means cheaper, extra income for the owners, and a new social-networked communities. We foresee that sharing economy will keep evolving and become more flexibility and eminent in the near future because of its fundamental economic drives.

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<sup>1</sup> See detailed information about crowdfunding on <https://en.wikipedia.org/wiki/Crowdfunding>

<sup>2</sup> See detailed information about couchsurfing on <https://en.wikipedia.org/wiki/CouchSurfing>

To some extent, sharing sounds like rental<sup>3</sup> which is a classic form of economy because under both circumstances, the owner of the good makes money by transferring the right to use it without changing the ownership of the good. However, there are some differences between sharing and rental. First of all, sharing economy is more like a group behavior while rental is an individual behavior. For example, the users of Uber who do not know each other may take one car to the same destination for saving the cost and time, but renting a car usually means only the lessee could use the car during the tenancy term no matter how he uses it. Secondly, the owner could use the good with others at the same time in sharing economy while that would not happen in rental economy. For instance, the users of AirBnB might find a room on the website which needs to live with the owner of the house, but renting a house always means renting the whole house and a formal lease contract is provided. To summarize, sharing economy is more flexible and convenient than rental while the rental is more standard and traditional, so people choose sharing or rental according to their different demands and purposes.

Gift economy is a method for people to transfer goods or services without any payoff of exchange. Nowadays, applications based on the gift economy principles varies widely. For example, we have the charitable donation, collectivism, cooperativeness, donation requested, pay as you will, pay it forward, and proceeds of sale donated. The gift economy represents an optimistic attitudes of people and it's like a way to transfer the goods or services from relative abundance to relative scarcity. What's more, it's motivated by people's compassion, generosity and favor the common good over individual advantages. However, another important perspective forces us to review and reflect on how we think about and measure value. This awareness can be transferred into normal market transactions as well, taking the indirect

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<sup>3</sup> See detailed information about renting on <https://en.wikipedia.org/wiki/Renting>

costs like inventory costs and profits of specific acts of material consumption into consideration.

Resale marketplace is another option that the owner can seek in order to transfer the ownership of the goods/services. Because of the lack of pricing structure of un-uniform resale market, auction is often used in order to retrieve the genuine value of the goods in demand, for example eBay. Fixed price or negotiation are also common, for example Amazon marketplace. The transaction cost can be very high and the value can be underestimated due to the lack of standardized pricing structure in the resale market. Before the end of life time stamp of a good or service, the owner has the free choice to use, share, give, or sell its remaining value. For examples, the old clothes, the unused instruments, a used car, an apartment, their value can be realized by various economic forms. What affects an owner's decision to choose one form that makes the best economic sense? There are several important elements that we must consider: the value of the goods, inventory cost, transaction costs, policy incentives and available marketplaces. A costly inventory would normally give the owner a strong incentive to detach the good's ownership by resale or gift-giving. On the contrary, a high remaining value of the good would make the owner willing to keep the ownership for individual or group consumption. In this thesis, I am motivated to investigate the impact of these key elements on sharing/gift/resale decisions and the balance/equilibrium in the economic market.

## **Practical Issues**

In recent years, many sharing marketplaces have emerged, targeting various economic segments, in the field of lodgement, tools and transportation, etc. Wide-spread adoption of the Internet, mobile technologies, and social-network platforms lowered the barrier to collaborative trade, contribution, and consumption significantly. This trend has resulted in new but significantly large business communities of shared and used

products. Sharing economy are foreseen to keep evolving and become more flexibility and eminent in the near future because of its fundamental economic drives. The sharing economy facilitates products and services to be used at levels closer to their full capacity through decentralized markets that enable peer-to-peer exchanges. The reselling economy represents the transfer of the remaining value of used products. These activities make the market more efficient and are enabled on a massive scale because of recent technological advances in information and communication technologies. On the other hand, consumers are changing their preference from long-term ownership to more eco-friendly short-term sharing options thanks to the fast development in technology and the increasing awareness of sustainability consumption. Therefore, the subscription become increasingly popular and expands rapidly, especially in the automobile industry. Subscription business seems to create incentives of additional asset acquisition for the service providers. The traditional automotive sellers also find incentives to update their business models, such as considering themselves offering the subscription services.

Supposing if there is no inventory cost, the owner of the goods/services would have the intention to keep them with any residue value. However, if there exists a reward to transfer the ownership as a gift or certain holding cost, the tendency to keep the goods may withdraw. It creates the economy of gifts. With non-zero inventory cost, depreciating value of the good and taxation benefit, the owner might make a negative utility if he/she holds the good. The gift economy, however, is not always attractive (Marcoux, 2009), and it can push people away and seek the valorized market as an alternative option. What's more, people pay little attention and hardly show their understanding to gift giving (Cheal, 2015), because of the privacy and conceptual framework of this activity.

Resale market heavily depreciated machines produced in these dispute-affected equipment (Mas, 2008). Besides, components of these machines were resold more frequently and received lower list prices. In the standard action, there is a bidder in resale market who doesn't have any use value for the good on sale (Garratt and Thomas, 2006). When resale leads the auction, there is an equilibrium in the auction-plus-resale game, which would determine the bidding price. But in perfect resale market, the auction with resale would not be the best choice for the seller (Ausubel and Peter, 2004).

Last but not least, the European General Data Protection Regulation (GDPR) has come into force since 25th May 2018, which means the usage of structured and unstructured data originating from disparate sources are under the supervision of the government (Hakim et al. 2018). This new regulation affects many business models and companies which depend on data collected from Internet users in Europe. Therefore, the sharing economy, which is an information-based peer-to-peer model, has also been affected by GDPR. It's necessary to study the relevant policy implement of GDPR to investigate the impact of GDPR on sharing economy. So far, the literature investigating the GDPR's details is limited, which increases the difficulties in identifying the legality of utilizing the collected data, and the current studies related to GDPR mainly focus on the Data Management Platforms (DMP) instead of sharing economy.

## **Research Gaps**

From the existing literature in sharing economy, gift economy and resale market, we find a common agreement that all forms of ownership must create real consumer value at the end. The concept of sharing bikes (Wheelz), cars (Uber), or houses (Airbnb) begins to become more and more popular (Cohen and Kietzman, 2014). In order to obtain the stable mobility, existing shared mobility business models try hard to find the optimal relationship between good owners and receivers. What's more, sharing economy now

achieves success in the competition with concrete firms and makes itself differential to acquire market share (Zervas et al., 2015). The economy of sharing is often linked to the collaborative consumption (Belk, 2014). In terms of how we think about ownership, collaborative consumption is often considered as important as the Industrial Revolution. Almost all industries are involved in this ongoing disruptive change of sharing economy and collaborative consumption. People can use collaborative consumption as a force to effect the sustainable development and a method to strengthen communities (Botsman and Roger, 2011). On the top of that, owing to information and communications technologies, collaborative consumption develops rapidly (Hamari et al., 2015). And different factors like sustainability play important roles in motivating the participation in Collaborative Consumption. However, its dark side needs to be deal with when the sharing economy grows up (Malhotra and Van Alstyne, 2014), which means to gain unfair advantages like regulatory arbitrage should be avoided. Democratizing the ownership and governance of the platform would help to control the power of new technologies (Schor, 2014). In the other hand, there are still fleets and inventory costs even in the sharing economy (Sundararajan, 2013). New sharing economy market models like re-engineered consumption models are needed.

Several recent works provide theoretical insights into the impact of sharing on incumbent markets for durable products. Einav et al. (2016) discuss the multiple elements and perspectives of peer market design, including search algorithms, pricing, reputation systems, and regulation issues. Horton and Zeckhauser (2016) propose an equilibrium model to analyze the impact of sharing on ownership, rental rates, and the surplus generated in a sharing market. Weber (2016) tackles a similar question and finds that sharing markets tend to increase the price of new products with the benefit greater for high-cost products. Jiang and Tian (2018) construct an alternative model

to highlight the role of transaction costs in the sharing market and the impact of sharing on firm's quality decision. On the top of those studies about sharing market, there are increasing researches interested in providing various strategies for the firms (e.g. Mocker and Fonstad, 2017 ; Zhang et al., 2018 ; and Frey et al., 2019) and sharing economy platforms (e.g. Constantiou et al., 2017 and Chasin et al., 2018). They describes different types of sharing economy platforms and identify the characteristics of firms in order to figure out the optimal strategy, which would help companies to resist the negative impact of sharing economy. As it can be observed from the literature, the focus of studies concerning sharing economy has been transferred from consumer side to the producer side. However, the theoretical insights for producer so far are limited.

Several studies have analyzed the leasing and buying options of a car, concerning a car manufacturing company's choice in a monopolistic environment using game-theoretic models. One of the earliest studies was conducted by Bulow (1982), who found out that leasing is a better option for companies than selling, as the effect of time-consistency lowers the profitability of the seller. Later research determined that profit maximization of a lease or sale option depends on the relative depreciation rate of the vehicle (Desai and Purohit, 1998). Thus, the depreciation of a car marginally increases over the cars lifetime. They state that car manufacturing companies can outperform through exclusively selling due to a higher rate of car depreciation. Later studies examined the leasing and selling market, with regards to a dynamic oligopoly model (Esteban and Shum, 2007; Andrikopoulos and Markellos, 2015). While previous research is based on descriptive results, the findings of Johnson et al. (2014) focused on predictive ones. They assumed leasing and financing to be imperfect substitutes and predicted that a positive relationship exists between sell rates and lease rates. Therefore, for lessors, it can have a negative outcome if leasing

rates are determined by predicted values based on the selling market, resulting in a loss on a long-term perspective. Compared to the other empirical findings, Johnson et al. (2014) emphasized the relationship between the two markets of selling and leasing from a company's perspective. The above-discussed literature is comparing the lease and finance options from a company's point of view, therefore disregarding the consumers' optimal choice. They consider the consumers' choice as being equivalent while only focusing on the firm's decision. However, this assumption omits several essential factors that impact consumers' choice of car ownership. Train and Winston (2007) observed the reason of a shrinking domestic automotive market in the U.S. The study revealed that a loss in consumer's willingness to buy is assigned to basic characteristics such as price, size, operating costs and reliability. Other studies examined that buying factors like financial contract costs, including down payment and monthly payment, duration, and interest rate are essential to consider. Moreover, unaccounted costs resulting from the usage of the car can have an impact on the buying decision of consumers as well as demographic factors such as income or age. Additionally, further literature emerged stressing the importance of considering other determining elements, rather than only the cost factors of down and monthly payments.

Since the GDPR went into effect in 2018, there are some researches investigating the impact of GDPR. They mainly focus on the data-sharing industries, such as online advertising (Urban et al., 2020) and healthcare (Phillips, 2018). Internet of Thing (IoT) is another unignorable topic regarding the impact of GDPR (Loideamin, 2019). According to the study of Lyu et al. (2020), the collaborative consumption applications for the sharing economy are cloud-based, which should follow strict data privacy protection required by the GDPR. However, the research in this field is extremely limited.

In summary, the following research gaps are remaining unanswered:

- A new business model for sharing economy market is lacked.
- The theoretical insights for producer so far are limited.
- The study about car subscription is limited.
- The impact of new regulation GDPR on sharing economy has not been investigated

As the result, the object of this thesis is to fill these research gaps and generate results which can contribute to the field of sharing economy theoretically and practically.

## Research Questions

In order to study the economic impact of sharing economy from a comprehensive perspective, it is necessary to consider consumer's behavior and producer's behavior respectively in the environment of sharing economy, which leads to two key questions naturally: *How does the consumer behave to participate in the sharing economy?* and *How does the manufacturer behave to deal with the impact of sharing economy?*

To answer the first question about consumer's behavior, we must consider the value of the good, its inventory and holding cost, the transaction costs, and potential income from the sales, usage, or collaborative contribution. Most of these parameters are temporal factors. For instance, a high inventory cost would normally provide the owner a strong motivation to transfer its ownership by resale or gift-giving. On the contrary, a high residual value of the good would motivate the owner to keep the ownership for individual or group consumption. In the first research of this thesis, we are motivated to investigate the properties of these temporal ownership variables and the boundary in the sharing economy.

To answer the second question about producer's behavior, we observe new forms of business competitions between traditional sellers and collaborative contributors. These new forms of competitions exist in a wide spectrum of industrial and consumer products markets. For example, consumers are able to find a large

variety of products that can be rented through sharing platforms or bought through reselling portals. On the supply side, we also notice that many automobile makers such as General Motors, BMW, and Daimler (the parent company of Mercedes-Benz) have launched their own car sharing services and invested in car sharing start-ups. This scenario casts an interesting pricing problem to these producers because each sold item may later enter the market and join the competition. Therefore, I investigate the self-cannibalization effect and car subscription for manufacturers respectively in the second and the third part of this thesis. Specifically, we nevertheless consider key variables that appear in the literature, including the transaction cost, holding cost of ownership, rental rates, price of new and used products, and surpluses generated in the markets. We also identify the differences between the car industry and real estate industry in sharing market, which leads to completely different results. Lastly, the sharing economy has brought new social issues that have never existed in the past, for example the data protection and privacy issue. The recent enactment of the GDPR in the European nations made me to think about the research question: *the legality and regulation of data analytics in the sharing economy?* In order to provide an answer, we review the state-of-arts of DMP (Data Management Platform) that are centralized systems for collecting and analyzing large sets of structured and unstructured data originating from disparate sources. Data is analyzed, organized and segmented first on the DMPs. Second and third party data of different user groups/types are also used for marketing and advertising campaigns. Our research discusses the challenges in the implementing of the new regulation policies. We highlight the required changes to facilitate the daily operations of DMPs and the policy implications of GDPR.

## Research Objectives

Based on the main research questions presented in the previous section, here I highlight the four primary objectives of this thesis.

In the first research, we aim to investigate the temporal ownership boundary that exists in the sharing economy, which indicates when the owner wants to share or give away. We study the temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We are interested in the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We are motivated to figure out the various conditions when this boundary may lean towards sharing, gift giving or reselling. We also show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods.

Based on the results of the first study, we are able to identify the residual value of used products in the sharing market. However, these used products charge for lower price with reduced value, which attracts lots of consumers. The reentering of used product causes a competition between the new products and the shared products in the market. Therefore, my second study is motivated to investigate this self-cannibalization effect of sharing market on producers. We are motivated to examine the economic rationality and marketplace mechanisms in today's ever-booming sharing/reselling platforms. We are also interested in the market equilibrium and the managerial implications in different types of durable product markets such as automobile (with value depreciation) and real estate (with value appreciation).

According to the findings of the second research, which states that sharing market actually protects the profit of producer from the damage of reselling market, we generate an idea that

whether it's possible for the manufacturer to compete with the sharing platform by providing sharing service. However, we notice that in the real practice, some car manufactures are providing the new car subscription contracts recently, which indicates this research question is valuable and meaningful. Thus in the third part of this thesis, we focus on the new car subscription contracts provided by car manufactures. The third research is aimed to investigate the consumers' choices among four options: owning, leasing, manufacturer subscription, and platform subscription. Consumers evaluate the contents of different contracts to choose the optimal one. We are interested in the probability of each choice by considering a two-step discrete choice model in which consumers firstly decide which attributes for comparing the options and secondly determine the optimal contract based on their needs. We are also motivated to study the effect of characteristics, including payments, maintenance costs and flexibility, on matching the contract agreements to the consumers' needs. The insights that can be used to design the best suitable contract for a targeted consumer are also interesting.

With the enactment of GDPR, its impact on the sharing economy, especially the data management platforms, has emerged. So, in the last research, the objective is to investigate the challenges that GDPR brings to DMPs, which can considerably affect a big part of their business. Facing the upcoming GDPR regulation, the entire business community should change their present way of running businesses as long as their business uses personal data. We plan to identify the challenges for DMPs to be overcome by reviewing the current practice of DMPs and the policy implications of GDPR. These challenges range from giving users more insight into their data applications to security and data protection plans to ensure a secure storage of personal information. The GDPR has been enforced in May 2018, which pressures DMPs and many other companies using personal data to

adapt their business models and techniques of utilizing personal data.

## Research Methodology

There are three principle methods applied in this thesis: analytical modelling research, empirical study and qualitative research. The analytical models are established in my first and second research. My third work is an emprical study, which analyzes the collected dataset with a discrete choice model. The last work is a qualitative reserch, which reviews the relevant literature.

In the first part of this thesis, in order to investigate the temporal ownership boundary that exists in the sharing economy, we define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. By this definition, we can decompose a merchandise as two substitute goods: the ownership good and the transferring good. The ownership good can be consumed or shared by the owner. The transferring good can either be given as a gift or be resold for an income. We find that temporal factors play an important role in the decisions of collaborative contribution and the temporal ownership boundary can be found by considering the owner's holding cost, various transaction costs, and the potential income from the sharing economy activities.

In the second part of this thesis, we study the economic outcome of a monopolistic producer's self-competition between old and new generations of products. When the seller sells a new product today, some of the sold items will become tomorrow's competition when the consumers decide to put their used or excess products on the sharing or reselling platforms. We consider a two-stage game in which a producer sells new products in the market in both stages and used products may enter the market in the form of shared and used goods in the second stage. The model considers

owner's holding costs, transaction costs, and income from sharing.

In the third study, we set up a discrete choice model to estimate the potential of the subscription model. By considering a set of contract variables we have been able to compare the car subscription model to conventional car ownership options. With data gathered from car manufacturers and rental platforms and by using a multinomial logit regression, we derive the maximum utility of a car contract for a certain consumer.

The fourth part of this thesis provide a comprefensive review of several published papers regarding the impact of new European GDPR. The challenges with implementing this new regulation are highlighted and changes to facilitate the daily operations are proposed.

## **Research Contributions**

This thesis endeavors to provide theoretical and managerial insights to sharing economy and answer the research questions that motivated the study. The thesis proposes several novel and fundamental models for sharing economy, which identify its core characteristics and properties. It contributes a lot to the development of theory. Besides, the findings can be applied to help producers increasing their profit and reducing the waste in practice.

To be specifically, in the first study, we are the first to study the temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We are first to define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We also base our analysis on two variations of substitute modeling and consider the properties of social welfare by incorporating the utility functions of different players. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or

reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting insights to today's sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness.

The second study is different from these prior works in that we consider the impact of co-existing markets in two stages where the sales from the first stage would shape the market in the second stage which in turn alters the market decision making in the first stage. We nevertheless consider key variables that appear in the literature, including the transaction cost, holding cost of ownership, rental rates, price of new and used products, and surpluses generated in the markets. We identify the market equilibrium of this two-stage game and provide managerial implications in different types of product markets that are represented by automobiles (with value depreciation) and real estates (with value appreciation). We also identify the differences between the car industry and real estate industry in sharing market, which leads to completely different results. We show that despite the many similarities between Airbnb and Uber, value depreciation/appreciation implies very different competition scenarios. Our results highlight the dynamics of two-stage price/quantity equilibria in various product market setups and provide managerial insights for producers of durable goods.

In the third study, findings suggest that the subscription model has great potential to overrule the conventional methods of car ownership that are available in the market. The recurring subscription fee was found to be one of the most powerful predictors in assessing the attractiveness of a subscription contract to a consumer. Moreover, we found that car manufacturers hold a competitive advantage over car renting platforms in their subscription offering.

In the fourth study, five main challenges are identified for DMPs to be overcome in order to comply with the GDPR. These challenges range from giving users more insight into their data applications to security and data protection plans to ensure a secure storage of personal information.

## **Layout and an Overview**

In this section, I explain the layout of this thesis and provide an overview of each of the following parts. This main body of the thesis consists of four parts. In Part 1, I present the first study about temporal ownership boundary in the sharing economy, which focuses on the side of consumer and government. This study has been presented at the 15th Workshop on E-Business and published in the Lecture Notes of Business Information Processing. In Part 2, I provide the second study which investigates the self-cannibalization caused by sharing economy from producer's perspective. This study is under review by the journal Management Information System Quarterly. I show the third study about the new subscription contract in Part 3, which is in revision currently. Part 4 presents the data policy study of data management platforms. This study is published on the website of Management & Datascience. Finally, I conclude and discuss future research in Part 5.

### **Part I : Temporal ownership boundary in sharing economy**

In general, the sharing economy refers to the economic activities when goods or services are arranged to be contributed and shared among a group of consumers. It is normally characterized by a discounted price and a partial income for the collaborative contributors. Before the end of life (EOL) of a good (or a service subscription), the owner can freely use, share, give, or sell the good's remaining value. For examples, old clothes, musical instruments, books, cars, apartments, their value can be realized by above mentioned economic forms. What affects an owner's decision to choose one from the others?

To answer this question, we must consider the value of the goods, its inventory and holding cost, the transaction costs, and potential income from the sales, usage, or collaborative contribution. Most of these parameters are temporal factors. For instance, a costly inventory would normally give the owner a strong incentive to transfer its ownership by resale or gift-giving. On the contrary, a high remaining value of the good would make the owner willing to keep the ownership for individual or group consumption. In this research, we are motivated to investigate the properties of these temporal ownership variables and the boundary in the sharing economy.

A good's remaining ownership can be transferred. It creates other two emerging markets: the reselling market and the gift economy. The Gift economy refers to the economic activities that aim to transfer goods or services freely to other individuals without an agreed method of quid pro quo. The economy of reselling represents the transfer of the remaining value of goods accompanied by a resale price. The goods that are idle for one person may be needed by others, so they can make a deal by sharing, giving, or reselling. During the ownership period, we make a simplified definition by considering individual consumption as a special case of collective consumption when only the owner utilizes the good/service. By considering all the factors that influence the decision making, with general rationality, the owner is more willing to keep the ownership when the future income and the value exceed the costs of holding it. When the holding cost is significantly high, the owner would be more likely to transfer the ownership. There should exist an equilibrium where the owner is indifferent of sharing, giving, or reselling. The indifference point is further adjustable by the sharing network, charity organizations, the taxation policy, and by resale marketplace.

In this research we aim to investigate the temporal ownership boundary that exists in the sharing economy. We study the

temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We base our analysis on two variations of substitute modeling and consider the properties of social welfare by incorporating the utility functions of different players. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting insights to today's sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness.

## **Part II : Self-cannibalization of durable goods with sharing**

With increased number of available shared and used products and services, we observe new forms of business competitions between traditional sellers and collaborative contributors. These new forms of competitions exist in a wide spectrum of industrial and consumer products markets. For example, consumers are able to find a large variety of products that can be rented through sharing platforms or bought through reselling portals. On the supply side, we also observe that many automobile makers such as General Motors, BMW, and Daimler (the parent company of Mercedes-Benz) have launched their own car sharing services and invested in car sharing start-ups. This scenario casts an interesting pricing problem to these producers because each sold item may later enter the market and join the competition.

In this study, we investigate the pricing game of a monopolistic producer of durable goods. When the seller sells a new product today, some of the sold items will become tomorrow's competition when the consumers decide to put their used or excess products

on the sharing or reselling platforms. We examine the economic rationality and marketplace mechanisms in today's ever-booming sharing/reselling platforms. We consider a two-stage game in which sellers sell new products to the market in two stages and previously sold products may enter the market in the form of shared or used goods in the second stage. We consider the owner's holding costs, transaction costs, and income from sharing of the products. We identify the market equilibrium of this two-stage game and offer managerial implications in different types of durable product markets such as automobile (with value depreciation) and real estate (with value appreciation).

For ease of exposition, we make a few simplifying assumptions in our model. First, we focus on the pricing problem of a producer who makes a durable good that can span two periods. We do not examine any vertical structure in which owners of such products compete with each other in the market. Second, we do not consider substitute products/services in this part. Although it is important to understand the substitution effect, we want to focus on a monopolistic producer's decision variables such as price and quantity.

### **Part III : Automobile subscription: new alternative to ownership, lease or mixed?**

Many automobile makers such as General Motors, BMW, and Daimler have launched their own car subscription services and invested in car subscription startups in the recent years. The subscription service for automobile meets the consumers' desire of having the newest technologies and experiencing an all-inclusive ownership package. Compared with the conventional ways of car ownership, such as financing and leasing, the subscription provides a broader amount of services to the customer. By subscribing to a car program, a subscription fee and a monthly payment include not only the ownership of a car but also the insurance, registration, taxes, maintenance, and car swap. Among those services, the option to switch between different car models steadily is a great advantage compared to the conventional

ownership options. It especially satisfies the users' demand for "tasting" the innovations that appear in different car models. Moreover, another advantage of subscription is its lower initial payment, which generates a popular substitution for traditional ownership choices. In particular, for young people who belong to a relatively low income class, credit constraint is a reason of not being able to lease a car due to the significant upfront payment (Attanasio, Koujianou Goldberg, and Kyriazidou, 2008). Lastly, the subscription offers a flexible contractual option that allows cancellation with a short-period notice. Compared with the contract length of financing (6 years on average) and leasing (4 years on average), the new offer adapts to the rapidly shifting consumers' preferences of owning the latest car. It has also been found that target customers of other subscription services value similar features like the convenience of the service, the superior quality, the exclusive value, and the additional services offered.

Although the traditional ownership options have been studied from various point of views in the existing literature (e.g. Johnson, 2000, and Dasgupta, Siddarth and Silva-Risso, 2007), it is a new scope of research to investigate the subscription option in the automotive industry and the available literature on this topic is limited. In this study, we investigate the consumers' choices among four options: owning, leasing, manufacturer subscription, and platform subscription. Consumers evaluate the contents of different contracts to choose the optimal one. We examine the probability of each choice by considering a two-step discrete choice model in which consumers firstly decide which attributes for comparing the options and secondly determine the optimal contract based on their needs. We study the effect of characteristics, including payments, maintenance costs and flexibility, on matching the contract agreements to the consumers' needs. In general, we find that consumers in the upper-income class are more willing to finance new cars.

Meanwhile, for customers that cannot afford the financing or leasing option, the subscription can be an attractive option but with some exceptions. The results also provide insights that can be used to design the best suitable contract for a targeted consumer. For example, for a luxurious car company, offering subscription enables it to target specific profiles in the customer segment.

#### **Part IV : The Impact of General Data Protection Regulation (GDPR) on Data**

##### **Management Platforms (DMP): A Policy perspective**

The role of data management platform in the context of media development and online advertising is to segment audiences by integrating data from proprietary and third part sources, including determining the quantity and quality of data, to buy and to manage all the aspects of this data. This includes controlling and restricting access to data, tracking its utilization and reporting operational changes, attributes and data cost. These processes and techniques are often used to leverage custom audience segments by Demand Side Platforms (DSPs) and Supply Side Platforms (SSPs) (Shah et al., 2011). Data incorporated into a DMP can be firsthand data, coming from an organization's own applications, systems, websites and products, as well as secondhand data from partners and other associates. DMPs also often use third-party data to fill in holes in a company's own data including partner data. As stated in the GDPR all data processors and controllers who have data that can personally identify an individual will have to abide by the new regulations. Since DMPs are in the business of identifying audiences and individuals for purposes of better online targeting they will be directly affected by the emerging data regulation policies.

Programmatic buying, for example, is a business model for online computational advertising in the age of big data. Based on analysis of massive amounts of cookie data generated by Internet users, programmatic buying advertising has the potential of

identifying in real-time the characteristic and interest of the target audience in each ad impression, automatically delivering best-matched ads, and optimizing their prices via auction-based programmatic buying scheme. Programmatic buying has significantly changed online advertising, evolving from the traditional pattern of media buying and ad-slot buying to target-audience buying. Through cookie analysis, the DMP can identify the interests and characteristics of user. When this user opens a webpage an auction will be triggered once she inputs the URL and presses the enter key. The publisher will send the user information to the SSP who forwards the information to the Ad Exchange (AdX). The AdX further sends the user information to eligible DSPs. These DSPs in turn, ask DMPs and know that this user is a car enthusiast. So, each DSP sends the user information to its advertisers and starts an auction where advertisers that sell cars can submit bids for the opportunity of showing ads to the user. The winner from each DSP auction will enter the second-round auction in the AdX. The highest bidder among all DSPs finally obtains the ad impression, and her ads will be fed back to the AdX and SSP, and displayed to the user on the webpages of the publisher (Yuan et al., 2014). Given the breadth and scope of the number of private companies including many third party companies involved in the process, it is important to understand the impact of General Data Protection Regulations (GDPR).

General Data Protection Regulations was first approved on 14th April, 2016 and becomes enforceable on the 25th May, 2018. The GDPR replaces the Data Protection Directive and is designed to harmonize data privacy laws across Europe (Zhou and Piramuthu 2013, 2015), to protect and empower all EU citizens' data privacy and to reshape the way organizations across the region approach data privacy. According to GDPR Article 4 personal data or personally identifiable data (PII) with reference to the online advertising industry is "any information relating to an identified or identifiable natural person (data subject); an

identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person". GDPR (24) further extends that regulations are not limited to first party service providers but also third party processors of personal data. In the context of GDPR, DMP and programmatic buying this study shall discuss the working of DMPs in detail & their role in programmatic buying, the various techniques used by online advertising companies to identify and segment users (in a limited scope), the regulations as defined in GDPR and finally how service providers including third party processors comply with GDPR.



# Introduction en Français

Grâce au développement rapide des technologies de l'information, des réseaux sociaux basés sur Internet et du marché en ligne, les économies de partage, de don et de revente sont devenues des éléments importants de notre vie quotidienne. L'économie du partage fait référence aux activités économiques lorsque des biens ou des services sont organisés pour être partagés entre un groupe de consommateurs, caractérisés par un prix réduit et un revenu partiel pour les contributeurs collaboratifs. L'économie du don fait référence aux activités économiques qui visent à transférer librement des biens ou des services à d'autres personnes sans méthode convenue de contrepartie. L'économie de la revente représente le transfert de la valeur résiduelle des biens accompagné d'un prix de revente.

Généralement identifiée par les activités commerciales où des biens ou des services sont organisés pour être partagés entre un groupe de consommateurs, l'économie du partage d'aujourd'hui est généralement établie sur une plate-forme en ligne (Huihui et al., 2016). De nombreux marchés de partage ont vu le jour, par exemple AirBnB et Roomorama pour l'hébergement, SnapGoods pour les outils, RelayRides pour les voitures, Wheelz pour les vélos, Uber et Lyft pour les services de taxi ad hoc, etc. prêts entre pairs, financement participatif et couchsurfing, coworking, partage des connaissances et des talents, etc. L'économie du partage se caractérise par des avantages de niche de marché, tels que des coûts faibles, des revenus supplémentaires et de nouvelles communautés en réseau social, et une consommation de groupe, ce qui signifie moins cher, un revenu supplémentaire pour les propriétaires et de nouvelles communautés en réseau social. Nous prévoyons que l'économie du partage continuera d'évoluer et deviendra plus flexible et éminente dans un proche avenir en raison de ses motivations économiques fondamentales.

Avant l'horodatage de fin de vie d'un bien ou d'un service, le propriétaire a le libre choix d'utiliser, de partager, de donner ou de vendre sa valeur résiduelle. Par exemple, les vieux vêtements, les instruments inutilisés, une voiture d'occasion, un appartement, leur valeur peut être réalisée sous diverses formes économiques. Qu'est-ce qui influe sur la décision d'un propriétaire de choisir une forme qui a le meilleur sens économique? Nous devons tenir compte de plusieurs éléments importants: la valeur des marchandises, le coût des stocks, les coûts de transaction, les incitations politiques et les marchés disponibles.

Un inventaire coûteux inciterait normalement le propriétaire à détacher la propriété du bien par la revente ou le cadeau. Au contraire, une valeur résiduelle élevée du bien inciterait le propriétaire à conserver la propriété pour une consommation individuelle ou collective. Dans cette recherche, nous sommes motivés à étudier l'impact de ces éléments clés sur les décisions de partage / cadeau / revente et l'équilibre / équilibre sur le marché économique.

Dans une certaine mesure, le partage ressemble à la location qui est une forme classique d'économie car dans les deux cas, le propriétaire du bien gagne de l'argent en transférant le droit de l'utiliser sans changer la propriété du bien. Cependant, il existe des différences entre le partage et la location. Tout d'abord, l'économie du partage s'apparente davantage à un comportement de groupe tandis que la location est un comportement individuel. Par exemple, les utilisateurs d'Uber qui ne se connaissent pas peuvent emmener une voiture vers la même destination pour économiser du temps et du coût, mais la location d'une voiture signifie généralement que seul le locataire peut utiliser la voiture pendant la durée de la location, peu importe comment il l'utilise. Deuxièmement, le propriétaire pourrait utiliser le bien avec d'autres en même temps en économie de partage alors que cela ne se produirait pas en économie locative.

Par exemple, les utilisateurs d'AirBnB peuvent trouver une chambre sur le site Web qui doit vivre avec le propriétaire de la maison, mais louer une maison signifie toujours louer toute la maison et un contrat de bail formel est fourni. Résumer, L'économie de partage est plus flexible et pratique que la location tandis que la location est plus standard et traditionnelle, de sorte que les gens choisissent le partage ou la location en fonction de leurs différentes demandes et objectifs.

L'économie du cadeau est une méthode permettant aux gens de transférer des biens ou des services sans aucune contrepartie. De nos jours, les applications basées sur les principes de l'économie du cadeau varient considérablement. Par exemple, nous avons le don de bienfaisance, le collectivisme, la coopération, le don demandé, le paiement à votre guise, le reversement et le produit de la vente donné. L'économie du don représente une attitude optimiste des gens et c'est comme un moyen de transférer les biens ou les services de l'abondance relative vers la rareté relative. De plus, il est motivé par la compassion, la générosité des gens et favorise le bien commun par rapport aux avantages individuels. Cependant, une autre perspective importante nous oblige à examiner et à réfléchir à la façon dont nous pensons et mesurons la valeur. Cette prise de conscience peut également être transférée dans les transactions normales du marché, en tenant compte des coûts indirects tels que les coûts d'inventaire et les bénéfices d'actes spécifiques de consommation de matières. Le marché de la revente est une autre option que le propriétaire peut rechercher afin de transférer la propriété des biens / services. En raison de l'absence de structure de prix sur le marché de la revente non uniforme, la vente aux enchères est souvent utilisée pour récupérer la valeur réelle des biens demandés, par exemple eBay. Le prix fixe ou la négociation sont également courants, par exemple sur le marché Amazon. Le coût de transaction peut être très élevé et la valeur peut être sous-

estimée en raison du manque de structure de prix normalisée sur le marché de la revente.

## Questions pratiques

Ces dernières années, de nombreux marchés de partage ont vu le jour, ciblant divers segments économiques, dans le domaine de l'hébergement, des outils et des transports, etc. L'adoption généralisée d'Internet, des technologies mobiles et des plateformes de réseaux sociaux a abaissé la barrière au commerce collaboratif, contribution, et la consommation de manière significative. Cette tendance a abouti à de nouveaux mais des communautés commerciales significativement importantes de produits partagés et usagés. L'économie du partage devrait continuer d'évoluer et devenir plus flexible et plus éminente dans un proche avenir en raison de ses motivations économiques fondamentales. L'économie du partage facilite l'utilisation des produits et services à des niveaux plus proches de leur pleine capacité grâce à des marchés décentralisés qui permettent des échanges entre pairs. L'économie de la revente représente le transfert de la valeur résiduelle des produits usagés. Ces activités rendent le marché plus efficace et sont activées à grande échelle en raison des récents progrès technologiques dans les technologies de l'information et de la communication. D'un autre côté, les consommateurs changent leur préférence de la propriété à long terme à des options de partage à court terme plus respectueuses de l'environnement grâce au développement rapide de la technologie et à la prise de conscience croissante de la consommation durable. Par conséquent, l'abonnement devient de plus en plus populaire et se développe rapidement, en particulier dans l'industrie automobile. L'activité d'abonnement semble créer des incitations à l'acquisition d'actifs supplémentaires pour les fournisseurs de services. Les vendeurs automobiles traditionnels trouvent également des incitations à mettre à jour leurs modèles commerciaux, par exemple en envisageant d'offrir les services d'abonnement.

En supposant qu'il n'y ait pas de coût d'inventaire, le propriétaire des biens / services aurait l'intention de les conserver avec une valeur résiduelle quelconque. Cependant, s'il existe une récompense pour transférer la propriété sous forme de don ou de certains frais de détention, la tendance à conserver les biens peut se retirer. Cela crée une économie de cadeaux. Avec un coût d'inventaire non nul, une dépréciation de la valeur du bien et un avantage fiscal, le propriétaire peut avoir une utilité négative s'il détient le bien. L'économie du cadeau n'est cependant pas toujours attractive (Marcoux, 2009), et elle peut repousser les gens et rechercher le marché valorisé comme alternative. De plus, les gens accordent peu d'attention et montrent à peine leur compréhension des cadeaux (Cheal, 2015), en raison de la vie privée et du cadre conceptuel de cette activité.

Le marché de la revente a fortement déprécié les machines produites dans ces équipements concernés par les conflits (Mas, 2008). En outre, les composants de ces machines ont été revendus plus fréquemment et ont reçu des prix catalogue inférieurs. Dans l'action standard, il y a un soumissionnaire sur le marché de la revente qui n'a aucune valeur d'usage pour le bien en vente (Garratt et Thomas, 2006). Lorsque la revente mène aux enchères, il y a un équilibre dans le jeu enchères-revente, qui déterminerait le prix de l'offre. Mais dans un marché de revente parfait, la vente aux enchères avec revente ne serait pas le meilleur choix pour le vendeur (Ausubel et Peter, 2004).

Enfin, le règlement général européen sur la protection des données (RGPD) est entré en vigueur depuis le 25 mai 2018, ce qui signifie que l'utilisation de données structurées et non structurées provenant de sources disparates est sous la supervision du gouvernement. Cette nouvelle réglementation concerne de nombreux modèles économiques et entreprises qui dépendent des données collectées auprès des internautes en Europe. Par conséquent, l'économie du partage, qui est un modèle

peer-to-peer basé sur l'information, a également été affectée par le RGPD. Il est nécessaire d'étudier la mise en œuvre de la politique pertinente du RGPD pour étudier l'impact du RGPD sur l'économie du partage. Jusqu'à présent, la littérature examinant les détails du RGPD est limitée, ce qui augmente les difficultés à identifier la légalité de l'utilisation des données collectées, et les études actuelles liées au RGPD se concentrent principalement sur les plateformes de gestion des données (DMP) au lieu de partager l'économie.

## Lacunes de la recherche

À partir de la littérature existante sur l'économie du partage, l'économie du cadeau et le marché de la revente, nous trouvons un accord commun selon lequel toutes les formes de propriété doivent créer une réelle valeur pour le consommateur à la fin. Le concept de partage de vélos (Wheelz), de voitures (Uber) ou de maisons (Airbnb) commence à devenir de plus en plus populaire (Cohen et Kietzman, 2014). Afin d'obtenir une mobilité stable, les modèles commerciaux de mobilité partagée existants s'efforcent de trouver la relation optimale entre les bons propriétaires et les destinataires. De plus, l'économie du partage maintenant réussit dans la concurrence avec des entreprises concrètes et se différencie pour acquérir des parts de marché (Zervas et al., 2015). L'économie du partage est souvent liée à la consommation collaborative (Belk, 2014). En termes de perception de la propriété, la consommation collaborative est souvent considérée comme aussi importante que la révolution industrielle. Presque toutes les industries sont impliquées dans ce changement de rupture permanent de l'économie du partage et de la consommation collaborative. Les gens peuvent utiliser la consommation collaborative comme une force pour effectuer le développement durable et une méthode pour renforcer les communautés (Botsman et Roger, 2011). De plus, grâce aux technologies de l'information et de la communication, la consommation collaborative se développe rapidement (Hamari et

al., 2015). Et différents facteurs comme la durabilité jouent un rôle important dans la motivation de la participation à la consommation collaborative. Cependant, son côté obscur doit être traité lorsque l'économie du partage se développe (Malhotra et Van Alstyne, 2014), ce qui signifie qu'il faut éviter d'obtenir des avantages injustes comme l'arbitrage réglementaire. Et la démocratisation de la propriété et de la gouvernance de la plateforme aiderait à contrôler le pouvoir des nouvelles technologies (Schor, 2014). D'un autre côté, il y a encore des flottes et des coûts d'inventaire même dans l'économie du partage (Sundararajan, 2013). De nouveaux modèles de marché d'économie de partage, tels que des modèles de consommation repensés, sont nécessaires.

Plusieurs travaux récents fournissent des aperçus théoriques sur l'impact du partage sur les marchés en place pour les produits durables. Einav et coll. (2016) discutent des multiples éléments et perspectives de la conception des marchés par les pairs, y compris les algorithmes de recherche, les prix, les systèmes de réputation et les questions de réglementation. Horton et Zeckhauser (2016) proposent un modèle d'équilibre pour analyser l'impact du partage sur la propriété, les taux de location et le surplus généré dans un marché de partage. Weber (2016) aborde une question similaire et constate que le partage des marchés a tendance à augmenter le prix des nouveaux produits avec l'avantage plus grand pour les produits à coût élevé. Jiang et Tian (2018) construisent un modèle alternatif mettre en évidence le rôle des coûts de transaction sur le marché du partage et l'impact du partage sur la décision qualité de l'entreprise. En plus de ces études sur le partage de marché, il y a de plus en plus de recherches intéressées à fournir diverses stratégies pour les entreprises (par exemple, Mocker et Fonstad, 2017; Zhang et al., 2018; et Frey et al., 2019) et les plateformes d'économie de partage ( par exemple Constantiou et al., 2017 et Chasin et al., 2018). Ils décrivent différents types de plates-formes

d'économie de partage et identifient les caractéristiques des entreprises afin de déterminer la stratégie optimale, qui aiderait les entreprises à résister à l'impact négatif de l'économie de partage. Comme il ressort de la littérature, le centre d'intérêt des études sur l'économie du partage a été transféré du côté du consommateur au côté du producteur. Cependant, les connaissances théoriques pour le producteur sont jusqu'à présent limitées.

Plusieurs études ont analysé les options de location et d'achat d'une voiture, concernant le choix d'un constructeur automobile dans un environnement monopolistique à l'aide de modèles de la théorie des jeux. L'une des premières études a été menée par Bulow (1982), qui a découvert que le crédit-bail est une meilleure option pour les entreprises que la vente, car l'effet de la cohérence dans le temps réduit la rentabilité du vendeur. Des recherches ultérieures ont déterminé que la maximisation du profit d'une option de location ou de vente dépend du taux d'amortissement relatif du véhicule (Desai et Purohit, 1998). Ainsi, la dépréciation d'une voiture augmente légèrement au cours de la durée de vie des voitures. Ils affirment que les entreprises de construction automobile peuvent surperformer en vendant exclusivement en raison d'un taux de dépréciation des voitures plus élevé. Des études ultérieures ont examiné le marché de la location et de la vente, en ce qui concerne un modèle d'oligopole dynamique (Esteban et Shum, 2007; Andrikopoulos et Markellos, 2015). Alors que les recherches précédentes sont basées sur des résultats descriptifs, les conclusions de Johnson et al. (2014) se sont concentrées sur les résultats prédictifs. Ils ont supposé que la location et le financement étaient des substituts imparfaits et ont prédit qu'il existe une relation positive entre les taux de vente et les taux de location. Par conséquent, pour les bailleurs, cela peut avoir un résultat négatif si la location les taux sont déterminés par des valeurs prédites basées sur le marché vendeur, ce qui entraîne une perte

dans une perspective à long terme. Par rapport aux autres résultats empiriques, Johnson et al. (2014) ont mis l'accent sur la relation entre les deux marchés de la vente et de la location du point de vue d'une entreprise. La littérature discutée ci-dessus compare les options de location et de financement du point de vue d'une entreprise, sans tenir compte du choix optimal des consommateurs. Ils considèrent le choix des consommateurs comme équivalent tout en se concentrant uniquement sur la décision de l'entreprise. Cependant, cette hypothèse omet plusieurs facteurs essentiels qui influent sur le choix des consommateurs de posséder une voiture. Train et Winston (2007) ont observé la raison du rétrécissement du marché automobile intérieur aux États-Unis. L'étude a révélé qu'une perte de volonté d'acheter des consommateurs est attribuée à des caractéristiques de base telles que le prix, la taille, les coûts d'exploitation et la fiabilité. D'autres études ont examiné que des facteurs d'achat tels que les coûts des contrats financiers, y compris l'acompte et le paiement mensuel, la durée et le taux d'intérêt sont essentiels à prendre en compte. De plus, les coûts non comptabilisés résultant de l'utilisation de la voiture peuvent avoir un impact sur la décision d'achat des consommateurs ainsi que sur des facteurs démographiques tels que le revenu ou l'âge. En outre, d'autres publications ont émergé soulignant l'importance de considérer d'autres éléments déterminants, plutôt que les seuls facteurs de coût des acomptes et des mensualités.

Depuis l'entrée en vigueur du RGPD en 2018, certaines recherches examinent l'impact du RGPD. Ils se concentrent principalement sur les industries du partage de données, telles que la publicité en ligne (Urban et al., 2020) et la santé (Phillips, 2018). L'Internet of Thing (IoT) est un autre sujet incontournable concernant l'impact du RGPD (Loideamin, 2019). Selon l'étude de Lyu et al. (2020), les applications de consommation collaborative pour l'économie du partage sont basées sur le cloud,

ce qui devrait suivre une protection stricte de la confidentialité des données requise par le RGPD. Cependant, la recherche dans ce domaine est extrêmement limitée.

En résumé, les lacunes de recherche suivantes restent sans réponse:

- Un nouveau modèle d'entreprise pour le partage du marché de l'économie fait défaut.
- Les connaissances théoriques pour le producteur jusqu'à présent sont limitées.
- L'étude sur l'abonnement automobile est limitée.
- L'impact de la nouvelle réglementation GDPR sur l'économie du partage n'a pas été étudié

En conséquence, l'objet de cette thèse est de combler ces lacunes de recherche et de générer des résultats qui peuvent contribuer au domaine de l'économie du partage théoriquement et pratiquement.

## Questions de recherche

Afin d'étudier l'impact économique de l'économie du partage dans une perspective globale, il est nécessaire de considérer respectivement le comportement du consommateur et le comportement du producteur dans l'environnement de l'économie du partage, ce qui conduit naturellement à deux questions clés: *comment le consommateur se comporte-t-il pour participer à la économie de partage? et Comment le fabricant se comporte-t-il pour faire face à l'impact de l'économie de partage?*

Pour répondre à la première question sur le comportement du consommateur, nous devons prendre en compte la valeur du bien, son inventaire et son coût de détention, les coûts de transaction et les revenus potentiels de la vente, de l'utilisation ou de la contribution collaborative. La plupart de ces paramètres sont des facteurs temporels. Par exemple, un inventaire coûteux inciterait normalement le propriétaire à transférer sa propriété par la revente ou le cadeau. Au contraire, une valeur résiduelle

élevée du bien inciterait le propriétaire à conserver la propriété pour une consommation individuelle ou collective. Dans la première recherche de cette thèse, nous sommes motivés à étudier les propriétés de ces variables temporelles de propriété et la frontière dans l'économie du partage.

Pour répondre à la deuxième question sur le comportement des producteurs, nous observons de nouvelles formes de concurrence commerciale entre vendeurs traditionnels et contributeurs collaboratifs. Ces nouvelles formes de concours existent dans un large éventail de marchés de produits industriels et de consommation. Par exemple, les consommateurs peuvent trouver une grande variété de produits qui peuvent être loués via des plateformes de partage ou achetés via des portails de revente. Du côté de l'offre, nous remarquons également que de nombreux constructeurs automobiles tels que General Motors, BMW et Daimler (la société mère de Mercedes-Benz) ont lancé leurs propres services d'autopartage et investi dans des start-ups d'autopartage. Ce scénario pose un problème de prix intéressant à ces producteurs, car chaque article vendu peut par la suite entrer sur le marché et rejoindre la concurrence. Par conséquent, j'étudie l'effet d'auto-cannibalisation et l'abonnement automobile pour les constructeurs respectivement dans la deuxième et la troisième partie de cette thèse. Nous considérons néanmoins des variables clés qui apparaissent dans la littérature, notamment le coût de transaction, le coût de possession, les taux de location, le prix des produits neufs et d'occasion et les surplus générés sur les marchés. Nous identifions également les différences entre l'industrie automobile et l'industrie immobilière sur le marché du partage, ce qui conduit à des résultats complètement différents.

L'économie du partage a apporté de nouveaux problèmes sociaux qui n'ont jamais existé dans le passé, par exemple la protection des données et la protection de la vie privée. La récente promulgation du RGPD dans les pays européens m'a amené à

réfléchir à la question de recherche: la légalité et la réglementation de l'analyse de données dans l'économie du partage? Afin d'apporter une réponse, nous passons en revue l'état de l'art des DMP (Data Management Platform) qui sont des systèmes centralisés de collecte et d'analyse de grands ensembles de données structurées et non structurées provenant de sources disparates. Les données sont d'abord analysées, organisées et segmentées sur les DMP. Les données de deuxième et de tiers de différents groupes / types d'utilisateurs sont également utilisées pour des campagnes de marketing et de publicité. Notre recherche aborde les défis de la mise en œuvre des nouvelles politiques de régulation. Nous soulignons les changements nécessaires pour faciliter les opérations quotidiennes des DMP et les implications politiques du RGPD.

## **Objectifs de recherche**

Sur la base des principales questions de recherche présentées dans la section précédente, je souligne ici les quatre objectifs principaux de cette thèse.

Dans le premier objectif de recherche, nous visons à étudier la frontière temporelle de propriété qui existe dans l'économie du partage, qui indique quand le propriétaire veut partager ou donner. Nous étudions les facteurs temporels, y compris le coût de détention des stocks, le revenu collaboratif potentiel et l'utilité individuelle de la consommation avec différents horodatages. Nous définissons la limite de propriété temporelle comme la limite lorsque le propriétaire est indifférent à transférer la propriété de son statut actuel d'utilisation ou de partage. Nous basons notre analyse sur deux variantes de modélisation de substitution et considérons les propriétés du bien-être social en intégrant les fonctions d'utilité des différents acteurs. Nous constatons qu'il existe diverses conditions dans lesquelles cette frontière peut pencher vers le partage, l'offre de cadeaux ou la revente. Nous montrons que l'utilité individuelle et le bien-être social total peuvent être

optimisés en ajustant les incitations, les coûts de transaction et éventuellement le moment du transfert de propriété des biens. Nos résultats apportent des informations significatives et intéressantes aux entreprises des plateformes de partage, de cadeaux et de revente d'aujourd'hui sur la manière d'améliorer l'efficacité et la compétitivité.

Dans le deuxième objectif de recherche, le but est d'étudier cet effet d'auto-cannibalisation du partage du marché sur les producteurs. Lorsque le vendeur vend aujourd'hui un nouveau produit, certains des articles vendus deviendront la concurrence de demain lorsque les consommateurs décideront de mettre leurs produits usagés ou excédentaires sur les plateformes de partage ou de revente. Nous examinons la rationalité économique et les mécanismes du marché dans les plateformes de partage / revente en plein essor d'aujourd'hui. Nous considérons un jeu en deux étapes dans lequel les vendeurs vendent de nouveaux produits sur le marché en deux étapes et les produits précédemment vendus peuvent entrer sur le marché sous la forme de biens partagés ou d'occasion dans la deuxième étape. Nous considérons les frais de détention du propriétaire, les transaction coûts et les revenus du partage des produits. Nous identifions l'équilibre de marché de ce jeu en deux étapes et proposons des implications managériales dans différents types de marchés de produits durables tels que l'automobile (avec dépréciation de la valeur) et l'immobilier (avec une appréciation de la valeur).

Dans le troisième objectif de recherche, nous visons à étudier les choix des consommateurs parmi quatre options: possession, crédit-bail, abonnement fabricant et abonnement plate-forme. Les consommateurs évaluent le contenu des différents contrats pour choisir le meilleur. Nous examinons la probabilité de chaque choix en considérant un modèle de choix discret en deux étapes dans lequel les consommateurs décident d'abord quels attributs pour comparer les options et ensuite déterminent le contrat optimal en fonction de leurs besoins. Nous étudions l'effet des

caractéristiques, y compris les paiements, les coûts de maintenance et la flexibilité, sur l'adaptation des accords contractuels aux besoins des consommateurs. En général, nous constatons que les consommateurs de la classe supérieure sont plus disposés à financer de nouvelles voitures. Pendant ce temps, pour les clients qui ne peuvent pas se permettre l'option de financement ou de location, l'abonnement peut être une option intéressante, mais à quelques exceptions près. Les résultats fournissent également des informations qui peuvent être utilisées pour concevoir le contrat le mieux adapté à un consommateur ciblé. Par exemple, pour un constructeur automobile de luxe, proposer un abonnement lui permet de cibler des profils spécifiques dans le segment de la clientèle.

Dans le dernier objectif de recherche, nous visons à étudier les défis que le RGPD apporte aux DMP, qui peuvent affecter considérablement une grande partie de leur activité. Face à la future réglementation GDPR, l'ensemble de la communauté des affaires devrait changer sa façon actuelle de gérer les entreprises tant que leur entreprise utilise des données personnelles. Nous prévoyons d'identifier les défis à surmonter pour les DMP en examinant la pratique actuelle des DMP et les implications politiques du RGPD. Ces défis vont de donner aux utilisateurs un meilleur aperçu de leurs applications de données à des plans de sécurité et de protection des données pour assurer un stockage sécurisé des informations personnelles. Le RGPD a été appliqué en mai 2018, ce qui oblige les DMP et de nombreuses autres entreprises utilisant des données personnelles à adapter leurs modèles commerciaux et leurs techniques d'utilisation des données personnelles.

## **Méthodologie de recherche**

Il existe trois méthodes principales appliquées dans cette thèse : la recherche de modélisation analytique, l'étude empirique et la recherche qualitative. Dans la première partie de cette thèse, nous étudions la frontière temporelle de propriété qui existe

dans l'économie du partage. Nous définissons la limite de propriété temporelle comme la limite lorsque le propriétaire est indifférent à transférer la propriété de son statut actuel d'utilisation ou de partage. Par cette définition, nous pouvons décomposer une marchandise en deux biens de substitution: le bien de propriété et le bien de transfert. Le bien de propriété peut être consommé ou partagé par le propriétaire. Le bien à transférer peut être soit offert en cadeau, soit revendu contre un revenu. Nous constatons que les facteurs temporels jouent un rôle important dans les décisions de contribution collaborative et que la limite temporelle de la propriété peut être trouvée en tenant compte du coût de détention du propriétaire, des divers coûts de transaction et du revenu potentiel des activités d'économie de partage.

Sur la base des résultats de la première étude, nous sommes en mesure d'identifier la valeur résiduelle des produits usagés sur le marché du partage. Cependant, ces produits usagés facturent un prix inférieur avec une valeur réduite, ce qui attire de nombreux consommateurs. La réintégration de produits usagés provoque une concurrence entre les nouveaux produits et les produits partagés sur le marché. Par conséquent, ma deuxième étude est motivée pour étudier cet effet d'auto-cannibalisation du partage du marché sur les producteurs. Dans la deuxième partie de cette thèse, nous étudions le résultat économique de l'auto-concurrence d'un producteur monopolistique entre les anciennes et les nouvelles générations de produits. Nous considérons un jeu en deux étapes dans lequel un producteur vend de nouveaux produits sur le marché aux deux étapes et des produits usagés peuvent entrer sur le marché sous la forme de biens partagés et usagés au cours de la deuxième étape. Le modèle prend en compte les coûts de détention du propriétaire, les coûts de transaction et les revenus du partage.

Selon les conclusions de la deuxième recherche, qui indique que le marché du partage protège en fait le profit du producteur des

dommages causés par le marché de la revente, nous générons une idée de la possibilité pour le fabricant de concurrencer la plate-forme de partage en fournissant un service de partage. Cependant, nous remarquons que dans la pratique réelle, certains constructeurs automobiles fournissent récemment les nouveaux contrats d'abonnement de voitures, ce qui indique que cette question de recherche est précieuse et significative. Ainsi, dans la troisième partie de cette thèse, nous nous concentrons sur les nouveaux contrats d'abonnement automobile fournis par les constructeurs automobiles. Nous avons mis en place un modèle de choix discret pour estimer le potentiel du modèle d'abonnement. En considérant un ensemble de variables contractuelles, nous avons pu comparer le modèle d'abonnement automobile aux options conventionnelles de propriété automobile. À partir des données recueillies auprès des constructeurs automobiles et des plateformes de location et en utilisant une régression logit multinomiale, nous calculons l'utilité maximale d'un contrat automobile pour un certain consommateur.

La quatrième partie de cette thèse propose une revue complète de plusieurs articles publiés sur l'impact du RGPD. Les défis liés à la mise en œuvre de cette nouvelle réglementation sont mis en évidence et des changements pour faciliter les opérations quotidiennes sont proposés.

## **Contributions à la recherche**

Cette thèse s'efforce de fournir des informations théoriques et managériales sur l'économie du partage et de répondre aux questions de recherche qui ont motivé l'étude. La thèse propose plusieurs modèles novateurs et fondamentaux d'économie du partage, qui identifient ses caractéristiques et propriétés fondamentales. Cela contribue beaucoup au développement de la théorie. En outre, les résultats peuvent être appliqués pour aider les producteurs à augmenter leurs profits et à réduire les déchets dans la pratique.

Plus précisément, dans la première étude, nous sommes les premiers à étudier les facteurs temporels dont le coût de détention des stocks, le revenu collaboratif potentiel et l'utilité individuelle de la consommation avec différents horodatages. Nous définissons la limite de propriété temporelle comme la limite lorsque le propriétaire est indifférent à transférer la propriété de son statut actuel d'utilisation ou de partage. Nous basons notre analyse sur deux variantes de modélisation de substitution et considérons les propriétés du bien-être social en intégrant les fonctions d'utilité des différents acteurs. Nous constatons qu'il existe diverses conditions dans lesquelles cette frontière peut pencher vers le partage, l'offre de cadeaux ou la revente. Nous montrons que l'utilité individuelle et le bien-être social total peuvent être optimisés en ajustant les incitations, les coûts de transaction et éventuellement le moment du transfert de propriété des biens. Nos résultats apportent des informations significatives et intéressantes aux entreprises des plateformes de partage, de cadeaux et de revente d'aujourd'hui sur la manière d'améliorer l'efficacité et la compétitivité.

La deuxième étude est différente de ces travaux antérieurs en ce que nous considérons l'impact des marchés coexistants en deux étapes où les ventes de la première étape façonneraient le marché dans la deuxième étape, ce qui à son tour modifie la prise de décision sur le marché dans la première étape. . Nous considérons néanmoins des variables clés qui apparaissent dans la littérature, notamment le coût de transaction, le coût de possession, les taux de location, le prix des produits neufs et d'occasion et les surplus générés sur les marchés. nous identifions l'équilibre de marché de ce jeu en deux étapes et fournissons des implications managériales dans différents types de marchés de produits qui sont représentés par les automobiles (avec dépréciation de la valeur) et les biens immobiliers (avec appréciation de la valeur). Nous identifions également les

différences entre l'industrie automobile et l'industrie immobilière sur le marché du partage, ce qui conduit à des résultats complètement différents. Nous montrons que malgré les nombreuses similitudes entre Airbnb et Uber, la dépréciation / appréciation de la valeur implique des scénarios de concurrence très différents. Nos résultats mettent en évidence la dynamique des équilibres prix / quantité en deux étapes dans diverses configurations de marché de produits et fournissent des informations managériales aux producteurs de biens durables. Dans la troisième étude, les résultats suggèrent que le modèle d'abonnement a un grand potentiel pour dépasser les méthodes conventionnelles de possession de voitures disponibles sur le marché. Les frais d'abonnement récurrents se sont avérés être l'un des prédicteurs les plus puissants pour évaluer l'attractivité d'un contrat d'abonnement pour un consommateur. De plus, nous avons constaté que les constructeurs automobiles détiennent un avantage concurrentiel sur les plateformes de location de voitures dans leur offre d'abonnement. Dans la quatrième étude, cinq défis principaux sont identifiés pour que les DMP soient surmontés afin de se conformer au RGPD. Ces défis vont de la fourniture aux utilisateurs d'un meilleur aperçu de leurs applications de données aux plans de sécurité et de protection des données pour assurer un stockage sécurisé des informations personnelles.

## **Disposition et un aperçu**

Dans cette section, j'explique la mise en page de cette thèse et donne un aperçu de chacune des parties suivantes. Ce corps principal de la thèse se compose de quatre parties. Dans la première partie, je présente la première étude sur les limites temporelles de la propriété dans l'économie du partage, qui se concentre du côté du consommateur et du gouvernement. Cette étude a été présentée lors du 15e atelier sur les affaires électroniques et publiée dans les Notes de cours sur le traitement de l'information commerciale. Dans la partie 2, je

présente la deuxième étude qui examine l'auto-cannibalisation causée par l'économie du partage du point de vue du producteur. Cette étude est en cours d'examen par la revue *Management Information System Quarterly*. Je montre la troisième étude sur le nouveau contrat d'abonnement dans la partie 3. La partie 4 présente l'étude de politique de données des plates-formes de gestion de données. Enfin, je conclus et discute des recherches futures dans la partie 5.

### **Partie I: Limite de propriété temporelle dans l'économie du partage**

En général, l'économie du partage fait référence aux activités économiques lorsque des biens ou des services sont conçus pour être apportés et partagés entre un groupe de consommateurs. Il se caractérise normalement par un prix réduit et un revenu partiel pour les contributeurs collaboratifs. Avant la fin de vie (EOL) d'un bien (ou d'un abonnement à un service), le propriétaire peut librement utiliser, partager, donner ou vendre la valeur restante du bien. Par exemple, les vieux vêtements, les instruments de musique, les livres, les voitures, les appartements, leur valeur peut être réalisée par les formes économiques mentionnées ci-dessus. Qu'est-ce qui affecte la décision d'un propriétaire de choisir l'un des autres?

Pour répondre à cette question, nous devons considérer la valeur de la marchandise, son inventaire et son coût de détention, les coûts de transaction et les revenus potentiels de la vente, de l'utilisation ou de la contribution collaborative. La plupart de ces paramètres sont des facteurs temporels. Par exemple, un inventaire coûteux inciterait normalement le propriétaire à transférer sa propriété par la revente ou le cadeau. Au contraire, une valeur résiduelle élevée du bien inciterait le propriétaire à conserver la propriété pour une consommation individuelle ou collective. Dans cette recherche, nous sommes motivés à étudier les propriétés de ces variables temporelles de propriété et la frontière dans l'économie du partage.

La propriété restante d'un bien peut être transférée. Il crée deux autres marchés émergents: le marché de la revente et l'économie du cadeau. L'économie du don fait référence aux activités économiques qui visent à transférer librement des biens ou des services à d'autres personnes sans méthode convenue de contrepartie. L'économie de la revente représente le transfert de la valeur résiduelle des biens accompagné d'un prix de revente. Les biens qui sont inutilisés pour une personne peuvent être nécessaires à d'autres, afin qu'ils puissent conclure un accord en partageant, en donnant ou en revendant. Pendant la période de possession, nous faisons une définition simplifiée en considérant la consommation individuelle comme un cas particulier de consommation collective lorsque seul le propriétaire utilise le bien / service. En considérant tous les facteurs qui influencent la prise de décision, avec une rationalité générale, le propriétaire est plus disposé à conserver la propriété lorsque les revenus futurs et la valeur dépassent les coûts de détention. Lorsque le coût de détention est significativement élevé, le propriétaire est plus susceptible de transférer la propriété. Il devrait exister un équilibre où le propriétaire est indifférent à partager, donner ou revendre. Le point d'indifférence est en outre ajustable par le réseau de partage, les organisations caritatives, la politique fiscale et le marché de la revente.

Dans cette recherche, nous cherchons à étudier la frontière temporelle de propriété qui existe dans l'économie du partage. Nous étudions les facteurs temporels, y compris le coût de détention des stocks, le revenu collaboratif potentiel et l'utilité individuelle de la consommation avec différents horodatages. Nous définissons la limite de propriété temporelle comme la limite lorsque le propriétaire est indifférent à transférer la propriété de son statut actuel d'utilisation ou de partage. Nous basons notre analyse sur deux variantes de modélisation de substitution et considérons les propriétés du

bien-être social en intégrant les fonctions d'utilité des différents acteurs. Nous constatons qu'il existe diverses conditions dans lesquelles cette frontière peut pencher vers le partage, l'offre de cadeaux ou la revente. Nous montrons que l'utilité individuelle et le bien-être social total peuvent être optimisés en ajustant les incitations, les coûts de transaction et éventuellement le moment du transfert de propriété des biens. Nos résultats apportent des informations significatives et intéressantes aux entreprises des plateformes de partage, de cadeaux et de revente d'aujourd'hui sur la manière d'améliorer l'efficacité et la compétitivité.

## **Partie II: Auto-cannibalisation des biens durables avec partage**

Avec l'augmentation du nombre de produits et services partagés et d'occasion disponibles, nous observons de nouvelles formes de concurrence commerciale entre vendeurs traditionnels et contributeurs collaboratifs. Ces nouvelles formes de concours existent dans un large éventail de marchés de produits industriels et de consommation. Par exemple, les consommateurs peuvent trouver une grande variété de produits qui peuvent être loués via des plateformes de partage ou achetés via des portails de revente. Du côté de l'offre, on observe également que de nombreux constructeurs automobiles tels que General Motors, BMW et Daimler (la société mère de Mercedes-Benz) ont lancé leurs propres services d'autopartage et investi dans des start-ups d'autopartage. Ce scénario pose un problème de prix intéressant à ces producteurs, car chaque article vendu peut par la suite entrer sur le marché et rejoindre la concurrence.

Dans cette étude, nous étudions le jeu des prix d'un producteur monopolistique de biens durables. Lorsque le vendeur vend aujourd'hui un nouveau produit, certains des articles vendus deviendront la concurrence de demain lorsque les consommateurs décideront de mettre leurs produits usagés ou excédentaires sur les plateformes de partage ou de revente. Nous examinons la rationalité économique et les mécanismes du marché dans les

plateformes de partage / revente en plein essor d'aujourd'hui. Nous considérons un jeu en deux étapes dans lequel les vendeurs vendent de nouveaux produits sur le marché en deux étapes et les produits précédemment vendus peuvent entrer sur le marché sous la forme de biens partagés ou d'occasion dans la deuxième étape. Nous prenons en compte les frais de détention du propriétaire, les coûts de transaction et les revenus provenant du partage des produits. Nous identifions l'équilibre de marché de ce jeu en deux étapes et proposons des implications managériales dans différents types de marchés de produits durables tels que l'automobile (avec dépréciation de la valeur) et l'immobilier (avec une appréciation de la valeur).

Pour faciliter l'exposé, nous faisons quelques hypothèses simplificatrices dans notre modèle. Tout d'abord, nous nous concentrons sur le problème de prix d'un producteur qui fabrique un bien durable pouvant s'étaler sur deux périodes. Nous n'examinons aucune structure verticale dans laquelle les propriétaires de ces produits se font concurrence sur le marché. Deuxièmement, nous ne considérons pas les produits / services de substitution dans cette partie. Bien qu'il soit important de comprendre l'effet de substitution, nous voulons nous concentrer sur les variables de décision d'un producteur monopolistique telles que le prix et la quantité.

### **Partie III: Abonnement automobile: nouvelle alternative à la propriété, location ou mixte?**

De nombreux constructeurs automobiles tels que General Motors, BMW et Daimler ont lancé leurs propres services d'abonnement automobile et investi dans des startups d'abonnement automobile ces dernières années. Le service d'abonnement pour l'automobile répond au désir des consommateurs de disposer des technologies les plus récentes et d'expérimenter une formule de propriété tout compris. Par rapport aux modes conventionnels de possession d'une voiture, tels que le financement et le crédit-bail, l'abonnement fournit un plus grand nombre de services au client. En souscrivant à un programme de voiture, les frais d'abonnement

et le paiement mensuel comprennent non seulement la possession d'une voiture mais aussi l'assurance, l'immatriculation, les taxes, l'entretien et l'échange de voiture. Parmi ces services, la possibilité de basculer régulièrement entre différents modèles de voitures est un grand avantage par rapport aux options de propriété conventionnelles. Il répond particulièrement à la demande des utilisateurs de «goûter» les innovations qui apparaissent dans différents modèles de voitures. De plus, un autre avantage de l'abonnement est son paiement initial plus bas, ce qui génère une substitution populaire aux choix de propriété traditionnels. En particulier, pour les jeunes appartenant à une classe de revenus relativement faible, la contrainte de crédit est une raison de ne pas pouvoir louer une voiture en raison du paiement initial important (Attanasio, Koujianou Goldberg et Kyriazidou, 2008). Enfin, l'abonnement offre une option contractuelle flexible qui permet une annulation avec un préavis de courte durée. Par rapport à la durée du contrat de financement (6 ans en moyenne) et de crédit-bail (4 ans en moyenne), la nouvelle offre s'adapte aux préférences des consommateurs qui changent rapidement de posséder la dernière voiture. Il a également été constaté que les clients cibles d'autres services d'abonnement apprécient des fonctionnalités similaires telles que la commodité du service, la qualité supérieure, la valeur exclusive et les services supplémentaires offerts.

Bien que les options de propriété traditionnelles aient été étudiées de divers points de vue dans la littérature existante (par exemple Johnson, 2000, et Dasgupta, Siddarth et Silva-Risso, 2007), il s'agit d'un nouveau champ de recherche pour étudier l'option d'abonnement dans le secteur automobile. L'industrie et la littérature disponible sur ce sujet est limitée. Dans cette étude, nous examinons les choix des consommateurs parmi quatre options: possession, crédit-bail, abonnement fabricant et abonnement plate-forme. Les consommateurs évaluent le contenu des différents contrats pour choisir le meilleur. Nous examinons

la probabilité de chaque choix en considérant un modèle de choix discret en deux étapes dans lequel les consommateurs décident d'abord quels attributs pour comparer les options et ensuite déterminent le contrat optimal en fonction de leurs besoins. Nous étudions l'effet des caractéristiques, y compris les paiements, les coûts de maintenance et la flexibilité, sur l'adaptation des accords contractuels aux besoins des consommateurs. En général, nous constatons que les consommateurs de la classe supérieure sont plus disposés à financer de nouvelles voitures. Pendant ce temps, pour les clients qui ne peuvent pas se permettre l'option de financement ou de location, l'abonnement peut être une option intéressante, mais à quelques exceptions près. Les résultats fournissent également des informations qui peuvent être utilisées pour concevoir le contrat le mieux adapté à un consommateur ciblé. Par exemple, pour un constructeur automobile de luxe, proposer un abonnement lui permet de cibler des profils spécifiques dans le segment de la clientèle.

#### **Partie IV: L'impact du règlement général sur la protection des données (RGPD) sur les plates-formes de gestion des données (DMP): une perspective politique**

Le rôle de la plateforme de gestion de données dans le cadre du développement des médias et de la publicité en ligne est de segmenter les audiences en intégrant des données provenant de sources propriétaires et tierces, notamment en déterminant la quantité et la qualité des données, d'acheter et de gérer tous les aspects de ces données. Cela comprend le contrôle et la restriction de l'accès aux données, le suivi de leur utilisation et le rapport des changements opérationnels, des attributs et du coût des données. Ces processus et techniques sont souvent utilisés pour tirer parti des segments d'audience personnalisés par les plates-formes côté demande (DSP) et les plates-formes côté offre (SSP) (Shah et al., 2011). Les données incorporées dans un DMP peuvent être des données de première main, provenant d'applications, de systèmes, de sites Web et de produits propres

à une organisation, ainsi que des données de seconde main provenant de partenaires et d'autres associés. Les DMP utilisent également souvent des données tierces pour combler les trous dans les propres données d'une entreprise, y compris les données des partenaires. Comme indiqué dans le RGPD, tous les sous-traitants et contrôleurs de données qui disposent de données permettant d'identifier personnellement une personne devront se conformer aux nouvelles réglementations. Étant donné que les DMP visent à identifier les publics et les individus à des fins de meilleur ciblage en ligne, ils seront directement affectés par les politiques émergentes de réglementation des données.

L'achat programmatique, par exemple, est un modèle commercial pour la publicité computationnelle en ligne à l'ère du big data. Sur la base de l'analyse de quantités massives de données de cookies générées par les internautes, la publicité d'achat programmatique a le potentiel d'identifier en temps réel les caractéristiques et l'intérêt du public cible pour chaque impression d'annonce, de diffuser automatiquement les annonces les mieux adaptées et d'optimiser leurs prix. via un programme d'achat programmatique basé sur des enchères. L'achat programmatique a considérablement changé la publicité en ligne, passant du modèle traditionnel d'achat de médias et d'achat d'espaces publicitaires à l'achat auprès du public cible. Grâce à l'analyse des cookies, le DMP peut identifier les intérêts et les caractéristiques de l'utilisateur. Lorsque cet utilisateur ouvre une page Web, une enchère sera déclenchée une fois qu'elle aura saisi l'URL et appuyé sur la touche Entrée. L'éditeur enverra les informations sur l'utilisateur au fournisseur de services partagés, qui les transmettra à Ad Exchange (AdX). L'AdX envoie en outre les informations de l'utilisateur aux DSP éligibles. Ces DSP à leur tour, demandent aux DMP et savent que cet utilisateur est un passionné de voitures. Ainsi, chaque DSP envoie les informations de l'utilisateur à ses annonceurs et lance une enchère où les annonceurs qui vendent des voitures

peuvent soumettre des offres pour avoir l'opportunité de diffuser des annonces à l'utilisateur. Le gagnant de chaque enchère DSP participera à l'enchère de deuxième tour dans AdX. Le plus offrant parmi tous les DSP obtient finalement l'impression de l'annonce, et ses annonces seront renvoyées à AdX et SSP, et affichées à l'utilisateur sur les pages Web de l'éditeur (Yuan et al., 2014). Compte tenu de l'ampleur et de la portée du nombre d'entreprises privées, y compris de nombreuses entreprises tierces impliquées dans le processus, il est important de comprendre l'impact du Règlement général sur la protection des données (RGPD).

Le règlement général sur la protection des données a été approuvé pour la première fois le 14 avril 2016 et devient exécutoire le 25 mai 2018. Le RGPD remplace la directive sur la protection des données et est conçu pour harmoniser les lois sur la confidentialité des données à travers l'Europe (Zhou et Piramuthu 2013, 2015), pour protéger et renforcer la confidentialité des données de tous les citoyens de l'UE et remodeler la manière dont les organisations de la région abordent la confidentialité des données. Selon l'article 4 du RGPD, les données personnelles ou les données personnelles identifiables (PII) en référence à l'industrie de la publicité en ligne sont « toute information relative à une personne physique identifiée ou identifiable (personne concernée); une personne physique identifiable est une personne qui peut être identifiée, directement ou indirectement, notamment par référence à un identifiant tel qu'un nom, un numéro d'identification, des données de localisation, un identifiant en ligne ou à un ou plusieurs facteurs propres à l'aspect physique, physiologique, identité génétique, mentale, économique, culturelle ou sociale de cette personne physique ». Le RGPD (24) étend en outre que les réglementations ne sont pas limitées aux fournisseurs de services de première partie, mais également aux sous-traitants tiers de données personnelles. Dans le contexte du RGPD, du DMP

et de l'achat programmatique, cette étude abordera en détail le fonctionnement des DMP et leur rôle dans l'achat programmatique, les différentes techniques utilisées par les sociétés de publicité en ligne pour identifier et segmenter les utilisateurs (dans un périmètre limité), les réglementations en tant que défini dans le RGPD et enfin comment les fournisseurs de services, y compris les processeurs tiers, se conforment au RGPD.



# Part I. Temporal Ownership Boundary in Sharing Economy



## Forewords

In this research, we investigate the temporal ownership boundary that exists in the sharing economy. We find that temporal factors play an important role in the decisions of collaborative contribution. A collaborative contributor needs not only consider the engagement duration and the potential income, but also the holding/inventory/maintenance costs during its ownership. We define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. By this definition, we can decompose a merchandise as two substitute goods: the ownership good and the transferring good. The ownership good can be consumed or shared by the owner. The transferring good can either be given as a gift or be resold for an income. The temporal ownership boundary can be found by considering the owner's holding cost, various transaction costs, and the potential income from the sharing economy activities. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling.

This research is coauthored with 1) Wei Zhou, ESCP Business School and 2) Selwyn Piramuthu, University of Florida. This study has been 1) presented at the 15th Workshop on E-Business and 2) published in the Lecture Notes of Business Information Processing.



## Chapter 1. Introduction

In recent years, many sharing marketplaces have emerged, targeting various economic segments, for example AirBnB and Roomorama for lodgement, Snap-Goods for tools, RelayRides for cars, Wheelz for bikes, Uber and Lyft for ad hoc taxi services, etc. Services can also be shared, for example peer-to-peer lending, crowdfunding, and couchsurfing, coworking, knowledge and talent-sharing, etc. We foresee that sharing economy will keep evolving and become more flexibility and eminent in the near future because of its fundamental economic drives.

In general, the sharing economy refers to the economic activities when goods or services are arranged to be contributed and shared among a group of consumers. It is normally characterized by a discounted price and a partial income for the collaborative contributors. Before the end of life (EOL) of a good (or a service subscription), the owner can freely use, share, give, or sell the good's remaining value. For examples, old clothes, musical instruments, books, cars, apartments, their value can be realized by above mentioned economic forms. What affects an owner's decision to choose one from the others?

To answer this question, we must consider the value of the goods, its inventory and holding cost, the transaction costs, and potential income from the sales, usage, or collaborative contribution. Most of these parameters are temporal factors. For instance, a costly inventory would normally give the owner a strong incentive to transfer its ownership by resale or gift-giving. On the contrary, a high remaining value of the good would make the owner willing to keep the ownership for individual or group consumption. In this research, we are motivated to investigate the properties of these temporal ownership variables and the boundary in the sharing economy.

A good's remaining ownership can be transferred. It creates other two emerging markets: the reselling market and the gift economy. The Gift economy refers to the economic activities that aim to

transfer goods or services freely to other individuals without an agreed method of quid pro quo. The economy of reselling represents the transfer of the remaining value of goods accompanied by a resale price. The goods that are idle for one person may be needed by others, so they can make a deal by sharing, giving, or reselling. During the ownership period, we make a simplified definition by considering individual consumption as a special case of collective consumption when only the owner utilizes the good/service. By considering all the factors that influence the decision making, with general rationality, the owner is more willing to keep the ownership when the future income and the value exceed the costs of holding it. When the holding cost is significantly high, the owner would be more likely to transfer the ownership. There should exist an equilibrium where the owner is indifferent of sharing, giving, or reselling. The indifference point is further adjustable by the sharing network, charity organizations, the taxation policy, and by resale marketplace.

In this research we aim to investigate the temporal ownership boundary that exists in the sharing economy. We study the temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We base our analysis on two variations of substitute modeling and consider the properties of social welfare by incorporating the utility functions of different players. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting insights to today's

sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness.

The remainder of this part is organized as follows. In chapter 2, We provide a brief review of literature in today's sharing economy, resale marketplace and gift economy. In chapter 3 we propose a substitute model that defines the temporal ownership boundary. We discuss the results and draw managerial implication in chapter 4. We make concluding remarks and give guidance to future research in chapter 5.



## Chapter 2. Literature Review

From the existing literature in sharing economy, gift economy and resale market, we find a common agreement that all forms of ownership must create real consumer value at the end. The concept of sharing bikes (Wheelz), cars (Uber), or houses (Airbnb) begins to become more and more popular (Cohen and Kietzman, 2014). In order to obtain the stable mobility, existing shared mobility business models try hard to find the optimal relationship between good owners and receivers. What's more, sharing economy now achieves success in the competition with concrete firms and makes itself differential to acquire market share (Zervas et al., 2015). The economy of sharing is often linked to the collaborative consumption (Belk, 2014). In terms of how we think about ownership, collaborative consumption is often considered as important as the Industrial Revolution. Almost all industries are involved in this ongoing disruptive change of sharing economy and collaborative consumption. People can use collaborative consumption as a force to effect the sustainable development and a method to strengthen communities (Botsman and Rogers, 2011). On the top of that, owing to information and communications technologies, collaborative consumption develops rapidly (Hamari et al., 2015). And different factors like sustainability play important roles in motivating the participation in Collaborative Consumption.

However, its dark side needs to be deal with when the sharing economy grows up (Malhotra and Van Alstyne, 2014), which means to gain unfair advantages like regulatory arbitrage should be avoided. And democratizing the ownership and governance of the platform would help to control the power of new technologies (Schor, 2014). In the other hand, there are still fleets and inventory costs even in the sharing economy (Sundararajan, 2013). New sharing economy market models like reengineered consumption models are needed.

Supposing if there is no inventory cost, the owner of the goods/services would have the intention to keep them with any residue value. If there exists a reward to transfer the ownership as a gift or certain holding cost, the tendency to keep the goods may withdraw. It creates the economy of gifts. With non-zero inventory cost, depreciating value of the good and taxation benefit, the owner might make a negative utility if he/she holds the good. The gift economy, however, is not always attractive (Marcoux, 2009), and it can push people away and seek the valorized market as an alternative option. What's more, people pay little attention and hardly show their understanding to gift giving (Cheal, 2015), because of the privacy and conceptual framework of this activity.

Resale market heavily depreciated machines produced in these dispute-affected equipment (Mas, 2008). Besides, components of these machines were resold more frequently and received lower list prices. In the standard action, there is a bidder in resale market who doesn't have any use value for the good on sale (Garratt and Thomas, 2006). When resale leads the auction, there is an equilibrium in the auction-plus-resale game, which would determine the bidding price (Ausubel and Peter, 2004). But in perfect resale market, the auction with resale would not be the best choice for the seller.

### Chapter 3. Temporal Boundary & Ownership Substitution

Today, the barrier of group trade, collaborative consumption, and donation has greatly diminished comparing to the recent past. It creates new yet phenomenally large business communities to share, resell and gift the remaining value of goods and services. We observe certain similarities among the mentioned three forms by considering the time when the good's ownership is transferred. Individual and collaborative consumption is characterized by holding the ownership. Well, collaborative consumption does not strictly follow the ownership if the consumer only "rent". Because the focus of this research is on the boundary of sharing and gift, we emphasize on the good owner's decision in the following model development. Gift and resale are similar because in both forms the ownership will be transferred. Figure 1 demonstrate how we can decompose a good or service simply based on its expected life and the time point of ownership transfer.

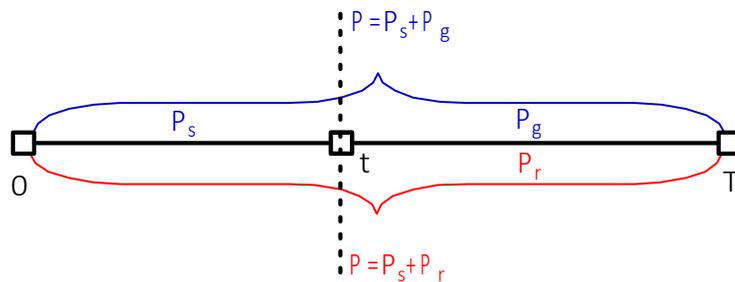


Figure 1 Decomposition of a good

Thus, a good can be decomposed into two substitutes by specifying the temporal boundary when the ownership is transferred, ranging from time zero to its end of life (Figure 1). Let T represent the end of life time stamp of a good. We decompose the good/service in two parts: the ownership part ( $P_s$ ) and the detachment part ( $P_g$  or  $P_r$ ).  $P_g$  represents the remaining part to be given as a gift and  $P_r$  indicates that the remaining value will be resold on a reselling market. Whenever the good still belongs to the owner, he/she has to choose whether to separate the ownership in the future, when (t), and how (gift or resale).

### 3.1 Analysis of the optimal decision

The gift economy is different from a free supply-demand market because the goods are not well organized, listed and marketed to the consumers. It involves transaction costs for both donors and receivers to give and find the right goods. In this sense, the intermediary plays a very important role in reducing the transaction costs from both side by giving effort to improve the service. We consider the intrinsic value of goods, inventory holding cost, transaction cost, and good-will rewards in the gift economy model. We use the following list of notations:

Table 1 Notations

<b>Natation</b>	<b>Brief Description</b>
V	Value of the good
HC	Holding cost of the good
R(v)	Good-will reward of giving a gift
S	Income from sharing
TC <sub>1</sub>	Transaction cost of sharing
TC <sub>2</sub>	Transaction cost of gift
TC <sub>3</sub>	Transaction cost of resale
T	Estimated remaining life of the good from time zero
Re(v)	Resale price
i	time interest/discount rate
U <sub>r</sub>	Utility from resale
U <sub>g</sub>	Utility from gift giving
U <sub>1</sub>	Utility from owning the good
U <sub>2</sub>	Utility from detaching the good
$\sigma_t$	Sharing income volatility

At any time point of a good before its end of life, the owner has three choices: 1) to give the good as a gift, or 2) to share(use) it, 3) to resell it. The utility of sharing/using the good is the value of the good (V) plus the income from

sharing/using it (S) minus the holding/maintenance cost (HC) and the transaction cost (TC<sub>1</sub>) as represented in Eq.(1). The utility of gift giving consists of the inventory holding credit (HC) plus the reward (R) minus the value of the good (V) and the transaction cost(TC<sub>2</sub>), as Eq. (2). The utility of reselling the good is price of the good according to the value of the good (V) minus the holding/maintenance cost (HC) and the transaction cost(TC<sub>3</sub>) as represented in Eq.(3). And the utility from detaching the good is the maximum of reselling and gift giving.

$$U_1(t) = V(t) - HC(t) - TC_1 + S(t) \quad (1)$$

$$U_2(t) = \max (U_g(t), U_r(t)) \quad (2)$$

$$U_g(t) = HC(t) - V(t) - TC_2 + R \quad (3)$$

$$U_r(t) = Re(V(t)) + HC(t) - V(t) - TC_3 \quad (4)$$

Equation (1) to (4) depict the economical rationality behind sharing/gift/resale decision in general. We can further define the product valuation, the holding cost, and the sharing income according to time as follows:

$$V(t) = A \left( \frac{e^k}{1+i} \right)^t \quad (5)$$

$$HC(t) = \frac{c}{\ln(1+i)} [1 - (1+i)^{-t}] \quad (6)$$

$$S(t) = V(t)E \left[ \frac{S}{V} \middle| x = t \right] = V(t)e^{\frac{1}{2}\sigma_t^2} \quad (7)$$

$$Re(V(t)) = V(t) \quad (8)$$

In Eq. (5), k is the a kind of value power which shows the change of value. The value of good decreases with the time when k<0 while the value increases when k > 0. In Eq. (6), we assume unit holding cost is a constant. In Eq. (7), we assume that at any time,  $\frac{S(t)}{V(t)}$  is a random variable, which has a logarithmic normal distribution with parameters 0 and  $\sigma_t$ . It's nature to consider  $\sigma_t$  increases when t increases because of the characteristic of volatility. So we could let  $\sigma_t = st$  with s>0. In Eq. (8), we assume  $Re(V(t))$  is a normal random variable with parameters V(t) and  $\sigma_t'$ . Eq. (5) to Eq. (8) are still very general,

and can be finetuned according to commodity types in different industries or applications. We use these equations to facilitate the calculations and to demonstrate the boundaries and conditions in the different economic forms.

Theorem 1. *At any time point if  $\alpha = Re(V(t)) - TC3 + TC2 - R > 0$ , resale is more preferable than gift giving. Otherwise, the good owner would rather like to make a donation.*

Proof. It can be easily proved by comparing  $U_r$  with  $U_g$  where  $\alpha$  stands for the difference between these two possible owner's utilities.

From now on we use  $U_2$  to represent the utility of detaching the good, where  $U_2(t) = \max(U_g(t), U_r(t))$ . If we consider  $U_1$  and  $U_2$  as two substitute choices for the owner, which means if  $U_1$  surpasses  $U_2$ , the owner intends to share. Otherwise, if  $U_2$  is greater than  $U_1$ , he/she prefers to detaching the good either as a gift or as a resale item. His/her maximization problem for perfect complements can be modeled as follow:

$$\text{Max } U\{x, y\}_t \quad (9)$$

subject to:

$$x_t U_1 + y_t U_2 = U\{x, y\}_t \quad (10)$$

$$x_t + y_t = 1 \quad (11)$$

$$x_t \in \{0,1\}, y_t \in \{0,1\} \quad (12)$$

From Eq. (5) to (7), We can form the following intermediate formulas regarding the remaining value of the good, the inventory cost/credit, and the sharing income.

$$V(t)' = A \left( \frac{e^k}{1+i} \right)^t [k - \ln(1+i)] \quad (13)$$

$$V(t)'' = A \left( \frac{e^k}{1+i} \right)^t [k - \ln(1+i)]^2 \quad (14)$$

$$HC(t)' = C(1+i)^{-t} \quad (15)$$

$$HC(t)'' = -C \ln(1+i) (1+i)^{-t} \quad (16)$$

$$S(t)' = S(t)[\sigma_t \sigma_t' + k - \ln(1+i)] \quad (17)$$

and draw the graphs of  $U_1$  and  $U_2$  respectively in the same coordinate system in order to determine whether  $x = 1$  or  $y =$

1. alternatively, we can also observe the function  $U_1 - U_2$  directly to find the even point. To be detailed:

$$U_1(t)' = V' - HC' + S' \quad (18)$$

$$U_1(t)'' = V'' - HC'' + S'' \quad (19)$$

$$U_1(0) = A - TC_1 \quad (20)$$

$$U_2(t)' = HC' - V' \quad (21)$$

$$U_2(t)'' = HC'' - V'' \quad (22)$$

$$U_2(0) = -A + R - TC_2 \quad (23)$$

Theorem 2. *If  $k > \ln(1+i)$ , the owner would be more likely to prefer to sharing/holding the good than giving it out as a gift.*

Proof. Because the value of the good always increases, the owner would consider keeping the ownership of the good as appreciation instead of depreciation.

So we will discuss under the circumstance  $k < \ln(1+i)$ , which makes  $HC' - V = A[k - \ln(1+i)] \left(\frac{e^k}{1+i}\right)^t - C(1+i)^{-t}$  lower than zero in that case.

In order to observe  $U_1$  and  $U_2$  more conveniently and clearly, the function  $[U_1 - U_2](t)$  would be discussed in the following. Let

$$[U_1 - U_2](t) = \phi(t) - \theta \quad (24)$$

where

$$\phi(t) = S(t) + 2(V - HC) \quad (25)$$

$$\theta = TC_1 + R - TC_2 \quad (26)$$

Then the condition  $U_1 > U_2$  is equivalent to  $\phi(t) > \theta$ , which is also equivalent to  $S(t) + 2(V - HC) > TC_1 + R - TC_2$ .

From the analysis above, we know that  $V - HC$  is a monotonous decreasing convex function based on the facts that  $V' - HC' < 0$  and  $V'' - HC'' > 0$ . On the other hand,  $S'$  is linear monotonous increasing function of  $t$  and when  $t = \frac{\ln(1+i)-k}{s^2}$ ,  $S' = 0$ . So  $\phi' = S' + 2V' - 2HC'$  is a monotonous increasing function from negative to positive with the unique zero point  $t_0$ . In other words, when  $0 < t < t_0$ ,  $\phi(t)$  decreases with  $t$ , while when  $t > t_0$ ,  $\phi(t)$  increases with  $t$ , which shows that  $t_0$  is the minimum point of the function  $\phi(t)$ .

Theorem 3. *If the minimum of the function  $\phi(t)$  is larger than or equal to  $\theta$ , which is the same with  $\phi(t_0) \geq \theta$ , then  $U_2(t)$  won't exceed  $U_1(t)$ , which means the owner will share the good until the end of product life cycle.*

Proof. From the perspective of  $[U_1 - U_2](t)$ , we can get the minimum of the function  $[U_1 - U_2](t)$  is not below zero given those conditions, which result in  $[U_1 - U_2](t) \geq 0$  is correct for all the  $t$ . In other words,  $U_1(t) \geq U_2(t)$  is always correct.

Let  $t^*$  is the first solution which satisfies that  $\phi(t^*) = \theta$ , then:

Theorem 4. *If the minimum of the function  $\phi(t)$  is smaller than  $\theta$ , which is the same with  $\phi(t_0) < \theta$ , then  $t^*$  is the potential separation point, which means the owner will give the good away at the time  $t^*$  indeed if the gray area is larger than the second red area, otherwise the owner will share it until the  $T$ . However, if  $t_0 \geq T$ , which indicates there is no red area, then  $t^*$  is surely separation point.*

Proof. Because of the former analysis of the property of the function  $\phi(t)$ , we know there are two intersections for us to consider when  $\theta$  is within the range of function value. To be detailed,  $t^*$  is sure to be achieved and it's more important than the second one because  $t^*$  is potential giving point while the second one is not. We just need it to determine whether to give the good at the time  $t^*$  by comparing the red area after the second intersection and the gray area before it. So actually, we don't care its existence and value of second intersection. If the second separation point doesn't exist when  $t_0 \geq T$ , then we can consider red area as zero, which is necessarily less than gray area.

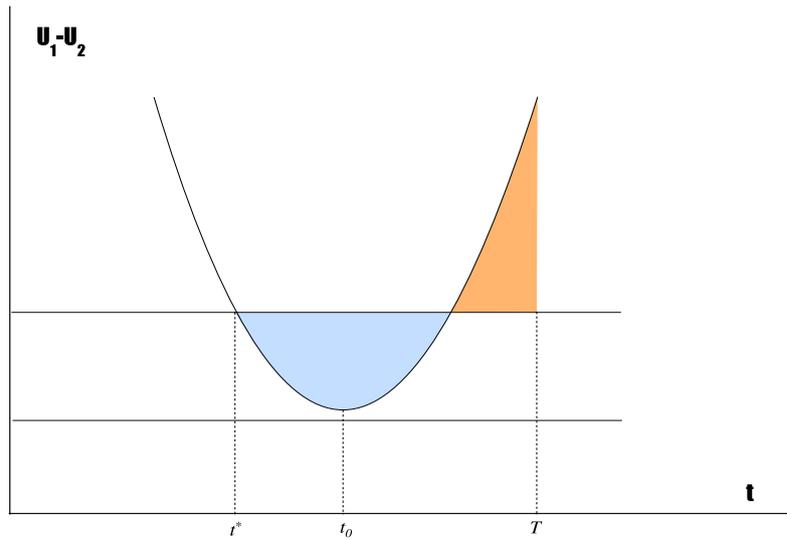


Figure 2 Temporal Ownership Boundary when  $t_0 < T$

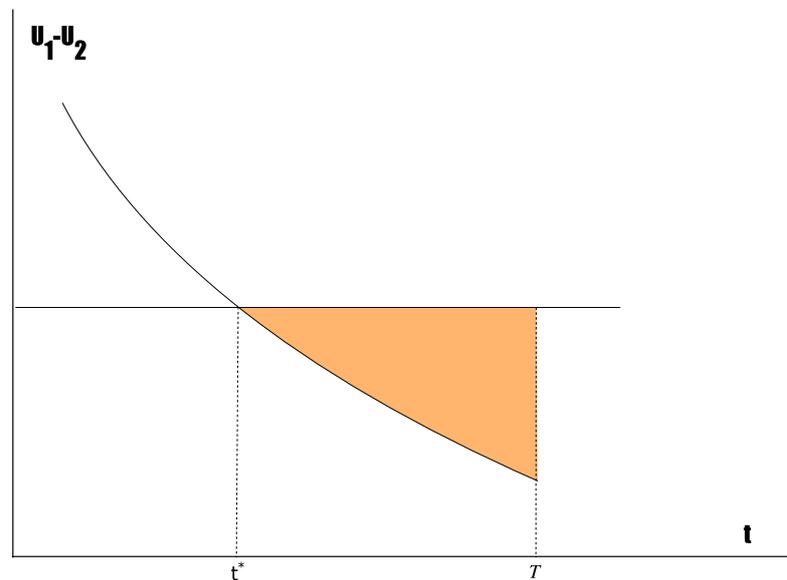


Figure 3 Temporal Ownership Boundary when  $t_0 \geq T$

### 3.2 An alternative Model

Because it's possible for the owner to share the good for a certain time period and give it as a gift in the future, we may consider  $x$  and  $y$  as the tendency of sharing and gift-giving respectively. In this case, we shall abandon constraints Eq. (10), (11) and (12) and make  $x$  and  $y$  continuous. In other words, we will take the two different statuses of a certain good, which are sharing and giving, as two competitors in order to find the result of the battle between sharing and giving.

If we consider the total remaining life of the good as  $T$  and when the owner gives it as a gift in a future time point  $t$ ,  $x$  represents the proportion of sharing as  $x = \frac{t}{T}$ , and  $y$  represents the proportion of gift-giving  $y = 1 - x$ . The original problem from Eq. (3) to Eq. (7) becomes:

$$\max U\{x, y\} \quad (27)$$

subject to:

$$xU_1 + yU_2 = U\{x, y\}_t \quad (28)$$

$$x + y = 1 \quad (29)$$

$$x = \frac{t}{T}, x \in [0,1] \quad (30)$$

$$y = 1 - \frac{t}{T}, x \in [0,1] \quad (31)$$

$$t \leq T \quad (32)$$

$$U_1(t) = V(t) - HC(t) - TC_1 + S(t) \quad (33)$$

$$U_2(t) = HC(t) - V(t) - TC_2 + R \quad (34)$$

$$V(t) = A \left( \frac{e^k}{1+i} \right)^t \quad (35)$$

$$HC(t) = \frac{c}{\ln(1+i)} [1 - (1+i)^{-t}] \quad (36)$$

Eq. (35) states the intrinsic value of the good at a future time  $t$  from time point 0. In order to calculate  $V$ , we take into consideration of depreciation that consists of the initial value of the asset and its estimated "life". Eq. (36) represents the accumulated value of released inventory cost as an "inventory holding credit".

For the perspective of Eq. (30),  $MRS = -1$ , while from the perspective of the linear utility function Eq. (29),  $\frac{MU_x}{MU_y} = -\frac{U_2}{U_1}$ .

As the result of principles in the microeconomics,  $MRS = \frac{MU_x}{MU_y}$

indicates that  $U_1(t) = U_2(t)$  is the condition for the optimal solution, which is the same condition with what we have discussed in the previous subsection.

What's more, for the purpose of maximizing the utility, we need to find the point  $t^*$ , which makes  $\frac{\partial U}{\partial t}(t^*) = 0$ . We can simplify that

$\frac{\partial U}{\partial t} = \frac{1}{T}[U_1 - U_2] + \frac{t}{T}[U'_1 - U'_2] + U'_2$ . And it's easy to prove that the solution of this equation is exactly the  $t^*$ .



## Chapter 4. Economic & Managerial Implications

### 4.1 Numerical analysis

In general, as been observed from Figure 2,  $P_s$  and  $P_g$  is separable by  $t^*$ , which could be affected by the gift rewards  $R$  and sharing income  $S$ . The reward usually has something to do with tax deduction, while sharing income usually directly relates to cost and sharing platform.

The impact from the sharing income is that if only  $s$  increases, then  $t_0$  decreases and  $t^*$  increases finally, even making giving not to happen as shown in the Table 2.

Table 2 Analysis of Temporal Ownership Boundary According to Various  $s$

PAR	Th2	Th3	Th4	Th5	Th6	Th7	Th8	Th9
A	10	10	10	10	10	10	10	10
i	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
k	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
C	2	2	2	2	2	2	2	2
s	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
R	7	8	9	10	10	10	10	10
TC1	1	1	1	1	1	1	1	1
TC2	2	2	2	2	2	2	2	2
T	20	20	20	20	20	20	20	20
$\theta$	9	9	9	9	9	9	9	9
$t^*$	NA	6.8	6.9	6.9	7.0	7.2	7.4	7.7

The impact from gift reward can be found by examining  $R$ . We can write  $R$  as  $\lambda V(t) + R_0$ . As a result, there is an adjustment from 2 to  $2 - \lambda$  in the coefficient of the  $V(t)$  and an added constant in the function of  $U_1 - U_2$ . However, this adjustment only creates small changes. If only  $R$  increase, then  $t^*$  decreases finally. And vice versa. The change in TC1 and TC2 also influences the value

of  $t^*$  via changing the minimum of the function  $[U_1 - U_2](t)$ . The integrated effect of  $R + TC_1 - TC_2$  can be shown in the Table 3.

Table 3 Analysis of Temporal Ownership Boundary According to Various  $\theta$

PAR	Th2	Th3	Th4	Th5	Th6	Th7	Th8	Th9
A	10	10	10	10	10	10	10	10
i	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
k	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
C	2	2	2	2	2	2	2	2
s	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
R	7	8	9	10	10	10	11	11
TC1	1	1	1	1	1	2	2	3
TC2	2	2	2	2	1	1	1	1
T	20	20	20	20	20	20	20	20
$\theta$	6	7	8	9	10	11	12	13
$t^*$	8.7	8.1	7.5	7.0	6.6	6.1	5.7	5.2

From above analysis, we can conclude that:

Theorem 5. *The decrease in  $s$  has the same effect with the increase in  $R + TC_1 - TC_2$ , which would both cause the decrease in  $t^*$ . Furthermore, inverse change in  $R + TC_1 - TC_2$  and  $S_r$  would strengthen their effect while synchronized change in  $R + TC_1 - TC_2$  and  $S_r$  would counteract their respective effects.*

#### 4.2 Managerial implications

From the perspective of the owner of the good, the higher  $\sigma_t$  would bring higher income but the high income would discourage the owner to give the good as a gift according to our results. However, the high  $\sigma_t$  would also make the good less competitive at the same time. As the result of that, there is an equilibrium in the price setting for the sharer to obtain the maximum income and meanwhile it wouldn't eliminate the possibility for the gift giving.

From the perspective of government, to increase the reward by enhance the tax deduction is a good method to encourage people to give the good away as soon as possible. But it's impossible to promote the tax deduction without limiting cap, which is the most common current practice. As it can be seen from our results, the game between the sharing income and gift economy reward would play a key role in the owner's decision. Adjusting the tax deduction corresponding to the price of sharing market would make the reward more effective.

From the perspective of firms that promote gift economy, normally these firms are considered non-profit. There exist many challenges that they have to overcome, such as the lack of supply, the increasing demand of charity, the lack of understanding of both donors and receivers, and sometimes the financial difficulties to operate the platform and to reduce the transaction cost. Our result shows that by reducing the transaction cost, the time for people to give the good as gift would be brought forward, which means the platform would receive the goods earlier. Even for those who will not donate the goods, the reduced transaction cost and increased rewards would give them the motivation to donate. Our results also shows that today's ever booming sharing and resale economy, because of the reduced transaction cost to share and to resell along with increasing sharing and resale income thanks to the Internet, actually shrink the already small market size for the gift economy. We prove that in order to boost the spirit of good-will in our society, the government and the charity organizations must come up with new models or effective taxation incentives to struggle with the increasing income of sharing or reselling in order to encourage the gift giving, like revising the tax deduction corresponding to the price of sharing market.

From the perspective of the sharing or reselling platform, reducing the transaction cost by new technology would help them receive more goods from the owner. And the goodwill for their

efficiency like well distribution of the goods would attract more people to share or give their goods because they may believe that platform could help them fulfill their purpose. In that way, owing to the double-sided model, platform would benefit from the increasing sharer/donors by attracting more receivers, which would in turn enhance the volatility of the platform. Nevertheless, transaction cost is the profit of platform, which means the transaction cost would not decrease without limit. Compared with that in gift economy, our results shows that the difference between two kinds of transaction cost could be utilized by government or charity organizations to encourage people to give their good as a gift.

## Chapter 5. Conclusion

In this research we investigate the temporal ownership boundary that exists in the sharing economy. We study the temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We base our analysis on two variations of substitute modeling and consider the properties of social welfare by incorporation the utility functions of different players. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting insights to today's sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness.

Thanks to the rapid development of various online social networks and recommender systems, today's consumers are able to gain access to information instantly, to communicate with other consumers conveniently, and to enjoy low cost online c2c transactions. The Internet has enabled the booming of the three emerging economic forms that we have discussed in this research. For future research, we foresee many variations and new economic models based on the temporal ownership boundary. For example, in reality the parameter of  $k \leq \ln(1 + i)$  in our model happens to appear more frequently than the ones when  $k > \ln(1 + i)$ . However, the existing reward function loses its influence in the case of  $k \leq \ln(1 + i)$ , which means an alternative reward mechanism should be designed.



## References

- Ausubel, L. M., & Cramton, P. (2004). Vickrey auctions with reserve pricing. *Economic Theory*, 23(3), 493-505.
- Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, 67(8), 1595-1600.
- Botsman, R., & Rogers, R. (2011). *What's mine is yours: how collaborative consumption is changing the way we live*. London: Collins.
- Cheal, D. (2015). *The gift economy*. Routledge.
- Cohen, B., & Kietzmann, J. (2014). Ride on! Mobility business models for the sharing economy. *Organization & Environment*, 27(3), 279-296.
- Garratt, R., & Thomas T. (2006). Speculation in standard auctions with resale. *Econometrica*, 74(3), 753-769.
- Hamari, J., Sjoekint, M., & Ukkonen, A. (2016). The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science and Technology*, 67(9), 2047-2059.
- Malhotra, A., & Van Alstyne, M. (2014). The dark side of the sharing econoy and how to lighten it. *Communications of the ACM*, 57(11), 24-27.
- Marcoux, J. S. (2009). Escaping the gift economy. *Journal of Consumer Research*, 36(4), 671-685.
- Mas, A. (2008) Labour unrest and the quality of production: Evidence from the construction equipment resale market. *The review of economic studies* 75.1: 229-258.
- Schor, J. (2016). *Journal of Self-Governance and Management Economics*, 4(3), 7-22.
- Sundararajan, A. (2013). From Zipcar to the sharing economy. *Harvard Business Review* 1(1), 1-2.
- Zervas, G., Proserpio, D. and Byers, J.W. (2017) The rise of the sharing economy: Estimating the impact of Airbnb on the hotel industry. *Journal of marketing research*, 54(5), pp.687-705.



Partie II. Self-  
Cannibalization of Durable  
Goods with Sharing: A  
Producer Perspective



## Forewords

Facilitated by various online platforms, transaction costs of sharing and selling used and excess products have become almost zero and this phenomenon has created new economic competition between new product sellers and those offering shared and used products. In this paper, we study the economic outcome of a monopolistic producer's self-competition between old and new generations of products. We consider a two-stage game in which a producer sells new products in the market in both stages and used products may enter the market in the form of shared and used goods in the second stage. The model considers owner's holding costs, transaction costs, and income from sharing. We identify the market equilibrium of this two-stage game and provide managerial implications in different types of product markets that are represented by automobiles (with value depreciation) and real estates (with value appreciation). We show that despite the many similarities between Airbnb and Uber, value depreciation/appreciation implies very different competition scenarios. Our results highlight the dynamics of two-stage price/quantity equilibria in various product market setups and provide managerial insights for producers of durable goods.

This study is coauthored with 1) Wei Zhou, ESCP Business School, 2) Selwyn Piramuthu, University of Florida, and 3) Michael Zhang, CUHK Business School. This study is currently under second-round review of Management Information System Quarterly.



## Chapter 1. Introduction

Wide-spread adoption of the Internet, mobile technologies, and social-network platforms lowered the barrier to collaborative trade, contribution, and consumption significantly. This trend has resulted in new but significantly large business communities of shared and used products and services. Many sharing marketplaces have emerged over the last few years: AirBnB and Roomorama for lodging, Snapproducts for tools, Zipcar and Turo (formerly RelayRides) for cars, Wheelz and Mobike for bikes, Uber, Lyft and Didi for ad hoc taxi services, Kickstarter and Lending Club for funding, Upwork and Freelancer for talents, etc. Generally identified by the business activities where products or services are designated to be shared among a group of consumers, today's sharing economy is typically established through various online and mobile platforms. The sharing economy facilitates products and services to be used at levels closer to their full capacity through decentralized markets that enable peer-to-peer exchanges. The reselling economy represents the transfer of the remaining value of used products. These activities make the market more efficient and are enabled on a massive scale because of recent technological advances in information and communication technologies.

With increased number of available shared and used products and services, we observe new forms of business competitions between traditional sellers and collaborative contributors. These new forms of competitions exist in a wide spectrum of industrial and consumer products markets. For example, consumers are able to find a large variety of products that can be rented through sharing platforms or bought through reselling portals. On the supply side, we also observe that many automobile makers such as General Motors, BMW, and Daimler (the parent company of Mercedes-Benz) have launched their own car sharing services and invested in car sharing start-ups. This scenario casts an interesting

pricing problem to these producers because each sold item may later enter the market and join the competition.

In this study, we investigate the pricing game of a monopolistic producer of durable goods. When the seller sells a new product today, some of the sold items will become tomorrow's competition when the consumers decide to put their used or excess products on the sharing or reselling platforms. We examine the economic rationality and marketplace mechanisms in today's ever-booming sharing/reselling platforms. We consider a two-stage game in which sellers sell new products to the market in two stages and previously sold products may enter the market in the form of shared or used goods in the second stage. We consider the owner's holding costs, transaction costs, and income from sharing of the products. We identify the market equilibrium of this two-stage game and offer managerial implications in different types of durable product markets such as automobile (with value depreciation) and real estate (with value appreciation).

For ease of exposition, we make a few simplifying assumptions in our model. First, we focus on the pricing problem of a producer who makes a durable good that can span two periods. We do not examine any vertical structure in which owners of such products compete with each other in the market. Second, we do not consider substitute products/services in this part. Although it is important to understand the substitution effect, we want to focus on a monopolistic producer's decision variables such as price and quantity.

The remainder of this part is organized as follows. In Chapter 2, We provide a brief review of literature on sharing and resale economy. In Chapter 3 we model the two-stage decisions and market responses. We discuss the results and draw managerial implications in Chapter 4. Finally, we conclude and discuss future research in Chapter 5.

## Chapter 2. Literature Review

There is a small but quickly growing literature on sharing economy's features and implications. Sundararajan (2016) provides a nice overview of determinants and economic outcomes of the sharing economy. Malhotra and Van Alstyne (2014) discuss the dark side of the sharing economy and the associated challenges. Cusumano (2015) examines possible strategies that incumbent firms can take to compete in the sharing economy. The empirical and theoretical economic impact of sharing on incumbent firms and consumers has gained increased attention from academic researchers. By using AirBnB data on accommodation sharing, Zervas et al. (2017) find a negative effect of AirBnB entry on hotel revenue, the effect is shown to be primarily driven by less aggressive room pricing. In the context of automobile market, Martin et al. (2010) observe a negative association between car sharing and ownership. Fraiberger and Sundararajan (2017) develop a calibrated model of peer-to-peer rental markets for cars and find a decrease in car ownership but an increase in car utilization after the introduction of car sharing. In contrast, Gong et al. (2017) find a significant positive association between Uber entry in China and new car ownership by exploiting spatio-temporal variation in Uber entry. Greenwood et Wattal 2017 find that the entry of ride-sharing would decrease the rate of alcohol related motor vehicle fatalities. More broadly, related work has examined the impact of online platforms in general in other domains. For example, several studies focus on the impact of Craigslist, an online platform for free classified ads, on the newspaper industry (e.g., Seamans and Zhu, 2013). Kim and Hann (2017) examine the relationship between online crowdfunding and bank financing to highlight the role of crowdfunding to democratize access to finance. Moreover, some researchers study the problems related to sharing information and dataset with empirical methods, such as Huang et al., 2019 ; Chen et al., 2017 and Menon and Sarkar,

2016. Bapna et al. (2017) discuss the relationship between social ties and economic measure of trust in online social networks.

Several recent works provide theoretical insights into the impact of sharing on incumbent markets for durable products. Einav et al. (2016) discuss the multiple elements and perspectives of peer market design, including search algorithms, pricing, reputation systems, and regulation issues. Horton and Zeckhauser (2016) propose an equilibrium model to analyze the impact of sharing on ownership, rental rates, and the surplus generated in a sharing market. Weber (2016) tackles a similar question and finds that sharing markets tend to increase the price of new products with the benefit greater for high-cost products. Jiang and Tian (2018) construct an alternative model to highlight the role of transaction costs in the sharing market and the impact of sharing on firm's quality decision. On the top of those studies about sharing market, there are increasing researches interested in providing various strategies for the firms (e.g. Mocker and Fonstad, 2017 ; Zhang et al., 2018 and Frey et al., 2019) and sharing economy platforms (e.g. Constantiou et al., 2017 and Chasin et al., 2018). They describes different types of sharing economy platforms and identify the characteristics of firms in order to figure out the optimal strategy, which would help companies to resist the negative impact of sharing economy.

As it can be observed from the literature, the focus of studies concerning sharing economy has been transferred from consumer side to the producer side. However, the theoretical insights for producer so far are limited. Our study is different from these prior works in that we consider the impact of co-existing markets in two stages where the sales from the first stage would shape the market in the second stage which in turn alters the market decision making in the first stage. We nevertheless consider key variables that appear in the literature, including the

transaction cost, holding cost of ownership, rental rates, price of new and used products, and surpluses generated in the markets. We also identify the differences between the car industry and real estate industry in sharing market, which leads to completely different results.

Our study is also related to the literature on secondary markets for durable products. When new products become available, they can severely influence the sales of the older generation, thereby creating the cannibalization effect on older products (Bulow, 1982; Fudenberg and Tirole, 1998). At the same time the resale value of a product in the secondary market can affect the valuation of the product for forward-looking consumers in the primary retail market (Chevalier and Goolsbee, 2009; Rust, 1986). There is a body of studies that examines various topics in this stream, including the impact of secondary markets on firms' profit (Anderson and Ginsburgh, 1994; Chen et al., 2013), firms' pricing and new product introduction decisions (Fishman and Rob, 2000), and firms' decisions on product durability (Johnson, 2011; Waldman, 2003). A small body of literature has focused particularly on Internet-enabled secondary markets. Ghose et al. (2006) find that sales of used books on Amazon.com, while significantly increasing consumer surplus, have a limited negative effect on the demand for new books on the website. Bapna et al. (2008) also observe an increase in consumer surplus mainly for used products at eBay. By examining an online auction market for used cars, Kuruzovich et al. (2010) show that Internet-enabled markets affect sellers' search strategies and associated market outcomes.

Table 4 Summary of Literature

Paper	Main Topic	Focus	Method	Monopoly	Decision Variables	Market
Bulow (1983)	Effect of secondary market on durable-goods monopolists	Seller	Theoretical	Y	P, Q, C	Durable
Rust (1986)	Equilibrium model of a durable goods market	Consumer / Seller	Theoretical	Y	P, Q, C	Durable
Anderson and Ginsburgh (1994)	Price discrimination in the second-hand market of durable products	Seller	Theoretical	Y	P, Q, C	Durable
Fudenberg and Tirole (1998)	Monopoly pricing of overlapping generations of a durable good	Seller	Theoretical	Y	P, Q	Durable
Fishman and Rob (2000)	Durability design for durable products	Seller	Theoretical	Y	P, Q	Durable

Waldman (2003)	Contribution to durable goods theory and firm practices	Seller	Commentary			Durable
Ghose et al. (2006)	Product Cannibalization between used products and new products	Seller	Theoretical/Empirical	Y	P,Q	Durable
Bapna et al. (2008)	Consumer surplus levels in online auctions	Consumer	Empirical	Y	P,Q	Durable/Auction
Chevalier and Goolsbee (2009)	Whether consumers are forward-looking about durable products	Consumer	Empirical	N	P,Q	Durable
Martin et al. (2010)	Association between car sharing and ownership	Consumer	Empirical	N	Q	Sharing
Kuruzov et al. (2010)	How market characteristics influence the final	Consumer/Seller	Empirical	Y	P,C	Durable/Auction

	sale price in online auctions					
Johnson (2011)	Effect of changes in consumer valuation on the secondary- market frictions	Seller	Theoretic al	Y	P,Q,C	Durable
Chen et al. (2013)	Effect of secondary market on firms	Consumer /Seller	Empirical	N	P,Q	Seconda ry
Seamean s and Zhu (2013)	Impact of Craigslist	Seller	Empirical	Y	P,Q	Sharing
Malhotra and Van Alstyne (2014)	Dark side and challenges	Seller/G overnmen t	Conceptua l			Sharing
Cusuman o (2015)	Strategies for firm to compete	Seller	Theoretic al	N	Q	Sharing
Frailbe rger and Sundara	Peer-to-peer rental market	Seller	Empirical	N	Q,C	Sharing /Durabl e

rajan (2015)						
Einav et al. (2016)	Peer market design	Seller	Theoretic al	N	Q	Sharing
Horton and Zeckhau ser (2016)	Impact of sharing on ownership, rental rate and the surplus	Consumer	Theoretic al	Y	P,C	Sharing
Jiang and Tian (2018)	Transaction costs and impact on firm's quality decision	Seller	Theoretic al	Y	P,Q,C	Sharing
Weber (2016)	Impact of sharing market on high-cost products	Consumer /Seller	Theoretic al	Y	P,Q	Sharing
Gong et al. (2017)	Effect of Uber entry on car ownership in China	Consumer	Empirical	N	Q	Sharing /Durabl e
Kim and Hann (2017)	Relationship between online crowdfunding	Consumer	Empirical	N	Q	Sharing

	and bankfinancin g					
Zervas et al. (2017)	Effect of AirBnB on hotel	Consumer /Seller	Empirical	N	P,Q	Sharing
This paper	How sharing changes competition	Supplier /Consume r/ Seller	Theoretic al	Y	P,Q,C	Sharing /Durabl e

## Chapter 3. Model

In this section, we first investigate the economic characteristics of sharing and reselling. We define the market segments of the two channels along with the new product sellers in a two-stage game. The market equilibrium is derived through backward induction.

We consider a monopolist producer that sells a durable good, which lasts for at least two periods. We assume that the producer has a constant marginal production cost. In period 1, only new products are available on the market. In period 2, new products along with used ones from period 1 are available in the market. Used products are considered different from the new ones in that the used ones may have their values depreciated (e.g., automobiles) or appreciated (e.g., real estate) over time.

We assume the markets of sales and sharing are separate. Separating the markets for sharing and reselling implies that consumers do not treat shared and used products as the same. Consumers are considered heterogeneous and they have different values for the durable goods in each period. We assume that these period-specific valuations are represented by the parameter  $\varphi = [0,1]$  (Mussa and Rosen 1978, Moorthy 1984, Desai and Purohit 1996). A higher  $\varphi$  implies a higher valuation for the product. We assume that  $\varphi$  is distributed uniformly between 0 and 1. In each period, each consumer uses at most one product. Because the product valuations may depreciate or appreciate, we can distinguish consumers' valuations provided by new and used products. Let  $V(\varphi)$  reflect a consumer's gross valuation of the products provided in each period. As a result,  $V(\varphi)$  equals  $\varphi$  for the new product and  $\varphi(1-\theta)$  for the used product where  $\theta$  represents depreciation or appreciation. Consequently, price varies with the depreciation/appreciation and age of the product.

### 3.1 Notations

Notations are summarized in Table 5.

Table 5 Notations

Notation	Brief Description
$q_{in}, \bar{q}_{in}$	quantity of new products sold for self-usage and sharing respectively in period $i, i \in \{1,2\}$
$Q_{in}$	the total quantity of new products sold in period $i, Q_{in} = q_{in} + \bar{q}_{in}$ for $i \in \{1,2\}$
$p_{in}, \bar{p}_{in}$	purchasing and sharing price of new products in period $i, i \in \{1,2\}$
$c_{in}$	wholesale (manufacturing) cost of new products in period $i, i \in \{1,2\}$
$k_i$	the ratio of the product sold in period 1 which would, in period 2, leave the market ( $i = 0$ ), enter the sharing market ( $i = 1$ ) or enter the resale market ( $i = 2$ )
$\bar{k}_i$	the ratio of the shared product in period 1 which would, in period 2, leave the market ( $i = 0$ ), enter the sharing market ( $i = 1$ ) or enter the resale market ( $i = 2$ )
$Q_{2u}$	the total quantity of used product in the 2nd period $Q_{2u} = k_2 q_{1n} + \bar{k}_2 \bar{q}_{1n}$
$\bar{Q}_{2u}$	the total quantity of shared product in the 2nd period $\bar{Q}_{2u} = k_1 q_{1n} + \bar{k}_1 \bar{q}_{1n}$
$p_{2u}, \bar{p}_{2u}$	purchasing and sharing price of used product in the 2nd period respectively
$T$	expected lifetime of the product
$t$	we let $T - t$ represent the expected remaining lifetime of the product

$\theta_t$	depreciation rate of the product over time with $0 \leq \theta_t \leq 1, \theta_t = \frac{t}{T}$
$v_t$	residual value of the product, $v_t = 1 - \theta_t$
$c_h$	holding cost per unit time
$C_t$	cumulative holding cost
$r_s$	sharing revenue per unit time
$R_t$	cumulative sharing revenue
$\omega_t$	overall residual value of a product, $\omega_t = v_t - C_t + R_t$
$\varphi$	consumer's valuation of the product, where $\varphi \in [0,1]$
$V(\varphi, \omega_t)$	the consumer's gross valuation, $V(\varphi, \omega_t) = \varphi \cdot \omega_t$
$\Pi_{ij}$	Profit function for product of type $j$ in period $i$ , $i \in \{1,2\}$ and $j \in \{u,n\}$ for used and new products
$C_{in}$	Cost function for new product in period $i$ , which is equal to producer's profit function, $i \in \{1,2\}$
1st period	A new product is first introduced in this period
2nd period	In this period, the market is aware of the product. Both new and used products coexist
*	indicator of an equilibrium value

First of all, we consider a product with life cycle  $T$ , which serves as the boundary condition. In other words, at the end of product's life  $T$ , for depreciated product, the value decreases to zero; while for appreciated product, the value reaches the maximum. Then, we use parameter  $\theta$  to capture the life cycle of the used product, where  $0 \leq \theta \leq 1$ . A new product has  $\theta = 0$ , and when

the product reaches its end of life  $\theta = 1$  at time  $T$ . We assume that the total amount of depreciation/appreciation is spread over an asset's entire lifetime in a linear way with respect to time. With the linear depreciation/appreciation scheme, we have  $\theta_0 = 0$ ,  $\theta_T = 1$ , and  $\theta_t = \frac{t}{T}$  for any  $t \in [0, T]$ . As a result, the unit residual value of the product  $v_t$  becomes  $1 - \theta_t$ , which can also be expressed alternatively as  $1 - \frac{t}{T}$ . In addition, the holding cost  $C_t = c_h \cdot (T - t)$  and sharing revenue  $R_t = r_s \cdot (T - t)$  accumulate linearly with the remaining time of the product.  $c_h$  and  $r_s$  are unit-time holding cost and sharing revenue, which are included in the valuation function to reflect consumers' valuation preferences on the potential behavioral change on holding and sharing. Finally, we let  $\omega_t$  denote the aggregated value for the product at time  $t$ , where

$$\omega_t = v_t - C_t + R_t$$

Because the product in the market have different valuations over time, consumers would have specific valuations for each product. We let  $\varphi \in [0, 1]$  represent consumers' valuation of the product, where a higher  $\varphi$  implies a higher valuation for the product. We further assume that  $\varphi$  is uniformly distributed between 0 and 1. We then let  $V(\varphi, \omega_t)$  represent a consumer's gross valuation of the utility generated by using the product in each period so  $V(\varphi, \omega_t) = \varphi \cdot \omega_t$ , where  $\omega_t$  is the aggregated value of product. We include the holding cost and sharing income in the valuation function to reflect consumers' valuation preferences on the potential behavioral change on holding and sharing. Finally, note that consumers' net utility for the product is dependent on the price paid, that is,  $U = V(\varphi, \omega_t) - p$ , where  $p$  is the price. For simplicity, we assume that the time periods modeled in this study are much shorter than the time it takes for the next new version of the item of interest becomes available. In other words, the new products

that are available during periods one and two are similar in all respects, and the market participants do not have to consider the existence of a third period.

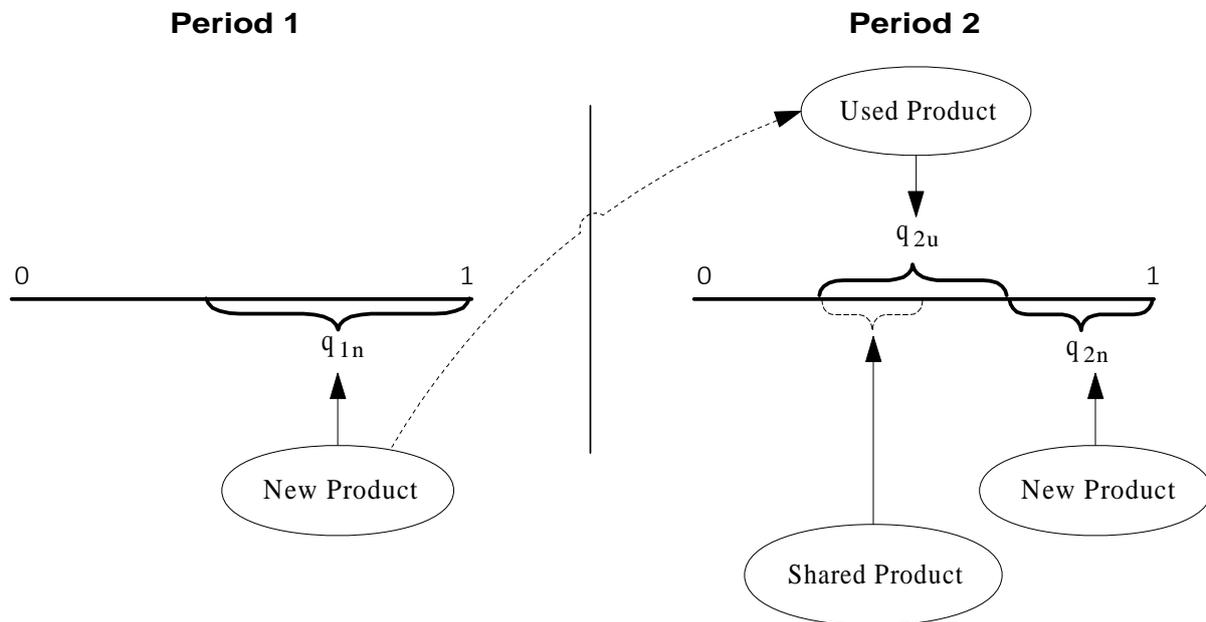


Figure 4 Consumer Valuation of New, Used, and Shared Product Market

### 3.2 Competition in a New Product Market

Consumers need to make two choices according to their demands. The first choice is about whether to rent or buy a product. For this decision, the consumers need to determine whether the ownership of the product is needed or not. Specifically, if they want to buy the product, they will go to the product market and look for what they want. If they just want to use the product for a certain time period, they could choose the rental market to rent the product at a lower price compared to purchasing the product. The second choice is between new and used products. This choice takes us to the focus of this research where the cross-period competition (i.e., self-cannibalization) takes place.

We use the notations  $Q_{ij}$  and  $p_{ij}$  to represent quantities and prices. Specifically, we write  $Q_{1n}$  and  $Q_{2n}$  for the quantities of new products that are available during period 1 and period 2

respectively,  $Q_{2u}$  for the quantity of used products that are only available during period 2 (Figure 1). It's easy to observe that

$$Q_{2u} \leq Q_{1n}$$

which indicates that the used products in period 2 come from new products that are sold in period 1. When used products have non-zero value in the second period, the new-product seller would make adjustments to defend the profits through changing the price of new products in periods 1 and 2 ( $p_{1n}$  and  $p_{2n}$ ) and the quantity in period 2 ( $Q_{2n}$ ).

Clearly, marginal consumers for new and used products will divide the market into three segments according to the lowest valuation of consumers for the two types of products ( $\varphi_u$  and  $\varphi_n$ ). At  $\varphi_u$ , buying a used product would have the same benefit as keeping out of the market because consumers are indifferent between the two. This implies  $\varphi_u * \omega_t - p_{2u} = 0$ , where  $\varphi_u = 1 - Q_{2u} - Q_{2n}$ . As a result, we have

$$p_{2u} = \omega_t(1 - Q_{2u} - Q_{2n}) \quad (37)$$

The same consideration can be applied to the point  $\varphi_n$  with  $\varphi_n = 1 - Q_{2n}$ . Specifically,  $\omega_t(1 - Q_{2n}) - p_{2u} = (1 - Q_{2n}) - p_{2n}$ . This leads to the equation:

$$p_{2n} = p_{2u} + (1 - \omega_t)(1 - Q_{2n}) \quad (38)$$

We first discuss the new-product seller's profit function in period 2 and maximize the profit. We let  $\Pi_{2n} = Q_{2n}(p_{2n} - c_{2n}) = -Q_{2n}^2 + Q_{2n}[1 - c_{2n} - \omega_t Q_{2u}]$  according to equations (1) and (2). We now find the optimal point for  $Q_{2n}$ :

$$Q_{2n}^* = \frac{1 - c_{2n} - \omega_t Q_{2u}}{2} \quad (39)$$

We can determine the cost to the seller with the function  $C_{2n} = Q_{2n}^* c_{2n}$ :

$$c_{2n}^* = \frac{1 - \omega_t Q_{2u}}{2} \quad (40)$$

Plugging it back to equations (37) to (39), we can get

$$Q_{2n}^* = \frac{1}{4}[1 - \omega_t Q_{2u}] \quad (41)$$

$$p_{2n}^* = \frac{3}{4}[1 - \omega_t Q_{2u}] \quad (42)$$

$$p_{2u}^* = \omega_t \left[ \frac{3}{4} + \left( \frac{\omega_t}{4} - 1 \right) Q_{2u} \right] \quad (43)$$

These results allow us to draw some interesting findings in Theorems (1) and (2).

*Theorem 1. In the new-product market with reselling option, both price and quantity of new products in the 2nd period decrease at a rate that is proportional to the quantity of the 2nd period's used products.*

Proof: In the extreme condition when there is no used products in the secondary market, we let  $Q_{2u}$  approach to 0 in the model. We then set  $p_{1n} = p_{2n}$ ,  $Q_{1n} = Q_{2n}$ ,  $p_{1n} = 1 - Q_{1n}$ , and  $p_{2n} = 1 - Q_{2n}$ . The equilibrium at the limit becomes equations (8) and (9):

$$\lim_{Q_{2u} \rightarrow 0} Q_{1n}^* = \lim_{Q_{2u} \rightarrow 0} Q_{2n}^* = \frac{1}{4} \quad (44)$$

$$\lim_{Q_{2u} \rightarrow 0} p_{1n}^* = \lim_{Q_{2u} \rightarrow 0} p_{2n}^* = \frac{3}{4} \quad (45)$$

By considering equations (41) to (42), we come to the conclusion that  $\Delta Q_{2n}^* = Q_{2n}^* - \lim_{Q_{2u} \rightarrow 0} Q_{2n}^* = -\frac{\omega_t Q_{2u}}{4}$ ,  $\Delta p_{2n}^* = p_{2n}^* - \lim_{Q_{2u} \rightarrow 0} p_{2n}^* = -\frac{3\omega_t Q_{2u}}{4}$ . In other words, when  $Q_{2u}$  increases,  $\Delta Q_{2n}^*$  decreases at a rate of  $\frac{\omega_t}{4}$  and  $\Delta p_{2n}^*$  decreases at a rate of  $\frac{3\omega_t}{4}$  because of the cannibalization effect brought about by the used products in the second period. Q.E.D.

In most markets the residual value of the products decreases over time. In some rare occasions (such as antiques or the real estate market in certain areas), it may increase. Theorem 2 outlines the market responses of these two different market types.

*Theorem 2. In the mixed market of the 2nd period with decreasing residual value over time, the earlier the used products are sold by the owners, the lower the 2nd period new-product's quantity and price. In contrast, if the residual value increases over time, new-product's quantity and price increase in the 2nd period.*

Proof: If the aggregated residual value  $\omega_t = v_t - C_t + R_t$  increases over time  $t$ , the first deviation of  $\frac{\Delta Q_{2n}^*}{Q_{2u}} = -\frac{1}{4}\omega_t$  on  $t$ , which is

$\partial \frac{\Delta Q_{2n}^*}{Q_{2u}} / \partial t$ , would be negative, meaning that the 2nd period sales of new product decrease at an increasing rate over time.

On the other hand, if  $\omega_t$  decreases over time  $t$ , the first deviation of  $\frac{\Delta Q_{2n}^*}{Q_{2u}} = -\frac{1}{4}\omega_t$  on  $t$ , which is  $\partial \frac{\Delta Q_{2n}^*}{Q_{2u}} / \partial t$ , would be positive, meaning that the 2nd period sales of new product decrease at a decreasing rate over time.

Because the 2nd period price  $\frac{\Delta p_{2n}^*}{p_{2u}} = -\frac{3}{4}\omega_t$  is of the same form as the quantity, it has similar results. Q.E.D.

By backward induction, we now consider period 1 optimal price for the new-product seller to compensate the sales loss in period 2. Since only  $Q_{1n}$  products are available in the market in the first period, there is only one point of division  $\varphi = 1 - Q_{1n}$ . To determine the expression for  $Q_{1n}$ , we consider the profit in buying a new product in period 1 and keeping it during period 2, which is  $\varphi - p_{1n} + \varphi * \omega_t$ . However, this equals the profit in buying a used product in period 2, which is  $\varphi * \omega_t - p_{2u}$ . With a similar analysis as above, we get:

$$p_{1n} = p_{2u} + (1 - Q_{1n}) \quad (46)$$

The profit to the new-product seller in period 1 could be written as  $\Pi_{1n} = Q_{1n}(p_{1n} - c_{1n}) + Q_{2n}^*(p_{2n}^* - c_{2n}^*)$ , and with an assumption that  $Q_{2u} = Q_{1n}$  (all the products sold in the first period will enter the used market in the second period), the optimal solution to this function is:

$$Q_{1n}^* = \frac{1 - c_{1n} + \frac{5}{8}\omega_t}{2\omega_t + 2 - \frac{5}{8}\omega_t^2} \quad (47)$$

With the same consideration for the cost to the seller in period 1, we observe  $C_{1n} = Q_{1n}^*c_{1n} + C_{2n}^*$ , which leads to Eq. (48).

$$c_{1n}^* = \frac{128 + 240\omega_t + 56\omega_t^2 - 45\omega_t^3}{256 + 256\omega_t - 96\omega_t^2} \quad (48)$$

### 3.3 Competition Among New, Used & Shared Products

In this section, we assume that two types of consumers (regular consumers and sharers) coexist in the new-product market in

period 1. We therefore separate the total number of new products sold in the market  $Q_{1n}$  into two parts and use the notation  $q_{1n}$  and  $\bar{q}_{1n}$  to distinguish them, between which  $q_{1n}$  indicates the quantity of products that are purchased for regular usage and  $\bar{q}_{1n}$  represents the quantity of products for sharing. The same consideration is applied to the sales market in period 2, and we use  $q_{2n}$  and  $\bar{q}_{2n}$  to denote these two types of consumers. Figure 5 illustrates the consumer valuation of products in the mixed market where  $\{Q_{1n}, Q_{2n}, Q_{2u}\}$  follows the comparative order. The pairs,  $\{q_{1n}, \bar{q}_{1n}\}$ ,  $\{q_{2n}, \bar{q}_{2n}\}$ ,  $\{k_2 q_{1n}, \bar{k}_2 \bar{q}_{1n}\}$ , only represent proportions and are not ordered on the valuation scale ( $k_2$  and  $\bar{k}_2$  represent the proportions of new/shared product that will be in the used-product market in period 2.). In period 2, the quantity of shared products is the sum of a part of  $q_{1n}$  and another part of  $\bar{q}_{1n}$ , including consumers who want to share the products after using them for some time and people who choose to continue sharing the product after sharing them in period 1. Similarly, the quantity of used products consists of a part from  $q_{1n}$  and another part from  $\bar{q}_{1n}$ , which means people want to resell the products after owning them for some time no matter what they are used for. Hence,  $Q_{2u} + \bar{Q}_{2u} \leq Q_{1n}$  always holds (where  $\bar{Q}_{2u} = k_1 q_{1n} + \bar{k}_1 \bar{q}_{1n}$  ).

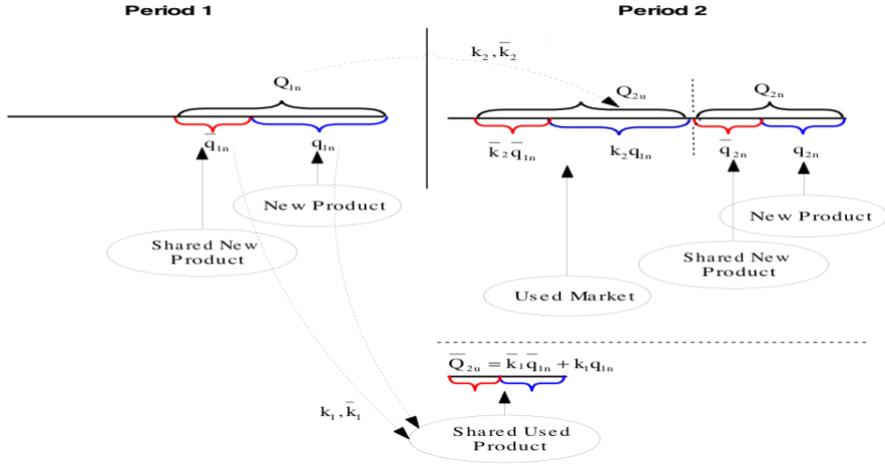


Figure 5 Consumer Valuation of Gift, Sharing, Reselling, and New Product Market

To consider the overlapping new, used and shared products, we combine the demand functions and adjust the profit function to reflect the relations among these three types of products (Figure 5). In period 1, new products are sold for both individual (new product) and collaborative consumption purposes (shared product). In period 2, used products can be classified into three categories: products not in the market, used product, and shared used product. To analytically model these scenarios, we let  $k_0q_{1n}$  and  $\bar{k}_0\bar{q}_{1n}$  represent the used products that do not enter any market;  $k_1q_{1n}$  and  $\bar{k}_1\bar{q}_{1n}$  represent the shared part, and  $k_2q_{1n}$  and  $\bar{k}_2\bar{q}_{1n}$  represent the used product, with the condition that  $k_1 + k_2 + k_3 = 1$  and  $\bar{k}_1 + \bar{k}_2 + \bar{k}_3 = 1$ . All the coefficients  $\{k_i, \bar{k}_i\}$  are assumed to be exogenous. The assumption of exogeneity of this coefficient is based on the observation of physical constraints in the shared product market and empirical studies in the literature. For example, due to the lack of available parking spaces in the city of Paris, the percentages of car owners, renters, and public transporters are statistically stable over time. The relationships of different types of products in the market can be summarized in the following list of equations.

$$Q_{1n} = q_{1n} + \bar{q}_{1n} \quad (49)$$

$$Q_{2n} = q_{2n} + \bar{q}_{2n} \quad (50)$$

$$\bar{Q}_{2u} = k_1q_{1n} + \bar{k}_1\bar{q}_{1n} \quad (51)$$

$$Q_{2u} = k_2q_{1n} + \bar{k}_2\bar{q}_{1n} \quad (52)$$

As a result, we can rewrite the demand functions for new and shared product as:

$$p_{2u} = \omega_t(1 - Q_{2u} - Q_{2n}) \quad (53)$$

$$p_{2n} = p_{2u} + (1 - Q_{2n})(1 - \omega_t) \quad (54)$$

$$p_{1n} = p_{2u} + 1 - Q_{1n} \quad (55)$$

$$\bar{p}_{2u} = (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n}) \quad (56)$$

$$\bar{p}_{2n} = \bar{p}_{2u} + (1 - \bar{q}_{2n})(1 - v_t + C_t) \quad (57)$$

$$\bar{p}_{1n} = \bar{p}_{2u} + 1 - \bar{q}_{1n} \quad (58)$$

In equations (56) and (57),  $v_t$  represents the physical value of the rental products and  $C_t$  represents the cumulative holding and maintenance cost that also represents the service quality. The new-product seller's profit function in period 2 is  $\Pi_{2n} = Q_{2n}(p_{2n} - c_{2n})$  and the cost function  $\mathbb{C}_{2n} = Q_{2n}^* \cdot c_{2n}$  of the seller remains unchanged. The optimal solution is:

$$c_{2n}^* = \frac{1 - \omega_t Q_{2u}}{2} \quad (59)$$

$$Q_{2n}^* = \frac{1 - \omega_t Q_{2u}}{4} \quad (60)$$

$$p_{2n}^* = \frac{3}{4}(1 - Q_{2u}\omega_t) \quad (61)$$

$$p_{2u}^* = \left[ Q_{2u} \left( \frac{\omega_t}{4} - 1 \right) + \frac{3}{4} \right] \omega_t \quad (62)$$

We can also consider the sharer's profit function in period 2,  $\Pi_{2u} = \bar{q}_{2n}(\bar{p}_{2n} - p_{2n}) + \bar{p}_{2u}\bar{Q}_{2u}$ . The optimum is achieved at:

$$\bar{q}_{2n}^* = \frac{3Q_{2u}\omega_t + 1}{8} - \bar{Q}_{2u}(v_t - C_t) \quad (63)$$

$$q_{2n}^* = \frac{1 - 5Q_{2u}\omega_t}{8} + \bar{Q}_{2u}(v_t - C_t) \quad (64)$$

$$\bar{p}_{2u}^* = \frac{C_t - v_t}{8} [8\bar{Q}_{2u}(1 - v_t + C_t) + 3Q_{2u}\omega_t - 7] \quad (65)$$

$$\bar{p}_{2n}^* = \frac{7 - 3Q_{2u}\omega_t}{8} \quad (66)$$

By backward induction, the seller's profit function in period 1 is  $\Pi_{1n} = Q_{1n}(p_{1n} - c_{1n}) + \Pi_{2n}^*$  and the cost function becomes  $\mathbb{C}_{1n} = Q_{1n}^*c_{1n} + \mathbb{C}_{2n}^*$ , which results in Equations (67) (68):

$$c_{1n}^* = \frac{1}{2} - \frac{k_2 - 6}{16}\omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{16}Q_{2u} \quad (67)$$

$$Q_{1n}^* = \frac{\frac{1}{4} \frac{k_2 - 6}{16} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{32} Q_{2u}}{2 + \omega_t k_2 (1 - \frac{\omega_t}{4})} \quad (68)$$

$$p_{1n}^* = \frac{3}{2} + \frac{k_2 - 6}{32}\omega_t - \frac{\omega_t(\omega_t k_2 + 2\omega_t)}{32}Q_{2u} \quad (69)$$

On the other hand, in the sharing market, we have the sharer's profit function  $\Pi_{1u} = \bar{q}_{1n}(\bar{p}_{1n} - p_{1n}) + \Pi_{2u}^*$ . Through similar derivation, we obtain the optimal sales quantity in the first period:

$$\bar{q}_{1n}^* = \frac{AQ_{2u} + B\bar{Q}_{2u} + C}{D} \quad (70)$$

$$q_{1n}^* = Q_{1n}^* - \bar{q}_{1n}^* = \frac{\frac{1}{4} \frac{k_2 - 6}{16} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{32} Q_{2u}}{2 + \omega_t k_2 (1 - \frac{\omega_t}{4})} - \frac{AQ_{2u} + B\bar{Q}_{2u} + C}{D} \quad (71)$$

$$\bar{p}_{1n}^* = 1 - \frac{7(C_t - v_t)}{8} + (C_t - v_t)(1 - v_t + C_t)\bar{Q}_{2u} + \frac{3\omega_t(C_t - v_t)}{8}Q_{2u} - \frac{AQ_{2u} + B\bar{Q}_{2u} + C}{D} \quad (72)$$

where we have the following definitions:

$$A \equiv \frac{\omega_t^2(k_2 + 2)}{32} + \frac{3\omega_t(1 + 2\bar{k}_1)(C_t - v_t)}{8} + \frac{27\omega_t(1 + 3\omega_t\bar{k}_2)}{64} \quad (74)$$

$$B \equiv (C_t - v_t) \left[ (1 + 2k_1)(1 - v_t + C_t) + \frac{1 + 6\omega_t\bar{k}_2}{8} \right] \quad (75)$$

$$C \equiv \frac{17 + (6 - k_2 + 3\bar{k}_2\omega_t)}{32} - \frac{7 + 6\bar{k}_1}{8} (C_t - v_t) \quad (76)$$

$$D = 2 - \frac{C_t - v_t}{8} [8\bar{k}_1(1 - v_t + C_t) + 3\bar{k}_2\omega_t] - \frac{\omega_t^2(k_2 + 2)}{32}\bar{k}_2 \quad (77)$$

By integrating Eq. (70) and Eq. (71) in  $Q_{2u}$  and  $\bar{Q}_{2u}$ , we determine the optima of  $Q_{2u}$  and  $\bar{Q}_{2u}$ , as:

$$\begin{aligned} Q_{2u}^* = & (4k_2 + 4\bar{k}_2 - 15C_t k_2 + 9C_t \bar{k}_2 + 15k_2 R_t - 9\bar{k}_2 R_t + 15k_2 v_t - 9\bar{k}_2 v_t) / (12C_t \bar{k}_2 \\ & - 20C_t k_2 + 20k_2 R_t - 12\bar{k}_2 R_t + 20k_2 v_t - 12\bar{k}_2 v_t - 5C_t^2 k_2 + 3C_t^2 \bar{k}_2 \\ & - 5k_2 R_t^2 + 3\bar{k}_2 R_t^2 - 5k_2 v_t^2 + 3\bar{k}_2 v_t^2 + 10C_t k_2 R_t - 6C_t \bar{k}_2 R_t + 10C_t k_2 v_t \\ & - 6C_t \bar{k}_2 v_t - 10k_2 R_t v_t + 6\bar{k}_2 R_t v_t + 32) \end{aligned}$$

$$\begin{aligned} \bar{Q}_{2u}^* = & (4k_1 + 4\bar{k}_1 - 15C_t k_1 + 9C_t \bar{k}_1 + 15k_1 R_t - 9\bar{k}_1 R_t + 15k_1 v_t - 9\bar{k}_1 v_t + k_1 \bar{k}_2 R_t^2 \\ & - k_2 \bar{k}_1 R_t^2 + k_1 \bar{k}_2 v_t^2 - k_2 \bar{k}_1 v_t^2 + 4C_t k_1 \bar{k}_2 - 5C_t^2 k_2 + 3C_t^2 \bar{k}_2 - 5k_2 R_t^2 \\ & + 3\bar{k}_2 R_t^2 - 5k_2 v_t^2 + 3\bar{k}_2 v_t^2 + 10C_t k_2 R_t - 6C_t \bar{k}_2 R_t + 10C_t k_2 v_t - 6C_t \bar{k}_2 v_t \\ & - 10k_2 R_t v_t + 6\bar{k}_2 R_t v_t + 32) + 2C_t k_2 \bar{k}_1 v_t + 2k_1 \bar{k}_2 R_t v_t \\ & - 2k_2 \bar{k}_1 R_t v_t) / (12C_t \bar{k}_2 - 20C_t k_2 + 20k_2 R_t - 12\bar{k}_2 R_t + 20k_2 v_t - 12\bar{k}_2 v_t \\ & - 4C_t k_2 \bar{k}_1 - 4k_1 \bar{k}_2 R_t + 4k_2 \bar{k}_1 R_t - 4k_1 \bar{k}_2 v_t + 4k_2 \bar{k}_1 v_t + C_t^2 k_1 \bar{k}_2 - C_t^2 k_2 \bar{k}_1 \\ & - 2C_t k_1 \bar{k}_2 R_t + 2C_t k_2 \bar{k}_1 R_t - 2C_t k_1 \bar{k}_2 v_t \end{aligned}$$

The formulation is simple and the result is in closed-form. To derive managerial insights, we parameterize the model and conduct further analysis in the next Chapter.

## Chapter 4. Parameterization Analysis & Managerial

### Implications

In this section, we analyze the self-cannibalization among the new product, used product, and the shared product in two stages. Because the characteristics of these products (overtime value, sharing income, depreciation rate, holding and maintenance cost) are not always the same, we further investigate the impact of price competition in two markets in which the durable goods' values develop in opposite directions. It is clear here that when we examine the value-appreciation market, the economic decision maker is a car manufacturer, not Uber, or Uber drivers. Similarly, when we examine the value-depreciation market, the economic agent is a real estate developer, not hotels, Airbnb, or Airbnb hosts.

#### 4.1 Parameterization for Automobile (Value Depreciation) and Real Estate (Value Appreciation) Markets

Table 6 Parameterization for Analysis

Parameter	Description
$v_t$	ranges from 0% to 200%. Under certain conditions, the remaining value may increase and exceed 100%
$R_t$	ranges from 0% to 100%.
$C_t$	ranges from 0% to 60%.
$k_0$	proportion of new product that is kept away from the market, we set it to be 5%
$k_1$	proportion of new product that enters the rental market, which ranges from 10% to 50%
$k_2$	proportion of new product that enters the used product market, which ranges from 0% to 85%

$\bar{k}_0$	proportion of shared product in period 1 that is removed from the market, we set it to be 5%
$\bar{k}_1$	proportion of shared product in period 1 that is rented out in period 2, we set it to vary from 0% to 33.3%
$\bar{k}_2$	proportion of shared product in period 1 that is sold as used product in period 2, we set it to vary from 61.7% to 95%

Determined by the exogenous variables on residual value and market share, the dynamics of price/quantity competition varies under different circumstances. Table 6 specifies the parameterization for the analysis. The residual value ranges from 0% to 200%. Under certain conditions, the residual value may increase and exceed 100%, for example, in the rising real estate market. Certain new products never enter the market, so  $k_0 \geq 0$  and  $\bar{k}_0 \geq 0$ . If we let 5% of the products to be kept away from the market, we have  $k_1 + k_2 = 0.95$  and  $\bar{k}_1 + \bar{k}_2 = 0.95$ . We further let parameters  $k_1, k_2, \bar{k}_1$  and  $\bar{k}_2$  be distributed according to scaled percentages. Moreover, we assume that higher percentage of used products will enter the sharing market over time. In summary, we consider nine parameters in the general purpose numerical setup as listed in Table 6.

The ratio of used cars to new cars in the North American market is around 6/11.4 This ratio is around 12% in the rental market according to Edmunds 2016.<sup>5</sup> In our analysis, we use these parameters to estimate  $k_1$  and  $\bar{k}_1$  in the automobile new, used and shared markets. We summarize the parameters in Table 7.

<sup>4</sup> See details in <http://economictimes.indiatimes.com/industry/services/retail/rise-of-used-products-markets-why-e-commerce-companies-like-olx-ebay-are-chasing-second-hand-products/articleshow/49488856.cms>

<sup>5</sup> See details in <https://www.edmunds.com/industry-center/data/used-car-market-quarterly-report.html>

Table 7 Parameter Variations

Parameter	Market with Value Depreciation	Market with Value Appreciation
$v_t$	[100%, 0%]	[100%, 200%]
$R_t$	[50%, 0%]	[50%, 100%]
$C_t$	[30%, 0%]	[30%, 60%]
$k_0$	5%	5%
$k_1$	[10%, 50%]	[10%, 50%]
$k_2$	[0%, 85%]	[0%, 85%]
$\bar{k}_0$	5%	5%
$\bar{k}_1$	[0%, 33.3%]	[0%, 33.3%]
$\bar{k}_2$	[61.7%, 95%]	[0%, 66.7%]

In real estate, the first-hand to second-hand housing transaction ratio is around 10% to 25%.<sup>6</sup> The ratio of used house in the market is around 80% to 91%. We also expect this ratio to increase because of the increasing popularity of shared properties. The housing rental ratio also depends on regional differences.<sup>7</sup> In Germany, the property ownership rate is 41%, while in Spain this rate is 83.2%.

#### 4.2 Analysis of the Value Depreciation Market

We illustrate the price and quantity dynamics in the new/used/shared overlapping markets. In period 1, only new products are available on the market for sale and for sharing. In period 2, the used products acquired from the first period re-enter the market either as shared or as used products. The

<sup>6</sup> See details in <https://ecyyiu.wordpress.com/2013/10/24/first-hand-to-second-hand-housing-transaction-ratio-1-2-htr/>

<sup>7</sup> See details in <https://qz.com/167887/germany-has-one-of-the-worlds-lowest-homeownership-rates/>

residual value of each used product may decrease, increase, or remain unchanged, which is determined by the intrinsic properties of the used product itself, possible sharing income, and the holding cost. To facilitate the demonstration, we assume that the sharing income and holding cost represent a proportion of the used product value.

The resulting price dynamics of  $p_{1n}, p_{2n}$  and  $p_{2u}$  are shown in Figure 6. All the prices are scaled as a percentage of  $v_t$ . In Diagrams (B), the sales quantities are normalized as percentages to the total consumer valuation spectrum, as defined in Section 3.2, Figure 4. With zero residual value (100% depreciation in Diagrams (A) and (B), no used products will enter the second period, resulting in the same first and second period prices, as shown by point I. Consequently, used products have zero value and price, as shown by point III. When residual value drops to zero, the quantity of used products drops to zero sharply, which makes  $Q_{2u}$  a discontinuous function at this point. The reason for this phenomenon is that as long as the product does not reach its end of life, it can still create revenue and holding cost but the end of life status terminates everything. If the used products retain the same original value and enter the second period with 0% depreciation, it drives most new-product sales to the first period and boosts the  $p_{1n}$  to the maximum. When the residual value of the used products and the new products are the same in the second period, the used-product market is less competitive than the new-product market because some existing owners will hold the product for sharing, as illustrated in segment II in Diagram (A). This yields an interesting but counter-intuitive result. The intuition is that when the product holds value unchanged from period 1 to 2, the seller's profit would be optimized by setting  $p_{2n}$  less than  $p_{2u}$  while setting a higher price for new product  $p_{1n}$  in the first period. In general, consumers are more willing to make a purchase in period 1 when the value holds well to the second period. In Diagram (B), the

supply of  $Q_{2u}$  decreases because its price  $p_{2u}$  decreases; the negative impact of used products on new products has also been weakened. The main findings and managerial implications are  
 Proposition 1: *Decreasing product residual value decreases the first period new product price.*

Proposition 2: *If the product residual value is equal to the original value in the second period, used product from the first period enter the second period as perfect competition with the second period's new product.*

Proposition 3: *If the residual value of the product equals zero in the second period, first- and second-period new product prices are the same.*

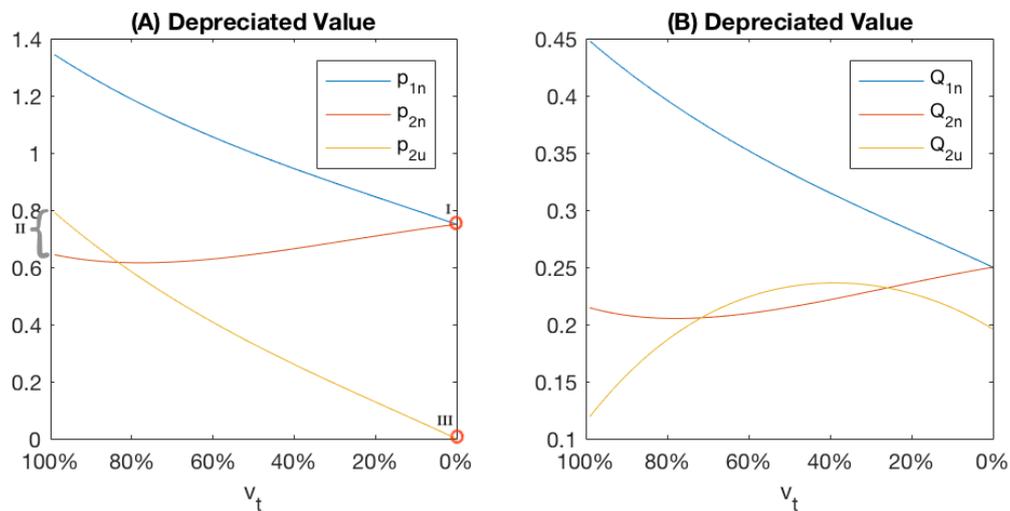


Figure 6 Market Price Dynamics of Period 1 New-Product Price, Period 2 New-Product Price, and Period 2 Used-Product Price for Value Depreciation Product

Figure 7 shows the price and quantity dynamics in the sharing markets. Diagram (A) demonstrates that the sharing price changes when the product's residual value decreases. In this diagram, the sharing price of the used product decreases while that of the new product in the second period increases and the two prices intersect at point IV. This point is a division point which corresponds to point V in Diagram (B). Diagram (B) shows that, when the residual value is in the range of  $[100\%, 79.23\%]$ , the quantity changes,  $\bar{q}_{1n}$  and  $\bar{q}_{2n}$ , are both below zero before point

V. Moreover,  $\bar{q}_{1n}$  remains negative until the residual value decreases to 45.89%.

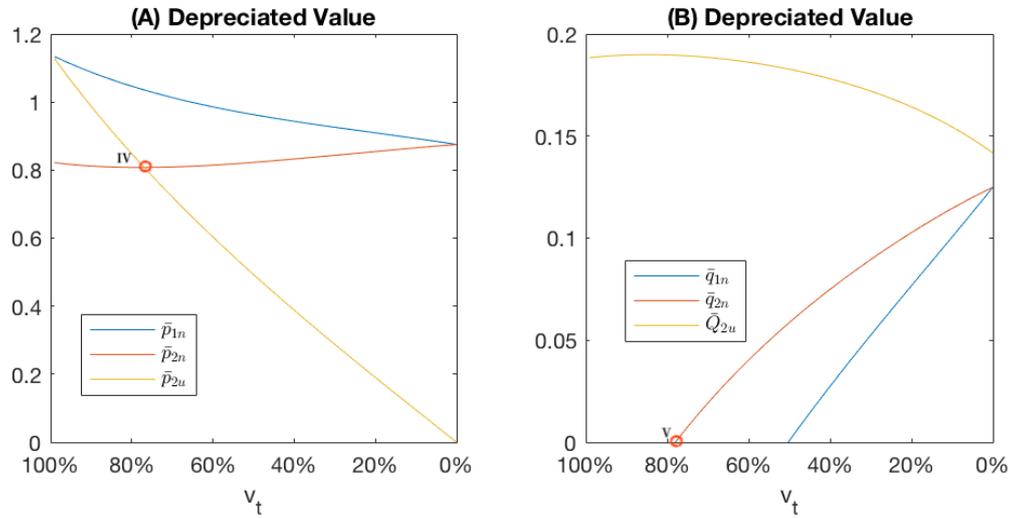


Figure 7 Price-Quantity Dynamics in the Shared-Product Market for Value Depreciation Product

Table 8 provides a list of scenarios with fixed parameters on  $v_t, R_t, C_t, k_1, k_2, \bar{k}_1$  and  $\bar{k}_2$ .

Table 8 Analysis of Equilibrium in Automobile Market ( $T = 100, c_h = 0.005, s_r = 0.003$ )

	1	2	3	4	5	6	7	8
$t$	5	12	29	33	49	57	61	72
$v_t$	0.95	0.88	0.71	0.67	0.51	0.43	0.39	0.28
$R_t$	0.475	0.44	0.355	0.335	0.255	0.215	0.195	0.14
$C_t$	0.283	0.264	0.213	0.201	0.153	0.129	0.117	0.084
$k_1$	0.34	0.40	0.42	0.46	0.50	0.53	0.60	0.64
$k_2$	0.61	0.55	0.54	0.49	0.45	0.42	0.35	0.31
$\bar{k}_1$	0.03	0.05	0.10	0.13	0.14	0.19	0.20	0.23
$\bar{k}_2$	0.92	0.90	0.85	0.82	0.81	0.76	0.75	0.72
$q_{1n}^*$	0.32	0.32	0.31	0.31	0.30	0.29	0.29	0.28

$p_{1n}^*$	0.95	0.95	0.92	0.93	0.90	0.88	0.88	0.82
$q_{2n}^*$	0.10	0.13	0.16	0.17	0.20	0.21	0.22	0.23
$p_{2n}^*$	0.31	0.37	0.48	0.51	0.59	0.63	0.65	0.69
$q_{2u}^*$	0.62	0.58	0.51	0.48	0.42	0.38	0.34	0.30
$p_{2u}^*$	0.26	0.26	0.23	0.24	0.2	0.18	0.17	0.13
$\bar{q}_{1n}^*$	0.47	0.45	0.41	0.40	0.35	0.33	0.32	0.29
$\bar{p}_{1n}^*$	1.10	1.08	1.02	1.01	0.98	0.92	0.90	0.86
$\bar{q}_{2n}^*$	0.28	0.25	0.22	0.20	0.20	0.20	0.19	0.20
$\bar{p}_{2n}^*$	0.60	0.62	0.65	0.67	0.70	0.71	0.72	0.73
$\bar{q}_{2u}^*$	0.12	0.15	0.17	0.19	0.20	0.22	0.24	0.25
$\bar{p}_{2u}^*$	0.57	0.53	0.43	0.40	0.30	0.25	0.22	0.15

### 4.3 Managerial Implications for the Value Depreciation Market

In the value depreciation market, product value depreciates over time. In this case, both  $q_{1n}^*$  and  $p_{1n}^*$  are influenced by the decreasing value of  $v_t$ . The price of used product is more sensitive to the depreciation rate. We take the automobile market as an example.

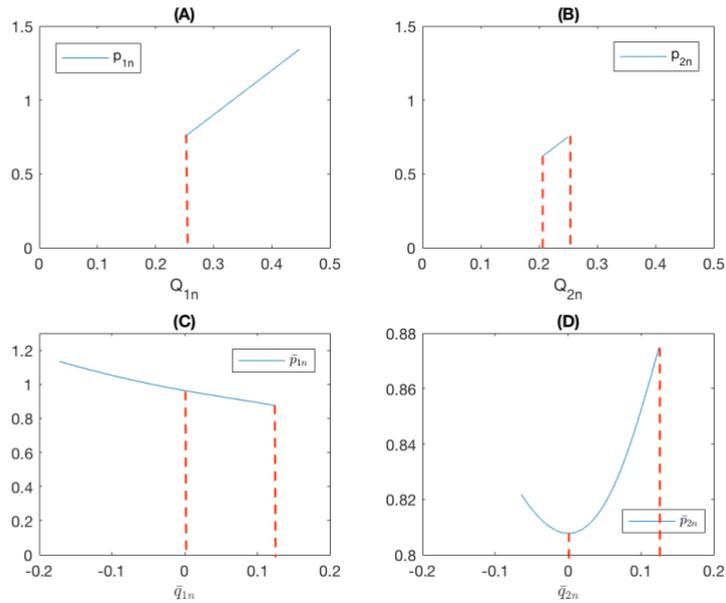


Figure 8 Price-Quantity Dynamics in the New/Used/Shared Product Market: Automobiles

Figures 8(A) and 8(B) illustrate the relationship between quantity and price in the new product market of both periods. Both periods show the same level of price elasticity but are limited inside a lower and upper bound in market sizes. Figures 8(C) and 8(D) illustrate the relationship between quantity and service price in the shared product market of both periods. While they also show market size boundaries, the value of quantity below zero is an indicator of consumers' unwillingness to share the products. Managerial Implications A.1 to A.3 summarize the characteristics of the automobile new, used, and shared product markets.

Managerial Implication A.1: *New car sellers are always subject to higher competition on price and quantity with the existence of used and shared product markets.*

The underlying intuition is that the used and shared products become substitutes to the new product. We analyze the results in the table from the two periods. We observe in period 1 that both the price and the quantity of new cars are decreasing because more used cars enter the market in the second period. However, we also observe that the initial price of a new car is higher

than its earlier initial value, which could be explained as the seller's setting a high price for new cars in order to compensate for the potential loss brought about by the market entry of used cars. In period 2, we see the price and quantity of new cars are increasing, but the total number of new cars sold in the two periods is decreasing. This indicates that new product is losing market share in competition. The worst case is that the price of a new car in this period is always set under its own value, in order to compete with the cheap price of used cars.

*Managerial Implication A.2: At certain rate of depreciation, there exist car models that consumers prefer to sell in the used-product market.*

Because the value of certain car models depreciates faster than the others, the associated retail prices in both periods converge as shown in Figure 6 Diagram (A). While the used-product price always decreases due to the diminishing value, consumers are more willing to put certain models (depending on depreciation rates) on the used-product market as shown in Figure 6 Diagram (B).

*Managerial Implication A.3: If the residual value holds well, the used-product price may exceed its new-product price in the second period.*

When the value of the used product and the new product are the same, the used-product price may exceed the new-product price in the second period because the used-product market size is constrained by the sales from the first period. This effect gradually diminishes with value depreciation and can be observed on segment II in Figure 6 Diagram (A).

*Managerial Implication A.4: The co-existence of new/used/shared product markets does not change the price elasticity of the new product market in both periods when the value depreciates.*

While it is desirable for a company to be responsive to changes in price, the new-product market in both periods has the same price elasticity, as shown in Figure 8 Diagrams (A) and (B).

#### 4.4 Analysis of the Value Appreciation Market

When residual value increases, it creates more incentives for consumers to purchase in the first period, thus increasing  $p_{1n}$  shown in Figure 9. At the same time, consumers are less inclined to purchase in the second period, thus driving down  $p_{2n}$ .

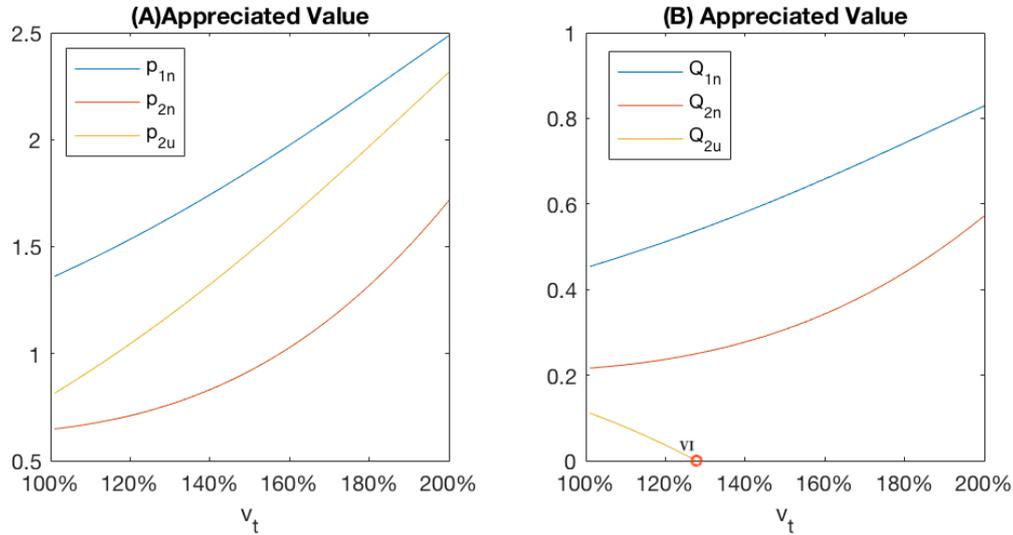


Figure 9 Market Price Dynamics of Period 1 New-Product Price, Period 2 New-Product Price, and Period 2 Used-Product Price for Value Appreciation Product

It follows that, when the value holds well, the new product owners in both periods are more inclined to keep owning the product, shrinking the used-product market. Consequently, products are more available on the new-goods market, which can be found in Diagrams (A) and (B) in Figure 10. Because the value holds well, those who enter the second period market for shared product are more inclined to invest in the first period, increasing  $\bar{Q}_{2u}$  and reducing  $\bar{q}_{2n}$ . When  $\bar{q}_{2n}$  is below zero, as shown in Diagrams (B), it also shows an arbitrage opportunity in which consumers are willing to sell their second-period purchase option for owning it from the first period. As shown in Diagram (B) of Figure 10,  $\bar{q}_{1n}$  decreases with increasing residual value because consumers can invest in the first period. The main findings and managerial implications are summarized in proposition 4.

Proposition 4: *When the residual value of the product increases, the quantity of shared used product increases. Potential sharers from the second period are more inclined to invest in the first period, creating an arbitrage opportunity.*

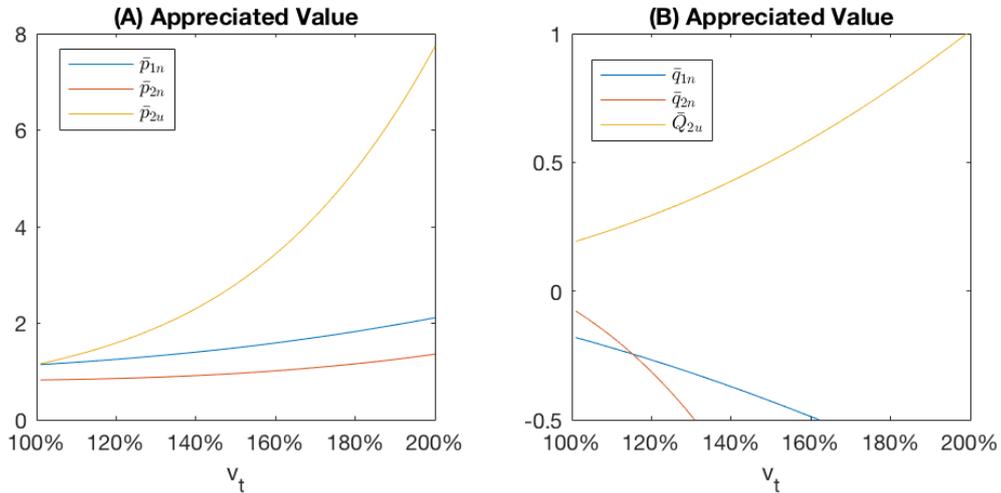


Figure 10 Price-Quantity Dynamics in the Shared-Product Market for Value Appreciation Product

The phenomenon described by proposition 4 can be observed when housing price increases very rapidly in recent years. In these regions, the housing rental price is often higher in the second-hand market than for the newly built properties. The price of second-hand houses are often higher than the newly developed properties.

Table 9 provides a list of scenarios with fixed parameters on  $v_t, R_t, C_t, k_1, k_2, \bar{k}_1$  and  $\bar{k}_2$ .

Table 9 Analysis of Equilibrium in Real Estate Market(T=100,  $c_h=0.005, s_r=0.003$ )

	1	2	3	4	5	6	7	8
$t$	8	18	24	30	46	52	62	78
$v_t$	1.06	1.18	1.24	1.30	1.46	1.52	1.62	1.78
$R_t$	0.53	0.59	0.62	0.65	0.73	0.76	0.81	0.89
$C_t$	0.318	0.354	0.372	0.390	0.438	0.456	0.486	0.534

$k_1$	0.32	0.41	0.42	0.41	0.49	0.51	0.65	0.68
$k_2$	0.63	0.54	0.53	0.54	0.46	0.44	0.30	0.27
$\bar{k}_1$	0.03	0.05	0.07	0.07	0.13	0.13	0.20	0.26
$\bar{k}_2$	0.92	0.90	0.88	0.88	0.82	0.82	0.75	0.69
$q_{1n}^*$	0.33	0.34	0.34	0.36	0.38	0.38	0.40	0.41
$p_{1n}^*$	1.14	1.22	1.26	1.29	1.40	1.44	1.55	1.65
$q_{2n}^*$	0.08	0.06	0.05	0.05	0.03	0.01	-0.02	-0.06
$p_{2n}^*$	0.25	0.18	0.16	0.15	0.10	0.03	-0.06	-0.18
$q_{2u}^*$	0.63	0.64	0.64	0.61	0.61	0.64	0.66	0.69
$p_{2u}^*$	0.30	0.36	0.37	0.44	0.51	0.53	0.59	0.65
$\bar{q}_{1n}^*$	0.49	0.51	0.52	0.55	0.60	0.63	0.69	0.79
$\bar{p}_{1n}^*$	0.88	0.91	0.92	0.93	0.97	0.98	1.02	1.05
$\bar{q}_{2n}^*$	0.27	0.24	0.23	0.13	0.004	0.003	-0.08	-0.25
$\bar{p}_{2n}^*$	0.58	0.56	0.50	0.55	0.53	0.51	0.48	0.44
$\bar{q}_{2u}^*$	0.14	0.17	0.18	0.25	0.32	0.32	0.37	0.45
$\bar{p}_{2u}^*$	0.63	0.70	0.73	0.81	0.86	1.02	1.17	1.41

#### 4.5 Managerial Implications for the Value Appreciation Market

In the value appreciation market, the residual value increases. In this section, we specifically consider the case when housing price increases. The resale price of used product is more sensitive to the depreciation rate. If the housing price decreases, the market dynamics exhibit a similar pattern as those

in the results presented from A.1 to A.4 in the previous section.

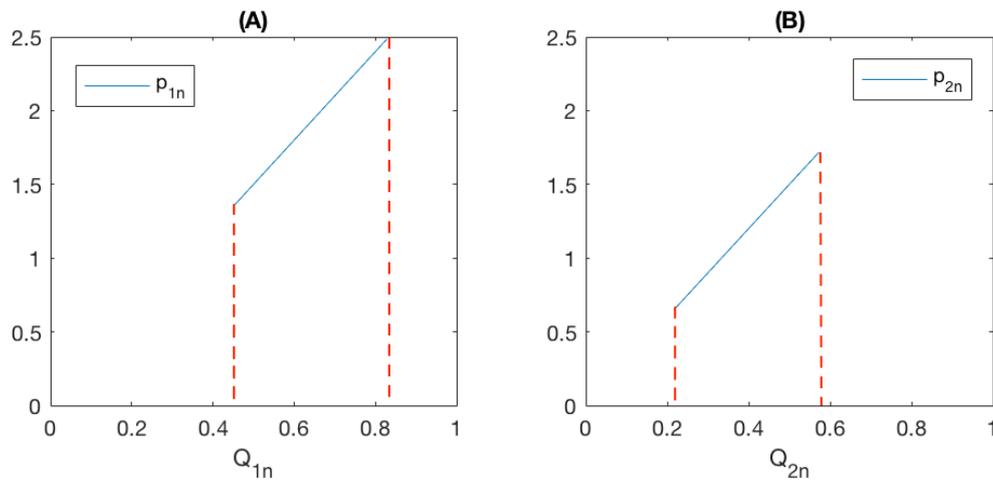


Figure 11 Price-Quantity Dynamics in the New/Used/Shared Product Market: Real Estate

Managerial Implication B.1: *In an area where the value of housing increases over time,  $q_{1n}^*$ ,  $q_{2n}^*$ ,  $p_{1n}^*$  and  $p_{2n}^*$  increase. On the other hand, when the housing price is stable or slightly decreases, both  $q_{1n}^*$  and  $p_{1n}^*$  decrease.*

If the value of house is increasing, it is easy to understand why its price is increasing. In this case, people tend to buy houses early in order to buy at a relatively lower price. However, if the price is too high, the number of new houses sold would decrease. If housing value depreciates, the dynamics are similar to those of automobile.

Managerial Implication B.2: *Property owners are more willing to keep their properties than reselling the product with an increasing value.*

It is intuitive that consumers would like to purchase in the first period and hold on to the product if the value is projected to increase. As a result, the reselling market in the second period shrinks and the demand drives the price up in both periods but with an emphasis on the first period. This is shown in Figure 9 Diagrams (A) and (B).

Managerial Implication B.3: *In an area where property price decreases, the property owners are more inclined to sell than to keep them or to share them.*

If the property value is projected to decrease, the sharing price in the first period will decrease, as shown in Figure 7 Diagram (A). Consumers are less likely to purchase the property and share it in the market.

*Managerial Implication B.4: When property price increases, more owners are inclined to offer sharing services in the used product market, and keep the new property purchases as an investment decision.*

This result can be found in Diagrams (B) in Figure 7 and 10. When the residual value increases, the supply of shared product gradually decreases. One of the reasons for this phenomenon is that consumers are more willing to make new product purchases in both periods as an investment decision without putting the product in the shared-product market.

*Managerial Implication B.5: The co-existence of new/used/shared product markets does not change the price elasticity of the market in both periods when the value increases.*

It is shown in Figure 11 Diagrams (A) and (B). The same result is also obtained from managerial implication A.4.

## Chapter 5. Conclusion

In this part, we consider the co-existence of new, used, and shared products in a sharing-economy market. We study a producer's pricing decisions and decode the economic rationality and marketplace mechanisms in the ever booming new/used/shared product networks. We contribute to the economics of information systems literature by considering a two-stage game where a producer of durable goods sells new products to the market in the first stage, and in the second stage used products may enter the market in the form of used or shared products. We consider the buyers' holding costs, transaction costs, and income from sharing. We identify the market equilibrium of this two-period game. We provide managerial implications for two different and representative types of product markets that include automobile (with value depreciation) and real estate (with value appreciation). Our findings show the dynamics of two-stage price/quantity equilibrium in these two market setups.

The managerial implications from our findings are relevant to the real world. Airbnb and Uber, the epitomes of the sharing economy, are often thought to follow the same business logic. However, our model shows that due to intrinsic differences in holding costs and depreciation/appreciation rates, competition can be markedly different in these two markets.

Our findings cover a wide range of industries and applications. Some of the results can be extended for empirical verification. For example, we find that used product price can exceed new product price when the product's residual value increases. It's also an interesting finding that certain product types have higher probability to enter the used- and shared-product market. We also find that if the sharing income is significant, new product price is higher in the first than in the second period. The findings in the change of price elasticity of supply over the two periods may be another interesting point for future research.



## Appendix

1.  $p_{2n}$  :

$$\begin{aligned}
 p_{2n} &= p_{2u} + (1 - \omega_t)(1 - Q_{2u}) \\
 &= \omega_t(1 - Q_{2u} - Q_{2n}) + (1 - \omega_t)(1 - Q_{2u}) \\
 &= \omega_t(1 - Q_{2u}) + (1 - \omega_t)(1 - Q_{2u}) - \omega_t Q_{2n} \\
 &= 1 - Q_{2u} - \omega_t Q_{2n}
 \end{aligned}$$

2.  $\Pi_{1n}$  :

$$\Pi_{1n} = (p_{1n} - c_{1n})Q_{1n} + (p_{2n} - c_{2n}^*)Q_{2n}^*$$

where

$$\begin{aligned}
 (p_{1n} - c_{1n})Q_{1n} &= (p_{2u} + 1 - Q_{1n} - c_{1n})Q_{1n} \\
 &= \left[ \omega_t \left( \frac{3}{4} + \frac{\omega_t Q_{2u}}{4} - Q_{2u} \right) + 1 - Q_{2u} - c_{1n} \right] Q_{2u} \\
 &= \left( 1 - c_{1n} + \frac{3}{4} \omega_t \right) Q_{2u} - \left( \omega_t + 1 - \frac{\omega_t^2}{4} \right) Q_{2u}^2
 \end{aligned}$$

$$\begin{aligned}
 (p_{2n} - c_{2n}^*)Q_{2n}^* &= \left[ \frac{3}{4}(1 - \omega_t Q_{2u}) - \frac{1 - \omega_t Q_{2u}}{2} \right] \frac{1 - \omega_t Q_{2u}}{4} \\
 &= \frac{1}{4}(1 - \omega_t Q_{2u}) * \frac{1 - \omega_t Q_{2u}}{4} \\
 &= \frac{(1 - \omega_t Q_{2u})^2}{16}
 \end{aligned}$$

$$\begin{aligned}
 \frac{\partial \Pi_{1n}}{\partial Q_{2u}} &= 1 - c_{1n} + \frac{3}{4} \omega_t - \frac{\omega_t}{8} \\
 &\quad - \left[ 2 \left( \omega_t + 1 - \frac{\omega_t^2}{4} \right) - \frac{\omega_t^2}{8} \right] Q_{2u} = 0
 \end{aligned}$$

and we get :

$$Q_{2u}^* = \frac{1 - c_{1n} + \frac{5}{8} \omega_t}{2\omega_t + 2 - \frac{5}{8} \omega_t^2}$$

3.  $\mathbb{C}_{1n}$  :

We set  $X = 1 + \frac{5}{8} \omega_t$  and  $Y = 2\omega_t + 2 - \frac{5}{8} \omega_t^2$ , then

$$\mathbb{C}_{1n} = c_{1n}Q_{1n} + c_{2n}^*Q_{2n}^*$$

where

$$\begin{aligned}
 c_{1n}Q_{1n} &= \frac{\left( 1 + \frac{5}{8} \omega_t \right) c_{1n} - c_{1n}^2}{2\omega_t + 2 - \frac{5}{8} \omega_t^2} \\
 &= \frac{Xc_{1n} - c_{1n}^2}{Y}
 \end{aligned}$$

$$\begin{aligned}
 c_{2n}^*Q_{2n}^* &= \frac{1 - \omega_t Q_{2u}}{2} * \frac{1 - \omega_t Q_{2u}}{4} \\
 &= \frac{1}{8} \left[ 1 - \omega_t \frac{X - c_{1n}}{Y} \right]^2 \\
 &= \frac{1}{8} \left[ 1 - 2 \frac{\omega_t(X - c_{1n})}{Y} + \frac{(X - c_{1n})^2 \omega_t^2}{Y^2} \right]
 \end{aligned}$$

From the above, we find that:

$$\frac{\partial \mathbb{C}_{1n}}{\partial c_{1n}} = \frac{X}{Y} + \frac{\omega_t}{4Y} - \frac{\omega_t^2}{4Y^2} + \left[ \frac{\omega_t^2}{4Y^2} - \frac{2}{Y} \right] c_{1n} = 0$$

which results in:

$$\begin{aligned} c_{1n}^* &= \frac{4XY + Y\omega_t - X\omega_t^2}{8Y - \omega_t^2} \\ &= \frac{128 + 240\omega_t + 56\omega_t^2 - 45\omega_t^3}{256 + 256\omega_t - 96\omega_t^2} \end{aligned}$$

4.  $\bar{p}_{2n}$  :

$$\begin{aligned} \bar{p}_{2n} &= \bar{p}_{2u} + (1 - v_t + C_t)(1 - \bar{q}_{2n}) \\ &= (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n}) + (1 - v_t + C_t)(1 - \bar{q}_{2n}) \\ &= (v_t - C_t)(1 - \bar{q}_{2n}) + (1 - v_t + C_t)(1 - \bar{q}_{2n}) - (v_t - C_t)\bar{Q}_{2u} \\ &= 1 - \bar{q}_{2n} - (v_t - C_t)\bar{Q}_{2u} \end{aligned}$$

5.  $\Pi_{2u}$  :

$$\Pi_{2u} = (\bar{p}_{2n} - p_{2n})\bar{q}_{2n} + \bar{Q}_{2u}\bar{p}_{2u}$$

where

$$\begin{aligned} (\bar{p}_{2n} - p_{2n})\bar{q}_{2n} &= [1 - \bar{q}_{2n} - \bar{Q}_{2n}(v_t - C_t) - p_{2n}]\bar{q}_{2n} \\ &= -\bar{q}_{2n}^2 + \bar{q}_{2n}[1 - \bar{Q}_{2n}(v_t - C_t) \\ &\quad - \frac{3}{4}(1 - \omega_t Q_{2u})] \end{aligned}$$

$$\begin{aligned} \bar{p}_{2u}\bar{Q}_{2u} &= (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n})\bar{Q}_{2u} \\ &= -(v_t - C_t)\bar{Q}_{2u}\bar{q}_{2n} + (v_t - C_t)(1 - \bar{Q}_{2u})\bar{Q}_{2u} \end{aligned}$$

$$\frac{\partial \Pi_{2u}}{\partial \bar{q}_{2n}} = -2\bar{q}_{2n} + \left[ 1 - (v_t - C_t)\bar{Q}_{2u} - \frac{3}{4}(1 - \omega_t Q_{2u}) - (v_t - C_t)\bar{Q}_{2u} \right] = 0$$

and we get:

$$\begin{aligned} \bar{q}_{2n}^* &= \frac{1 - 2(v_t - C_t)\bar{Q}_{2u} - \frac{3}{4}(1 - \omega_t Q_{2u})}{2} \\ &= \frac{1 - 8(v_t - C_t)\bar{Q}_{2u} + 3\omega_t Q_{2u}}{8} \end{aligned}$$

6.  $\Pi_{1n}$  :

$$\Pi_{1n} = Q_{1n}(p_{1n} - c_{1n}) + \Pi_{2n}^*$$

where

$$\begin{aligned} Q_{1n}(p_{1n} - c_{1n}) &= Q_{1n}(p_{2u} + 1 - Q_{1n} - c_{1n}) \\ &= -Q_{1n}^2 + Q_{1n} \left[ 1 - c_{1n} \right. \\ &\quad \left. + \omega_t \left( 1 - Q_{2u} - \frac{1 - \omega_t Q_{2u}}{4} \right) \right] \end{aligned}$$

$$\begin{aligned} \Pi_{2n}^* &= \left( \frac{1 - \omega_t Q_{2u}}{4} \right)^2 \\ &= \frac{1 - 2\omega_t Q_{2u} + \omega_t^2 Q_{2u}^2}{16} \end{aligned}$$

From the calculations above, we get:

$$\begin{aligned} \frac{\partial \Pi_{1n}}{\partial Q_{1n}} &= -2Q_{1n} + 1 - c_{1n} + Q_{1n} \left[ -\omega_t k_2 + \frac{\omega_t^2}{4} k_2 \right] \\ &\quad + \frac{3}{4} \omega_t + \left[ \frac{\omega_t^2}{4} - \omega_t \right] Q_{2u} + \frac{\omega_t^2}{8} k_2 Q_{2u} - \frac{\omega_t}{8} k_2 = 0 \end{aligned}$$

resulting in:

$$Q_{1n}^* = \frac{1 - c_{1n} - \frac{(k_2 - 6)}{8} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{8} Q_{2u}}{2 + \omega_t k_2 (1 - \frac{\omega_t}{4})}$$

7.  $\mathbb{C}_{1n}$  :

$$\mathbb{C}_{1n} = c_{1n} Q_{1n} + c_{2n}^* Q_{2n}^*$$

which makes :

$$\begin{aligned} \frac{\partial \mathbb{C}_{1n}}{\partial c_{1n}} &= \frac{-2c_{1n} + 1 + \frac{(k_2 - 6)}{8} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{8} Q_{2u}}{2 + \omega_t k_2 (1 - \frac{\omega_t}{4})} \\ &= 0 \end{aligned}$$

As the result of that,

$$c_{1n}^* = \frac{1}{2} - \frac{(k_2 - 6)}{16} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{16} Q_{2u}$$

8.  $\Pi_{1u}$  :

$$\Pi_{1u} = (\bar{p}_{1n} - p_{1n}) \bar{q}_{1n} + \Pi_{2u}^*$$

where

$$\begin{aligned} (\bar{p}_{1n} - p_{1n}) \bar{q}_{1n} &= [\bar{p}_{2u} + 1 - \bar{q}_{1n} - (A + B Q_{2u})] \bar{q}_{1n} \\ &= \bar{q}_{1n}^2 + \bar{q}_{1n} [1 - A - B Q_{2u} + (v_t - C_t) \\ &\quad * (1 - \bar{Q}_{2u} - \frac{1 - 8(v_t - C_t) \bar{Q}_{2u} + 3\omega_t Q_{2u}}{8})] \end{aligned}$$

$$\begin{aligned} \Pi_{2u}^* &= \bar{q}_{2n}^* (\bar{p}_{2n} - p_{2n}) + \bar{p}_{2u} \bar{Q}_{2u} \\ &= \frac{1 - (v_t - C_t)(4\bar{Q}_{2u} - Q_{2u})}{4} [1 - \bar{Q}_{2u} - \omega_t \bar{Q}_{2u} \\ &\quad - \frac{1 - (v_t - C_t) Q_{2u}}{4}] + \bar{Q}_{2u} (v_t + C_t) (1 - \bar{Q}_{2u} - \bar{q}_{2n}) \end{aligned}$$

$$\begin{aligned} \frac{\partial \Pi_{1u}}{\partial \bar{q}_{1n}} &= -\bar{q}_{1n} \{2 + B \bar{k}_2 + (v_t + C_t) [\bar{k}_1 + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}}]\} \\ &\quad + 1 - A - B Q_{2u} + (v_t - C_t) [1 - \bar{Q}_{2u} - \bar{q}_{2n}] \\ &\quad + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}} \left[1 - \bar{q}_{2n} - \omega_t \bar{Q}_{2u} - \frac{1 - (v_t - C_t) Q_{2u}}{2}\right] \\ &\quad + \bar{q}_{2n} \left(1 - \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}} - \omega_t \bar{k}_1 + \frac{(v_t - C_t)}{2} \bar{k}_2\right) \\ &\quad + (v_t - C_t) (1 - \bar{Q}_{2u} - \bar{q}_{2n}) \bar{k}_1 - (v_t - C_t) \bar{Q}_{2u} (\bar{k}_1 + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}}) \\ &= 0 \end{aligned}$$

and we get:

$$\bar{q}_{1n}^* = \frac{1 - A - B Q_{2u} - C \frac{(v_t - C_t)(4\bar{k}_1 - \bar{k}_2)}{4} + D \bar{Q}_{2n} - E}{2 + B \bar{k}_2 + (v_t - C_t) (\bar{k}_1 + \frac{(v_t - C_t)(4\bar{k}_1 - \bar{k}_2)}{4})}$$

among which,

$$\begin{aligned} A &= \frac{1}{2} - \frac{(k_2 - 6)}{16} \omega_t \\ B &= \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{16} \\ C &= \frac{1}{2} - 2\bar{Q}_{2n} - \omega_t \bar{Q}_{2u} - \frac{1 - \omega_t}{2} Q_{2u} \end{aligned}$$

$$D = 1 - \omega_t \bar{k}_1 + \frac{1 - \omega_t}{2} Q_{2u}$$
$$E = (v_t - C_t)[(1 - \bar{Q}_{2n} - \bar{Q}_{2u})(1 - \bar{k}_1) + \bar{Q}_{2n} \bar{k}_1]$$

## References

- Anderson, S. P., and Victor A. G. (1994). Price discrimination via second-hand markets. *European Economic Review* 38.1: 23-44.
- Bapna, R., Wolfgang J., and Galit S. (2008). Consumer surplus in online auctions. *Information Systems Research* 19(4), 400-416.
- Bapna, R., Gupta, A., Rice, S., and Sundarajan, A. (2017). Trust and the Strength of Ties in Online Social Networks: An Exploratory Field Experiment. *MIS Quarterly* 41(1), 115-130.
- Chasin, F., von Hoffen, M., Hoffmeister, B., and Becker, J. (2018). Reasons for Failures of Sharing Economy Businesses. *MIS Quarterly Executive* 17(3), 185-199.
- Chen, J., Susanna E., and Matthew S. (2013) When do secondary markets harm firms?. *American Economic Review* 103(7), 2911-34.
- Chen, Y., Anandhi B., and Khim-Yong G. (2017) An Empirical Analysis of Intellectual Property Rights Sharing in Software Development Outsourcing. *Mis Quarterly* 41(1).
- Chevalier, J., and Austan, G. (2009). Are durable goods consumers forward-looking? Evidence from college textbooks. *The Quarterly Journal of Economics* 124(4), 1853-1884.
- Chi, H., Zhou, W., & Piramuthu, S. (2016). Temporal ownership boundary in sharing economy. In *Workshop on E-Business*, pp. 54-66. Springer, Cham.
- Chian T., Felix, T., Cahalane, M., Tan, B., and Englert, J. (2017) How GoGet CarShare's Product-Service System is Facilitating Collaborative Consumption. *MIS Quarterly Executive* 16(4).
- Constantiou, I., Attila M., and Virpi K. T. (2017) Four Models of Sharing Economy Platforms. *MIS Quarterly Executive* 16(4).
- Cusumano, M. A. (2015). How traditional firms must compete in the sharing economy. *Communications of the ACM* 58(1), 32-34.
- Desai, P., and Purohit, D. (1998). Leasing and selling: Optimal marketing strategies for a durable goods firm. *Management Science* 44(11), S19-S34.
- Einav, L., Chiara F., and Jonathan L. (2016). Peer-to-peer markets. *Annual Review of Economics* 8, 615-635.
- Fishman, A., and Rafael, R. (2000). Product innovation by a durable-good monopoly. *The RAND journal of Economics*, 237-252.

- Fraiberger, S. P., and Arun S. (2015) Peer-to-peer rental markets in the sharing economy. NYU Stern School of Business research paper (6). Available at SSRN: <https://ssrn.com/abstract=2574337>
- Frey, A., Manuel T., and Daniel V. (2019). Three Differentiation Strategies for Competing in the Sharing Economy. *MIS Quarterly Executive* 18(2).
- Fudenberg, D., and Jean T. (1998). Upgrades, trade-ins, and buybacks. *The RAND Journal of Economics*, 235-258.
- Ghose, A., Michael, D. S., and Rahul T. (2006). Internet exchanges for used books: An empirical analysis of product cannibalization and welfare impact. *Information systems research* 17(1), 3-19.
- Gong, J., Brad N. G., and Yiping S. (2017). Uber might buy me a mercedes benz: An empirical investigation of the sharing economy and durable goods purchase. Available at SSRN 2971072.
- Greenwood, B. N., and Sunil W. (2017). Show Me the Way to Go Home: An Empirical Investigation of Ride-Sharing and Alcohol Related Motor Vehicle Fatalities. *MIS quarterly* 41(1), 163-187.
- Hakim, S., Li, Z., Pan, Y., Zaumseil, F., Chi, H. and Zhou, W. (2018). The Impact of General Data Protection Regulation (GDPR) on Data Management Platforms (DMP): A Policy Perspective. *Management & Datascience*, 2(3).
- Huang, K., InduShobha C., and Alain P. (2019). Sharing Is Caring: Social Support Provision and Companionship Activities in Healthcare Virtual Support Communities. *MIS Quarterly* 43(2).
- Horton, J. J., and Richard J. Z. (2016). Owning, using and renting: some simple economics of the "sharing economy". No. w22029. National Bureau of Economic Research.
- Jiang, B., and Lin T. (2016). Collaborative consumption: Strategic and economic implications of product sharing. *Management Science* 64(3), 1171-1188.
- Johnson, J. P. (2011). Secondary markets with changing preferences. *The RAND Journal of Economics* 42(3), 555-574.
- Kim, K., and Hann, I. (2017). Housing prices, collateral, and online crowdfunding. Robert H. Smith School Research Paper. Available at SSRN.

- Kuruzovich, J., Siva V., and Ritu A. (2011). Seller search and market outcomes in online auctions. *Management Science* 56(10), 1702-1717.
- Malhotra, A., and Van Alstyne, M. (2014). The dark side of the sharing economy and how to lighten it. *Communications of the ACM* 57(11), 24-27.
- Martin, E., Susan A. S., and Jeffrey L. (2010). Impact of carsharing on household vehicle holdings: Results from North American shared-use vehicle survey. *Transportation Research Record* 2143(1), 150-158.
- Menon, S., and Sumit S. (2016). Privacy and Big Data: Scalable Approaches to Sanitize Large Transactional Databases for Sharing. *MIS Quarterly* 40(4).
- Mocker, M., and Nils O. F. (2017). How AUDI AG is Driving Toward the Sharing Economy. *MIS Quarterly Executive* 16(4).
- Moorthy, K. S. (1984). Market segmentation, self-selection, and product line design. *Marketing Science* 3(4), 288-307.
- Mussa, M., and Sherwin R. (1978). Monopoly and product quality. *Journal of Economic theory* 18(2), 301-317.
- Rust, J. When is it optimal to kill off the market for used durable goods?. *Econometrica: Journal of the Econometric Society*, 65-86.
- Seamans, R., and Feng Z. (2013). Responses to entry in multi-sided markets: The impact of Craigslist on local newspapers. *Management Science* 60(2), 476-493.
- Sundararajan, A. (2016) *The sharing economy: The end of employment and the rise of crowd-based capitalism*. Mit Press.
- Waldman, M. (2003). Durable goods theory for real world markets. *Journal of Economic Perspectives* 17(1), 131-154.
- Weber, T. A. (2016). Product pricing in a peer-to-peer economy. *Journal of Management Information Systems* 33(2), 573-596.
- Zervas, G., Proserpio, D. and Byers, J.W. (2017). The rise of the sharing economy: Estimating the impact of Airbnb on the hotel industry. *Journal of marketing research*, 54(5), 687-705.

Zhang, C, Kolte, P., Kettinger, W. J., and Yoo, S. (2018).  
Established Companies' Strategic Responses to Sharing Economy  
Threats. MIS Quarterly Executive 17(1).

Partie III. Automobile  
Subscription: New  
Alternative to Ownership,  
Lease or Mixed?



## Forewords

Recently, a new way of car ownership is emerging to challenge the traditional business models in the automotive industry. This new trend, as known as car subscription, offers customer a flexible, short-term car usage rather than a long-term commitment. This car subscription contract provide not only but the ownership factor of traditional car contracts also the flexibility of car-sharing, which includes additional services such as insurance, maintenance and car swaps. To estimate the advantages of the subscription model, we set up a discrete choice model by considering the variables related to user's characteristics and contact's parameters. With data gathered from car manufacturers and rental platforms, we compare the car subscription model to conventional car ownership options. We further compare the subscription contract provided by car manyfacturers and sharing platforms. Findings indicate that the subscription model shows great advantages over the conventional methods of car ownership and in terms of the attractiveness of a subscription contract to a consumer, the recurring subscription fee is one of the most powerful factor. Moreover, we find that car manufacturers hold a competitive advantage over car renting platforms in their subscription offering.

This study is in revision.



## Chapter 1. Introduction

Thanks to the fast development in technology and the increasing awareness of sustainability consumption, consumers are changing their preference from long-term ownership to more eco-friendly short-term sharing options. In the recent years, car subscription platforms become increasingly popular and expands rapidly. Subscription business seems to create incentives of additional asset acquisition for the service providers. The traditional automotive sellers also find incentives to update their business models, such as considering themselves offering the subscription services.

Many automobile makers such as General Motors, BMW, and Daimler have launched their own car subscription services and invested in car subscription startups in the recent years. The subscription service for automobile meets the consumers' desire of having the newest technologies and experiencing an all-inclusive ownership package. Compared with the conventional ways of car ownership, such as financing and leasing, the subscription provides a broader amount of services to the customer. By subscribing to a car program, a subscription fee and a monthly payment include not only the ownership of a car but also the insurance, registration, taxes, maintenance, and car swap. Among those services, the option to switch between different car models steadily is a great advantage compared to the conventional ownership options. It especially satisfies the users' demand for "tasting" the innovations that appear in different car models. Moreover, another advantage of subscription is its lower initial payment, which generates a popular substitution for traditional ownership choices. In particular, for young people who belong to a relatively low income class, credit constraint is a reason of not being able to lease a car due to the significant upfront payment (Attanasio, Koujianou Goldberg, and Kyriazidou, 2008). Lastly, the subscription offers a flexible contractual option that allows cancellation with a short-period notice. Compared

with the contract length of financing (6 years on average) and leasing (4 years on average), the new offer adapts to the rapidly shifting consumers' preferences of owning the latest car. It has also been found that target customers of other subscription services value similar features like the convenience of the service, the superior quality, the exclusive value, and the additional services offered.

Although the traditional ownership options have been studied from various point of views in the existing literature (e.g. Johnson, 2000, and Dasgupta, Siddarth and Silva-Risso, 2007), it is a new scope of research to investigate the subscription option in the automotive industry and the available literature on this topic is limited. In this study, we investigate the consumers' choices among four options: owning, leasing, manufacturer subscription, and platform subscription. Consumers evaluate the contents of different contracts to choose the optimal one. We examine the probability of each choice by considering a two-step discrete choice model in which consumers firstly decide which attributes for comparing the options and secondly determine the optimal contract based on their needs. We study the effect of characteristics, including payments, maintenance costs and flexibility, on matching the contract agreements to the consumers' needs. In general, we find that consumers in the upper-income class are more willing to finance new cars. Meanwhile, for customers that cannot afford the financing or leasing option, the subscription can be an attractive option but with some exceptions. The results also provide insights that can be used to design the best suitable contract for a targeted consumer. For example, for a luxurious car company, offering subscription enables it to target specific profiles in the customer segment.

The remainder of this part is organized as follows. In Chapter 2, we provide a brief review of the extant literature that elaborates different car ownership options. In Chapter 3, we

develop the discrete choice model for consumer's decision and identify the parameters. In Chapter 4, we conduct a data analysis based on the dataset and discuss the results as well as the managerial implications. Lastly, we conclude and suggest future research topics in Chapter 5.



## Chapter 2. Literature Review

### 2.1 Contract Options

Several studies have analyzed the leasing and buying options of a car, concerning a car manufacturing company's choice in a monopolistic environment using game-theoretic models. One of the earliest studies was conducted by (Bulow, 1982) who found out that leasing is a better option for companies than selling, as the effect of time-consistency lowers the profitability of the seller. Later research determined that profit maximization of a lease or sale option depends on the relative depreciation rate of the vehicle (Desai and Purohit, 1998). Thus, the depreciation of a car marginally increases over the cars lifetime. They state that car manufacturing companies can outperform through exclusively selling due to a higher rate of car depreciation. Later studies examined the leasing and selling market, with regards to a dynamic oligopoly model (Esteban and Shum, 2007; Andrikopoulos and Markellos, 2015). While previous research is based on descriptive results, the findings of Johnson, Schneider and Waldman (2014) focused on predictive ones. They assumed leasing and financing to be imperfect substitutes and predicted that a positive relationship exists between sell rates and lease rates. Therefore, for lessors, it can have a negative outcome if leasing rates are determined by predicted values based on the selling market, resulting in a loss on a long-term perspective. Compared to the other empirical findings, Johnson et al. (2014) emphasized the relationship between the two markets of selling and leasing from a company's perspective.

The above-discussed literature is comparing the lease and finance options from a company's point of view, therefore disregarding the consumers' optimal choice. They consider the consumers' choice as being equivalent while only focusing on the firm's decision. However, this assumption omits several essential factors that impact consumers' choice of car ownership. Train and Winston (2007) observed the reason of a shrinking

domestic automotive market in the U.S. The study revealed that a loss in consumer's willingness to buy is assigned to basic characteristics such as price, size, operating costs and reliability. Other studies examined that buying factors like financial contract costs, including down payment and monthly payment, duration, and interest rate are essential to consider. Moreover, unaccounted costs resulting from the usage of the car can have an impact on the buying decision of consumers as well as demographic factors such as income or age. Additionally, further literature emerged stressing the importance of considering other determining elements, rather than only the cost factors of down and monthly payments.

## **2.2 Subscription Model**

Although car subscription is a topic not yet extensively studied, several types of research exist that analyzed the subscription market on other products than automotive, such as telecommunication and (online) newspapers. Most of these studies base their research on the so-called Bass (1969) model, which focuses on developing an optimal pricing strategy for companies by clustering customers into two groups, namely innovators and imitators (Robinson and Lakhani; 1975, Mesak and Darrat, 2002; Fruchter and Rao, 2001). Another focal point in the research of subscription is the network effect. It describes the relationship between the rise in the number of users and the increased value of the subscription service. Due to this dependency, studies observed that as more consumers subscribe to the service, the optimal membership fee and discount rate needs to be adjusted (Fruchter et al., 2006; Dhebar and Oren, 1985). All previously mentioned literature investigated the pricing model of subscriptions but concentrated on identifying the best dynamic pricing model for companies. As a result, the prime focus is set on how pricing changes over time as the adoption process evolves. Mainly, the differentiation between certain customer groups during the product life cycle of a subscription service

is studied. Previous research is lacking to compare the subscription pricing option to other contract choices available to the consumer. The subscription offer is always the sole option for the customer available. The effect of current offers that act as substitutions to the subscription service is not analyzed. Therefore, it is assumed that a study about the impact of other options available to the consumer next to the subscription one, is crucial. The financing and leasing are weighted against the subscription option to explore the discrepancy among the choices. These variations are explored by setting up a statistical model which includes the coefficients, that are identified from existing literature.

Five critical variables that impact the consumer choice for leasing and financing are studied already. The subscription model, however, offers additional services to the customer, which exceed the services that are provided by the traditional contract options. The monthly subscription payment includes several services on top of owning a car. One of the most significant advantages it provides is being able to swap a car model whenever a customer would prefer to, by just making a request using the application (Mercedes Benz US, 2019). Also, insurance, maintenance, and flexible contract conditions with only a minimum rent of one month are noteworthy characteristics. To generate a fair comparison among all contract options that are analyzed, we introduce a sixth factor to our statistical model. It accounts for the additional flexibility that the subscription model offers to the customer.

### **2.3 Attributions**

To get insights on consumers intention of choosing an alternative, Aizcorbe and McCluer (1997) studied the behavior of car purchasers and realized that they perceive leasing as the more profitable contract option. This is because it offers a low monthly and small down payment. However, Nunnally and Plath (1989) found out that several other factors, such as the after-tax cash

rate of return a lessee receives from investments, the opportunity cost of capital and payment period, heavily influence the optimal contract choice. Hence, it depends on the rate of return on invested capital derived from the after-tax cash flow and on the effective annual lease hurdle rate. If the effective annual lease hurdle is lower than the after-tax return of the invested capital, the customer is better off with a leasing option. It implies that each consumer has his individual best choice. However, since it is not consistent that a lease is a more valuable choice, Nunnally and Plath (1989) concluded that leasing is not always outperforming the alternative of financing a car. Their research revealed that it is important to also incorporate the cash rebates, annual percentage, and residual value in the economic model. These insights are incorporated in the following research, and the composition of the price is described in detail in a later section of this part. The price is the first determinant in our model.

Next, to the financial contract costs, the linkage between annual mileage driven and the selection of a specific car was studied by Verboven (2002). Significant findings imply that customers with a higher annual amount of miles driven chose a car with a different, long-lasting engine. Also, the yearly limit of mileage varies among the contract options. Mannering et al. (2002) researched that consumers who drive more than 12,000 miles a year are less inclined to a car lease. Driving over 12,000 miles is exceeding the annual limit of most of the leasing contracts resulting in additional costs per mile driven above the specified limit. Therefore, it can be assumed that mileage has a significant impact on the consumers choice of car contracts, as different costs result if limits are exceeded. We add the mileage vector to our model to account for its effect on car ownership alternatives studied.

Further, maintenance costs can also have an impact on the different modes of buying a vehicle. Since a customer only owns

the car half as long with a leasing contract than with a financing one, maintenance costs are estimated to be lower (Dasgupta et al., 2007). It assumes that car servicing increases during the life cycle of a car. In our model, maintenance costs are investigated and considered as the third factor in the equation.

Aizcorbe and Starr-McCluer (1997) observed that despite a lower or even no down payment and a smaller monthly payment for leasing a car, compared to financing one, lessees belong to households with relatively high income and to an age group of 35 to 54 years. These findings are supported by the research of Mannering et al. (2002), which investigated that leasing is especially favorable for the upper U.S. household income classes, whose income increased tremendously in the 1990s. Moreover, along a consumers' life cycle, the quality of the car owned is increasing, meaning leasing is used to upgrade the quality of the vehicle. These findings are in line with the ones of Desai and Purohit (1998) who analyzed that leasing cars are often identified as the more expensive ones, however, due to a higher quality rather than more luxurious. A later study of Kathleen Johnson (2000), on the contrary, demonstrated that leasing options are mostly chosen by people who are credit-constrained but still want to have a luxurious model. To explore the effect of income on the contract choice, we add it as a factor to the function.



## Chapter 3. The Discrete Choice Model

We construct a two-level discrete choice model that analyses the customers' contractual choice based on three available options: financing, leasing, and subscribing. The benefits and costs are estimated to identify the best contract option and terms for consumers according to their profiles. In what follows, we first describe the nested logit structure. Then we list the assumptions and notations used in the model. We discuss the utility function and calculate the choice probabilities in detail. Lastly, we investigate the effects of the key parameters.

### 3.1 The Nested Logit Structure

We assume that there are  $I$  consumers and  $N$  models available for them. We consider that the sets of choices are clustered into three branches according to the type of contract it belongs to. Different contracts for various models are assigned to consumers by different providers. For example, Mercedes Benz allows all three contracts for most of their models available, while FlexWheel only provides the subscription for its models. In other words, for each model, there are 3 alternatives  $B_s$  on the first-level branch, where  $s$  is namely (1) financing, (2) leasing, and (3) subscribing, and for the nest subscribing, there are 2 choices on the second-level branch, namely (1) subscription platform and (2) manufacturer. The structure is presented in the Figure 12.

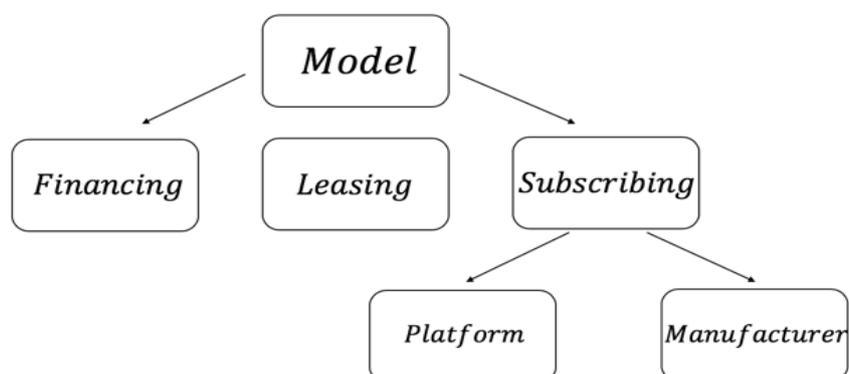


Figure 12 The Nested Logit Structure

A joint analysis cannot be performed with more than two purchasing options because the independence of irrelevant alternatives property (IIA) of the logit model is violated. Therefore, to compare three options at hand, a generalized extreme value model by McFadden (1978) is used. It assumes that the alternatives are grouped into nests. Those alternatives, which are similar to each other, are grouped into one nest. Within a given nest or set, alternatives are proportional substitutes, while among the nests the IIA property holds. Therefore, we consider the correlation inside the nest  $B_s$  as  $1 - \lambda_s$ . For the bottom-level set, a correlation exists among the choices that are grouped in the same branch but not between other branches. Each nest can be identified as one multinomial logit. Thus, for the consumer  $i$  and the model  $j$ , the upper level is estimated by the marginal probability  $P_{ijB_s}$ . The lower level is calculated by computing the conditional probability from the choices  $P_{ijk|B_s}$ . The probability for consumer  $i$  to choose the contract  $k$  for model  $j$  is estimated by computing the nested logit probability, which can be described as the product of the two probabilities mentioned.

In the following, we list the notation used in this study in Table 10.

Table 10 Notations

Notation	Brief Description
$i$	The $i$ th consumer
$j$	The $j$ th model of car
$k$	The $k$ th choice occasion, where choice set is buying (B), leasing (L), subscribing with platform (SP), and subscribing with manufacturer (SM)
$s$	Alternatives $s$ , where $s$ takes buying (B), leasing (L) and subscribing (S)
$B_s$	First-level branch
$1 - \lambda_s$	Correlation inside the nest $B_s$

$P_{ijk}, P_{ijB_s}$	Probability of consumer $i$ choosing the contract $k$ and set $B_s$ for model $j$
$P_{ijk B_s}$	Conditional probability of consumer $i$ choosing the contract $k$ if set $B_s$ is selected
$p_{jk}$	Price of model $j$ under the contract $k$
$d_{jk}, m_{jk}, t_{jk}$	Down payment, monthly payment and term required by the contract $k$ for model $j$
$l$	Annual interest rate
$mile_{jk}$	Mileage cost per mile over limitation required by the contract $k$ for model $j$
$main_{jk}$	Maintenance cost required by the contract $k$ for model $j$
$inc_i$	Income of consumer $i$
$flex_i$	Preference on flexibility of consumer $i$
$U_{ijk}$	Utility function for consumer $i$ to choose contract $k$ for model $j$

### 3.2 The Utility Function

Usually, the chance of being selected for an option is positively related to its utility to the consumer, where the utility of choice  $k$  in set  $B_s$  for individual  $i$  can be illustrated by the following equation:

$$U_{ijk} = X_i' \beta + Z_{jk}' \alpha + \varepsilon_{ijk} \quad (78)$$

where  $X_i = [inc_i, flex_i]'$  represents the characteristics of the consumer and  $Z_{jk} = [p_{jk}, mile_{jk}, main_{jk}]'$  represents the characteristics of the choice  $k$ .  $\varepsilon_{ijk}$  is a random term which is assumed to follow a generalized extreme value. We also assume that within the sets  $B_s$ , the correlation coefficient for the  $\varepsilon_{ijk}$  is approximately equal to  $1 - \lambda_s$ , while choices between the sets are independent. The  $\varepsilon_{ijk}$  is the proportion of information of the utility that is unknown to us.

To analyze the process of consumer's decision on a certain car, the characteristics of consumer  $i$  and contract for model  $j$  have to be taken into consideration. The variables about the consumer are called case-specific variables, including income and preference on flexibility in our model, while the variables about the contract are called alternative-specific variables, including price, mileage limitation, and maintenance cost. Afterwards, we are able to use the multinomial logit regression to get the result of the coefficients  $\alpha$  and  $\beta$  in the utility function. In the following, we discuss each factor in details.

### **3.2.1 The Income Factor**

Different income levels can result in different optimal contract choices. A customer that is constrained in purchasing a car that involves a high upfront payment can consider its opportunity of owning a car under leasing or subscription, which involves a lower down payment. Further, having an unstable income can be another effect of choosing the alternatives mentioned before as both offer a shorter period of ownership than the financing of a car. We refer the income factor as  $inc_i$  in the model.

### **3.2.2 The Flexibility Factor**

Another important case-specific factor is the flexibility factor. It measures the opportunity of having insurance and maintenance costs included in the monthly payment, of frequently exchanging a car for a new one and of enjoying a concierge service when exchanging it. The flexibility coefficient  $flex_i$  is crucial to identify the potential of the subscription offering. In this model, we use two factors to illustrate the flexibility: the desire of variety and the desire for simplified maintenance. The former one reflects the option of exchanging a car at any time and considering the number of different car models available to choose from. The latter one is accounting for the insurance as well as maintenance which is offered by the subscription option and included in a monthly payment.

### 3.2.3 The Pricing Factor

Based on the model developed by Dasgupta et al., (2007), the equation calculating the present value or net price for purchasing, leasing, and subscription is derived similarly. As earlier stated Nunally and Plath (1989) found out that it is crucial to include the period of payments, the borrower's opportunity cost of capital and the residual value, next to the upfront and monthly payments. The down payment and monthly payment differ among the options. The upfront payment of subscription is equivalent to a membership fee and thus only a small part of the installment from the other two options. The monthly payment is, in most cases, the highest for the subscription method and lowest for the buying and leasing ownership. It is due to the additional services provided by the contractor and the great variety of car models that can be accessed and exchanged by a concierge. Inequation (80) and (81) describe the dependencies of the monthly installments and upfront payment. Existing research add a term for final payment in the purchasing formula for leasing. Some leasing contracts require the lessee to pay for the diverging amount between the residual and present value. Recently, contracts exist that exempt lessee from paying the diverging amount. In our study, we focus on the latter ones and expect the companies to pay for the gap. Generally, we result in one pricing equation for all three alternatives:

$$p_{jk} = d_{jk} + m_{jk} \frac{1 - (\frac{1}{1+l})^{t_{jk}}}{1 - \frac{1}{1+l}}, k \in \{B, L, SP, SM\} \quad (79)$$

As discussed above, the upfront payment and monthly installments, as well as the contract length and interest rate, differ among the contract options. Thus, we have the following constrains:

$$m_{jB,jL} < m_{jSM,jSP} \quad (80)$$

$$d_{jSM,jSP} < d_{jL} < d_{jB} \quad (81)$$

### 3.2.4 The Mileage Factor

If the customers' annual mileage driven exceeds the yearly limit that is specified in a particular contract, an additional payment arises, which we determine as mileage cost. Since leasing, as well as subscription, include a limitation on the total mileage driven, a penalty arises when it exceeds the annual budget. If a consumer owns the car, he/she is neither encountering any restrictions in mileage drive nor realizing any charges, which indicates  $mile_{jB} = 0$ . The vector  $mile_{jk}$  determines the additional payments which might arise for a customer that decides on a subscription or leasing contract. We assume that a standardized penalty arises if annual miles driven surpasses the maximum allowed.

### 3.2.5 The Maintenance Factor

Intuitively, maintenance costs are marginally increasing over a vehicles lifetime. Hence, maintenance costs are expected to be lower for leasing than when buying a car. In the case of subscription, maintenance and repair costs are already included in the subscription package. To account for the costs that arise from maintaining the car, we include  $main_{jk}$  as a coefficient in our statistical model.

## 3.3 Choice Probabilities

In order to achieve the probability of choice, backward induction is applied. In other words, we start with the bottom-level equation. Since only the alternative subscription has bottom-level choices, we focus on this option and assume that  $s = S$ . Therefore, the lower level model degenerates to the random utility model inside this nest, which is

$$U'_{ijk} = V_{ijk} + \varepsilon_{ijk} \quad (82)$$

where  $V_{ijk}$  is the function of alternative-specific variables  $Z_{jl}$ . Therefore, for different nests, these variables vary across choices. Comparing it with Eq.(78), we know that  $V_{ijs} = Z'_{jk}\alpha$ . Consequently, the expected value of utility can be measured with

the coefficients estimated in the previous section and the situation of each individual. On the other hands, the parameter  $\lambda_s$  in the model is required to reflect the dissimilarity of choices belonging to a particular branch  $B_s$ .

By estimating  $V_{ijk}$  and  $\lambda_s$ , we can calculate the conditional probability with the multinomial logit. We set  $P_{ijk|B_s}$  to represent the conditional probability of a choice  $j$  given that we chose the model from the set  $B_s$ , which is also called the twig level probability.

$$P_{ijk|B_s} = \frac{e^{\frac{v_{ijk}}{\lambda_s}}}{\sum_{h \in B_s} e^{\frac{v_{ijh}}{\lambda_s}}} \quad (83)$$

where  $1-\lambda_s$  is the correlation inside the nest  $B_s$ . A lower  $\lambda_s$  implies that less independence and more correlation exist among the unobserved portions of utility for the options in nest  $B_s$ .

For the upper-level probability, the marginal probability of each choice in the set  $B_s$  has to be considered. In this case, we apply multinomial logit again to the branch-level equation and obtain that:

$$P_{ijB_s} = \frac{e^{X_i' \beta + \lambda_s IV_{ijs}}}{\sum_{h=B,L,S} e^{X_i' \beta + \lambda_h IV_{ijs}}} \quad (84)$$

Where  $IV_{ijs} = \ln \sum_{h \in B_s} e^{\frac{v_{ijh}}{\lambda_s}}$ . IV is denoted as inclusive value, which is the link between the upper and lower level model. The nested structure is only consistent if coefficients of inclusive value terms lie within the unit interval  $[0,1]$ . If parameters of inclusive values are greater than 1, there is a substitution across the nests and, as noted above, the nesting is not consist with utility maximization. Moreover,  $Z_s' \alpha$  is only dependent on the factors, which define the first-level branches .These factors vary among other options over the nest, but are similar within each nest.

As the result, the probability of consumer  $i$  choosing model  $j$  becomes:

$$P_{ijk} = P_{ijk|B_s}P_{ijB_s} = \frac{e^{X_i'\beta + \lambda_s IV_{ijs}}}{\sum_{h=B,L,S} e^{X_i'\beta + \lambda_h IV_{ijs}}} \frac{e^{\frac{V_{ijk}}{\lambda_s}}}{\sum_{h \in B_s} e^{\frac{V_{ijh}}{\lambda_s}}}, k \in \{B, L, SP, SM\} \quad (85)$$

With  $P_{ijk|B_s}$  showing the conditional probability of taking choice  $k$  given that an alternative in the nest  $B_s$  is chosen, and  $P_{ijB_s}$  indicating the marginal probability of choosing a specific alternative in nest  $B_s$ .

### 3.4 Parameters' Effects

According to Equation(85), for each contract, its probability of being chosen is determined theoretically if the information of consumer and contract is achieved. However, in order to increase this probability, different contractors would develop different attractive policies for their cars, like payment and mileage limitation. As a result, we will discuss how the details of a contract would affect the consumers' choices.

First of all, we investigate how the choice probabilities response to the changes in the parameters of the contract. The deviation of  $P_{ijk}$  with respect to  $Z_{jkh}$  should be:

$$\frac{\partial P_{ijk}}{\partial Z_{jkh}} = \alpha_h P_{ijs} (1 - P_{ijs}), h = 1, 2, 3 \quad (86)$$

where  $Z_{jsh}$  is the  $h$ th entry in vector  $Z_{jk}$  and  $\alpha_h$  is the corresponding coefficient of parameter  $h$ . Meanwhile, the elasticity is also vital, which measures the effect of changes in the value of parameters on choice probabilities.

$$\eta_{Z_{jkh}}^{P_{ijk}} = \frac{\frac{\partial P_{ijk}}{P_{ijk}}}{\frac{\partial Z_{jkh}}{Z_{jkh}}} = \frac{\partial P_{ijk}}{\partial Z_{jkh}} \frac{Z_{jkh}}{P_{ijk}} = \alpha_h Z_{jkh} (1 - P_{ijk}), h = 1, 2, 3 \quad (87)$$

Secondly, we turn to the characteristics of each consumer. Similarly, we result at:

$$\frac{\partial P_{ijk}}{\partial X_{ih}} = P_{ijk} [\beta_{k,h} - \bar{\beta}_h], h = 1, 2, 3 \quad (88)$$

$$\eta_{X_{ih}}^{P_{ijk}} = [\beta_{k,h} - \bar{\beta}_h] X_{ik}, h = 1, 2, 3 \quad (89)$$

where  $\beta_{k,h}$  is the coefficient that reflects the bias portion caused by the  $h$ th characteristic of the  $i$ th consumer on choice

$k$  and  $\overline{\beta}_n$  is the probability weighted average of the alternative specific parameters  $X_{ih}$ .



## Chapter 4. Data Analysis & Managerial Implications

In the following section, we estimate the probabilities to analyze the discrete choice model that we developed in the previous section based on data collected from car manufacturing and car renting companies' websites. First, we summarize the dataset. Second, we identify the coefficients of the variables of the utility function from literature and set up the model. Third, we present the results of data analysis. We also provide managerial implications according to the results to conclude the data analysis.

### 4.1 Dataset Summary

We collect data from car manufacturer, rental companies, leasing companies, and car subscription platforms. The data consists of 330 observations of different contract options available for 87 different car models. These ownership alternatives are offered by 15 car brands and five car rental companies. All records are based on offerings in the US market except the "Care by Volvo" subscription offer, which is currently only available in the German market.

To derive the net price, the upfront and monthly payment for each option, the corresponding interest rate offered, and the contract term are required. We calculated the net price according to Equation (2) and display the price in USD. The mileage cost is based on the specification that is made for the particular contract. We collect the annual mileage limit and use an average penalty of 0.15 USD which is adopted from the paper of Dasgupta et al. (2007) where we retrieve the maintenance factor from. The maintenance costs are taken from an online cost calculator of car ownership, which is [edmunds.com](http://edmunds.com),. We add costs for the leasing and financing options. Subscription, however, does not show any maintenance costs as the contractor buries them. All variables named are numerical ones.

To estimate the desire of variety, we retrieve data of how many car exchanges are available per year under a certain ownership

option. In addition, we collect data on the number of car models available for car exchanges. These variables both show categorical values. Also, the insurance and maintenance included in an offer are displayed as a categorical variable with the values 0 and 1 only. For an in-depth overview of the data set, a statistical summary of the variables and data collected is listed below in Table 11.

Table 11 Statistical Summary of Contract Information

<b>Contract</b>	<b>Financing</b>	<b>Leasing</b>	<b>Subscribing with Manufacturer</b>	<b>Subscribing with Platform</b>
Model (total)	84	84	55	56
Brand (total)	15	15	6	5
Upfront payment (average)	6598	3021	417	556
Monthly payment (average)	947	754	1886	1334
Contract length (average in month)	60	36	1.04	1
Mileage limitation (average)	unlimited	10795	Almost unlimited	18307
Maintenance (average)	7850	2278	0	0
Number of swap cars (average)	0	0	Almost unlimited	5 or unlimited
Variety of cars offered (average)	0	0	4.5	18

## 4.2 Setup

We conduct two perspectives: 1) to investigate the vehicle options from the customer's perspective and 2) to understand it from the company's point of view. In the first perspective, we consider the contracts are predetermined and provided for different consumers. Hence, we gradually change the income level and flexibility factors to simulate their impact on consumer choices. Changing these parameters alters the consumers utility and hence the probability of the best choice. We aim at identifying the target customer for specific car models and respective ownership decision. On the other hand, in the second perspective, we consider a certain consumer and hold the case-specific factors like income and flexibility preference fixed. In this case, we change the parameters in different contracts to observe the probability of being selected, which would give contractors insights on the important policies that customer values. Thus, conducting two simulations is valuable to not only understand the companies best choice but estimate how changes in case-specific factors can affect the consumers maximum utility.

To estimate the choice utility, we determine the parameter of the alternative-specific and case-specific factors by using past research results. Since it is a very new topic under research, we do not have the data available to measure the coefficients ourselves. Thus, the alternative-specific factors are taken from the study of Dasgupta et al. (2007). They included around 15,500 records from individual purchases of new cars in California. The research is comparable to ours from the car models studied and focuses on comparing financing and leasing. Since the factors of their analysis are similar to the ones covered in our study, we consider it as a good fit. In the Table 12, we can observe that the price coefficient is negative, which is -1.64. It is similar to the findings of other papers that analyzed comparable topics (Train et al., 2007; Moraga-Gonzalez et al., 2015). It implies

that the utility is decreased by increasing the price, holding every other factor of the equation equal. Mileage and maintenance also indicate a significant, negative coefficient since they result in additional costs to the customer, decreasing the customer's utility. All three cost factors are measured in USD. The brand factor shows a positive value, implying that the overall utility is increased if the brand choice of a particular vehicle is available.

Table 12 Estimated Coefficients

<b>Parameters</b>	<b>Coefficient</b>	<b>T-stat</b>
(1)Net price	-1.64	-23.34
(2)Mileage	-3.27	-3.54
(3)Maintenance	-7.47	-3.01
(4)Income	0.0068	0.437
(5)Desire for variety	0.102	0.000
(6)Desire for simplified maintenance	0.096	0.000

The lower part, which includes rows (4)-(6), of Table 12 consists of the parameters that represent the consumer's characteristics, namely the flexibility factor and the income factor. The flexibility factor is described by the desire for variety and desire for simplified maintenance. It does not exist as such one flexibility factor in past research as it is described throughout our study. So we refer to it as these two characteristics. We derive all three parameters from the study of Trocchia and Beatty (2003). The income factor we adopt from that paper and not from others since it is not considered as a dummy but introduced as a factor, showing a positive value of 0.068. The flexibility factor, however, cannot be directly extracted from any research as it is not studied yet in the same way as introduced in our study. Nevertheless, the research of

Trocchia and Beatty (2003) includes parameters, which can be related to the flexibility factor: the desire for variety and the desire for simplified maintenance. They both are highly significant and display a positive value. If the desire for variety is increased by one, the overall utility of the consumer is increased by 0.102, and 0.096 respectively if the desire for simplified maintenance is increased by one. In our case, the desire for variety is related to the number of swaps possible and car models available. These two measures predict whether a great variety is available to the consumer. The simplified maintenance we refer as the opportunity of having insurance, maintenance, and taxes included in the overall offer.

### **4.3 Results**

We firstly focus on the branch of each contract. For the nest of subscription, it is further divided according to where the contracts are provided, manufacture itself or renting platforms. Then we check the probability among contracts for different consumers. The value for each model is determined by variables in contract, while the probability is related to consumer's parameters.

#### **4.3.1 Alternative-specific Factors Fixed**

When the information of the existing contracts is determined, we compare the upper-level probabilities among the three contract decisions based on different individuals' choices. Figure 13 illustrates that when income level increases, the probability of financing increases significantly after an income of 4,000 USD (Subgraph (A)). Especially in an income level range of 4,000 to 10,000 USD the customer is indecisive between financing and subscribing. While the indifference curve of subscription is going close to 0 at 10,000 USD (Subgraph (C)), financing increases to a probability close to 1. Thus, the graphs of financing and subscription are inversely related. Also, leasing marginally increases until an income level of 8,000 USD (Subgraph (B)). However, the probability of leasing is all time fairly low,

whilst probability of subscription and financing are significantly high.

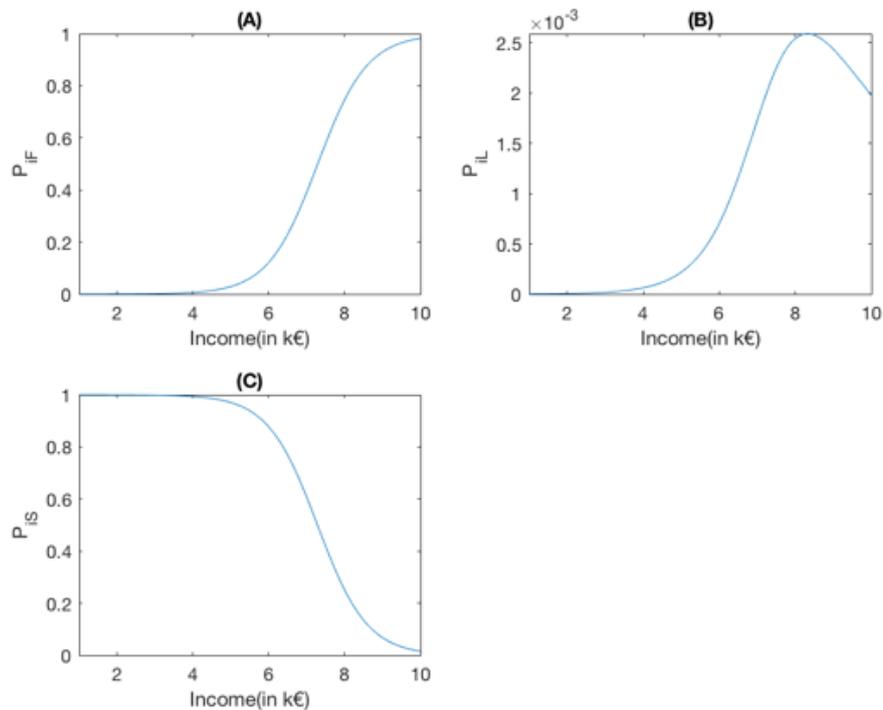


Figure 13 Probability Change Caused by Income

### 4.3.2 Case-specific factors fixed

We investigate, for a given consumer, how to improve the attractiveness of a contract by adjusting the alternative-specific factors in the contract. Since the case-specific factors is fixed, we start with checking the lower-level probabilities among the subscription contract from different providers for the same model. We can observe that there exists the optimal contract which has higher probability than others. Taking the model 2019 530e from BMW as an example, the manufacturer BMW provides financing, leasing and two subscribing contracts for it. There are also three automobile s platform, namely Drive Flow, Prime Flip and Drive Germain, providing subscription contracts for this model. The results show that the contract provided by Drive Flow received the highest probability, which is 39%, among 5 subscription contracts. It provides the most variety of cars with lowest price, which leads to its

advantages. For the manufacturers, although they do not set the limitation on mileage, they usually ask for a higher price and provide less models for car swap compared with subscription platforms. This shortcoming may come from the high cost of manufacturers.

Furthermore, we examine the upper- as well as the lower-level probability and study the effect of a change in the contract settings on the optimal contract choice. In particular, we observe the change in the optimal choice by altering the price level to figure out the optimal price. For example, we select the model AMG GLE 63 for a consumer with a monthly income of around 5,000 USD. The price provided by Mercedes Benz and Drive Germain is 2,090 USD and 2,013 USD, respectively. Further, Drive Germain requires a mileage limitation of 21,000 miles a year and offers 16 different car models for consumers. Mercedes Benz provides its customers with a subscription contract that includes unlimited mileage and a platform with nine different car models. The subgraphs (A) and (B) in Figure 14 display that when the price set by the subscription platform is 2,113 USD, a customer would intend to decide on buying the subscription offer from Mercedes Benz directly if the price is below 2,500 USD. However, if the price that Mercedes Benz offers exceeds 6,000 USD, which is around triple the price provided by Drive Germain, the customer would choose the subscription contract from the car rental platform. Similar results can be found within the graphs (C) and (D). When the price set by Mercedes Benz is 2,090 USD, the subscription contract from a rental platform will lose advantages when its price is higher than triple that provided by the manufacturer. As a result, the perfect choice of the consumer would shift, ending up buying from a rental platform.

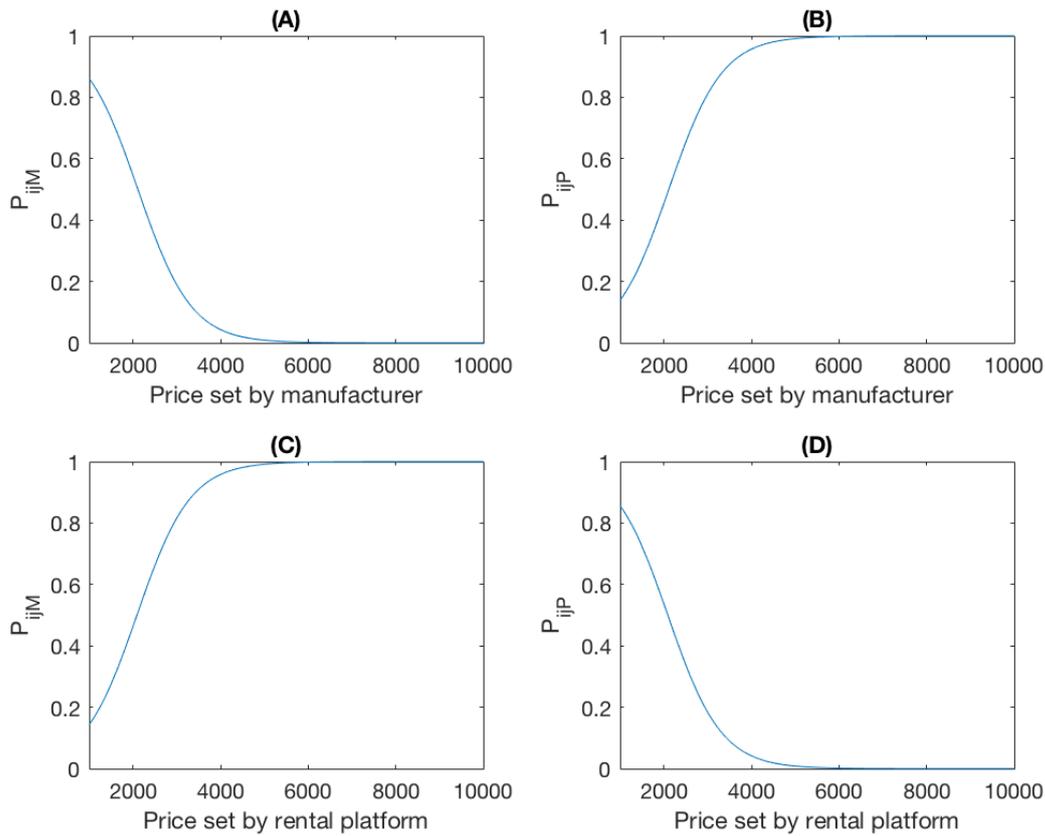


Figure 14 Probability Change Caused by Price

### 4.3.3 Managerial Implications

We can assess the contract options that render the highest impact on the probability of choice for a specific car model. By understanding the utilities of the consumers, managerial insights derived from this research can help the marketers improve their contract design and product offerings.

First of all, our findings indicate that, for each model, there exists an optimal subscription contract that significantly outperforms the others. Marketers should focus on these optimal contracts because they have the highest probability of choice. We also find that a change in pricing alters a consumers' choice regarding the subscription provider. Hence, for manufacturers and rental platforms it is crucial to be aware of the offering of competitors as consumers' perfect choice is strongly affected by the price. As the result, currently car manufacturers offer a more attractive upfront payment and mileage budget in their

contracts compared to car subscription platforms. However, the contracts they provide seem less cost efficient than that of subscription platforms. In order to improve the service level of their contracts, they could consider to redesign models targeted for subscription option especially with lower cost and expand the variety of models.

Secondly, we find that if the consumer has a high level of income, such as more than 10,000 USD per month, financing a car is a preferred choice. Therefore, we recommend contract providers to target people with a lower car budget for the subscription offering. Furthermore, people with lower income, which is less than 4,000 USD per month, should be the core of potential consumers for the subscription contract. The consumers with income level between 4,000-10,000 USD should be targeted from both options, since a consumer is indecisive between both, meaning financing and subscription, at that point. An aggressive marketing strategy or a more appealing offer could be relevant for marketers to attract more customers. Leasing, however, shows a reasonably low probability compared to the other two choices. For luxurious car manufacturers, these insights show that subscription provides the opportunity of reaching a new customer segment. The subscription model in particular could partly substitute the leasing option.

Furthermore, the research shows that subscription is an important ownership method next to leasing and financing and has to be regarded as a new competing factor. As discovered, if the value to the consumer of a subscription contract is increased, the subscription contract is more likely to be chosen than the conventional ownership methods. Thus, we advise marketers to include subscription in their portfolio next to the traditional options.



## Chapter 5. Conclusion

We analyze the conventional automobile contract options and investigate subscription as a newly emerging option. It is a new business model in the automobile industry that provides great flexibility and an all-inclusive service package with insurance, maintenance, taxes, exchange of cars, and a concierge service included in a monthly fee. In this research, we focus on identifying the optimal car contract option for a specific car model, given certain characteristics that vary among the three contract offerings and consumers' choices. We adopt the characteristics of past research that studied conventional ownership methods and adjust them accordingly so that it meets all three methods analyzed in this part. With the discrete choice model and a nested logit structure, we have analyzed the options and arrived at several important findings.

The study reveals that the car subscription service is indeed a rising alternative to the traditional automobile contract options. Car manufacturers manage to provide a contract with a more attractive upfront payment and no limitations on the annual mileage allowance, which is a competitive advantage over the offer from car rental platforms. Further, the research indicates that customers are inclined to choose financing over subscribing if the dedicated income of a car purchase exceeds 10,000 USD. Therefore, car manufacturers and rental platforms could offer the expensive financing options of luxury cars, at a cheaper rate, under a subscription contract. It allows the marketers to target a new customer segment that otherwise could not afford the car through a leasing or financing method. Moreover, we observe that subscription shows a potential to substitute the leasing offer. It is more attractive to some consumers as it offers more flexibility and a greater service at a lower price. One of the limitations of our study is that we only had market data available and that we decided to use estimates for the parameters and coefficients. Immediate future research should

consider collecting customer data to examine the parameters and to get more grounded estimates of the coefficients. The current development stage of car subscription offerings is quite early. Especially in the U.S., several providers are available, but many of them are still in a prototype or small roll-out phase. More data is becoming available in the upcoming years, offering better research base. With regards to the case-specific factors, having information from the individual customer on the desired flexibility or income level could lead to crucial findings for the companies.

For future research, we suggest collecting individual data and study the impact of individual-related factors on the contract choice designated to a car ownership. Also, the importance of the flexibility factor, including the variety of swaps as well as the short-term usage and other significant factors, should be analyzed in subsequent studies. Another future topic can be how to help car manufacturers polish their contracts from the perspective of operations, such as product design and product management. It's tough to figure out the equilibrium of cost and profit in this complicated competition for manufacturers. Last interesting topic is to study the difference between subscription with car- subscription. It might provide essential insights on how the car market and the ownership of a car could evolve in the future for both car manufacturers and car rental platforms. Analyzing how car manufacturers and car rental platforms intervene and transform the mobility sector is important.

Overall, we believe that the car subscription model has great potential to compete with the traditional ownership methods. As the lifestyle of consumers' shifts, their way of owning or using a car changes. Currently subscription contracts are mostly offered in the luxury segments. However, we believe that the subscription model will enter lower market segments in the future. With a growth in sharing economy, the subscription model can be

a great transition from the conventional way of owning a car to the new way of using a car.



## References

- Aakhus, M., Ågerfalk, P. J., Lyytinen, K., and Te'eni, D. (2014). Symbolic action research in information systems. *MIS Quarterly*, 38(4), 1187-1200.
- Aguirregabiria, V., and Mira, P. (2010). Dynamic discrete choice structural models: A survey. *Journal of Econometrics*, 156(1), 38-67.
- Ainscough, T. L., Trocchia, P. J., and Gum, J. R. (2009). Consumer rental car choice: Price, agent, and brand effects. *Journal of Business & Economics Research*, 7(7).
- Aizcorbe, A., and Starr-McCluer, M. (1997). Vehicle ownership, purchases, and leasing: Consumer survey data. *Monthly Lab. Rev.*, 120, 34-40.
- Andrikopoulos, A., and Markellos, R. N. (2015). Dynamic interaction between markets for leasing and selling automobiles. *Journal of Banking & Finance*, 50, 260-270.
- Attanasio, O. P., Koujianou Goldberg, P., and Kyriazidou, E. (2008). Credit constraints in the market for consumer durables: Evidence from micro data on car loans. *International Economic Review*, 49(2), 401-436.
- Bass, F. M. (1969). A new product growth for model consumer durables. *Management science*, 15(5), 215-227.
- Becker, H., Ciari, F., and Axhausen, K. W. (2017). Comparing car-sharing schemes in Switzerland: User groups and usage patterns. *Transportation Research Part A: Policy and Practice*, 97, 17-29.
- Bulow, J. I. (1982). Durable-goods monopolists. *Journal of political Economy*, 90(2), 314-332.
- Dasgupta, S., Siddarth, S., and Silva-Risso, J. (2007). To lease or to buy? A structural model of a consumer's vehicle and contract choice decisions. *Journal of Marketing Research*, 44(3), 490-502.
- Desai, P., and Purohit, D. (1998). Leasing and selling: Optimal marketing strategies for a durable goods firm. *Management Science*, 44(11), 19-34.
- Dhebar, A., and Oren, S. S. (1985). Optimal dynamic pricing for expanding networks. *Marketing Science*, 4(4), 336-351.

- Fruchter, G. E., Rao, R. C., and Shi, M. (2006). Dynamic network-based discriminatory pricing. *Journal of optimization theory and applications*, 128(3), 581-604.
- Fruchter, G. E., and Rao, R. C. (2001). Optimal membership fee and usage price over time for a network service. *Journal of Service Research*, 4(1), 3-14.
- Goldberg, P. K. (1995). Product differentiation and oligopoly in international markets: The case of the US automobile industry. *Econometrica: Journal of the Econometric Society*, 63 (4) 891-951.
- Johnson, J. P., Schneider, H. S., and Waldman, M. (2014). The role and growth of new-car leasing: Theory and evidence. *The Journal of Law and Economics*, 57(3), 665-698.
- Johnson, K. W. (2000). Credit Constraints, Consumer Leasing and the Replacement Decision. working paper, Federal Reserve Board.
- Mannering, F., Winston, C., and Starkey, W. (2002). An exploratory analysis of automobile leasing by US households. *Journal of Urban Economics*, 52(1), 154-176.
- Melville, N. P. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly*, 34(1), 1-21.
- Mesak, H. I., and Darrat, A. F. (2002). Optimal pricing of new subscriber services under interdependent adoption processes. *Journal of Service Research*, 5(2), 140-153.
- McFadden, D. (1978). Modeling the choice of residential location. *Transportation Research Record*, 673.
- Moraga-Gonzalez, J. L., Sndor, Z., and Wildenbeest, M. R. (2015). Consumer search and prices in the automobile market.
- Nunnally, B. H. and Plath, D. A. (1989). Leasing Versus Borrowing: Evaluating Alternative Forms of Consumer Credit. *The Journal of Consumer Affairs*, 23(2), 383-392.
- Parmer, L., and Dillard, J. (2015). The relationship between personality and consumer behavior buying patterns within the automobile industry. *International Journal of Management and Marketing Research*, 8(1), 1-13.
- Perktold, F., and von Racheck, M. (2019). PSS Design in Practice-How a Choice Experiment Can Help Configuring a New Subscription Offer. *The Case of Care by Volvo's Used Car Subscription Offer*.

- Robinson, B., and Lakhani, C. (1975). Dynamic price models for new-product planning. *Management science*, 21(10), 1113-1122.
- Shiraishi, S., Kim, B., and Yamaura, M. (2019). Subscription-based safety features in car sharing. U.S. Patent 10,346,765.
- Szamatowicz, M., and Paundra, J. (2019). Access or Ownership? The effect of car attributes and collective psychological ownership on the preference for car subscription services. *Psychological Research on Urban Society*, 2(1), 44-58.
- Train, K. E., and Winston, C. (2007). Vehicle choice behavior and the declining market share of US automakers. *International economic review*, 48(4), 1469-1496.
- Tiwana, A., Konsynski, B., and Bush, A. A. (2010). Research commentary—Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research*, 21(4), 675-687.
- Trocchia, P. J., and Beatty, S. E. (2003). An empirical examination of auto-mobile lease vs finance motivational processes. *Journal of Consumer Marketing*, 20(1), 28-43.
- Verboven, F. (2002). Quality-based price discrimination and tax incidence: evidence from gasoline and diesel cars. *RAND Journal of Economics*, 33(2), 275-297.
- Watson, R. T., Boudreau, M. C., and Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. *MIS Quarterly*, 23-38.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. (2010). Research commentary—the new organizing logic of digital innovation: an agenda for information systems research. *Information Systems Research*, 21(4), 724-735.



Partie IV. The Impact of  
General Data Protection  
Regulation (GDPR) on Data  
Management Platforms  
(DMP): A Policy perspective



## Forewords

Data Management Platforms (DMP) are centralized systems for collecting and analyzing large sets of structured and unstructured data originating from disparate sources. These platforms analyze, organize and segment first, second and third party data into different customer or audience types to be used for marketing and in advertising campaigns. Given the amount of sensitive personally identifiable information they have on customers, DMPs start to be monitored by the General Data Protection Regulation (GDPR) after 25th May 2018. Based on a comprehensive review of 17 published articles, this paper is among the first to review the current practice of DMPs and the policy implications of GDPR. We also highlight the challenges with implementing the new regulation and therefore the required changes to facilitate the daily operations of DMPs with GDPR.

This study is coauthored with 1) Sameer HAKIM, ESCP Business School, 2) Ziyang Li, ESCP Business School, 3) Yi Pan, ESCP Business School and 4) Wei Zhou, ESCP Business School. This study is published on the website of Management & Data Science.



## Chapter 1. Introduction

The role of data management platform in the context of media development and online advertising is to segment audiences by integrating data from proprietary and third part sources, including determining the quantity and quality of data, to buy and to manage all the aspects of this data. This includes controlling and restricting access to data, tracking its utilization and reporting operational changes, attributes and data cost. These processes and techniques are often used to leverage custom audience segments by Demand Side Platforms (DSPs) and Supply Side Platforms (SSPs) (Shah et al., 2011). Data incorporated into a DMP can be firsthand data, coming from an organization's own applications, systems, websites and products, as well as secondhand data from partners and other associates. DMPs also often use third-party data to fill in holes in a company's own data including partner data. As stated in the GDPR all data processors and controllers who have data that can personally identify an individual will have to abide by the new regulations. Since DMPs are in the business of identifying audiences and individuals for purposes of better online targeting they will be directly affected by the emerging data regulation policies.

Programmatic buying, for example, is a business model for online computational advertising in the age of big data. Based on analysis of massive amounts of cookie data generated by Internet users, programmatic buying advertising has the potential of identifying in real-time the characteristic and interest of the target audience in each ad impression, automatically delivering best-matched ads, and optimizing their prices via auction-based programmatic buying scheme. Programmatic buying has significantly changed online advertising, evolving from the traditional pattern of media buying and ad-slot buying to target-audience buying. Through cookie analysis, the DMP can identify the interests and characteristics of user. When this user opens

a webpage an auction will be triggered once she inputs the URL and presses the enter key. The publisher will send the user information to the SSP who forwards the information to the Ad Exchange (AdX). The AdX further sends the user information to eligible DSPs. These DSPs in turn, ask DMPs and know that this user is a car enthusiast. So, each DSP sends the user information to its advertisers and starts an auction where advertisers that sell cars can submit bids for the opportunity of showing ads to the user. The winner from each DSP auction will enter the second-round auction in the AdX. The highest bidder among all DSPs finally obtains the ad impression, and her ads will be fed back to the AdX and SSP, and displayed to the user on the webpages of the publisher (Yuan et al., 2014). Given the breadth and scope of the number of private companies including many third party companies involved in the process, it is important to understand the impact of General Data Protection Regulations (GDPR).

General Data Protection Regulations was first approved on 14th April, 2016 and becomes enforceable on the 25th May, 2018. The GDPR replaces the Data Protection Directive and is designed to harmonize data privacy laws across Europe (Zhou and Piramuthu 2013, 2015), to protect and empower all EU citizens' data privacy and to reshape the way organizations across the region approach data privacy. According to GDPR Article 4 personal data or personally identifiable data (PII) with reference to the online advertising industry is "any information relating to an identified or identifiable natural person (data subject); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person". GDPR (24) further extends that regulations are not limited to first party service providers but also third party processors of personal data. In

the context of GDPR, DMP and programmatic buying this study shall discuss the working of DMPs in detail & their role in programmatic buying, the various techniques used by online advertising companies to identify and segment users (in a limited scope), the regulations as defined in GDPR and finally how service providers including third party processors comply with GDPR.

Motivated by the lack of discussion of impact of GDPR on DMP industry, this part is among the first to review the current practice of DMPs and the policy implications of GDPR. We also highlight the challenges with implementing the new regulation and therefore the required changes to facilitate the daily operations of DMPs with GDPR. The remainder of the part is organized as follows. In Chapter 2, we review DMPs' structure and business Model. In Chapter 3, we present GDPR and its impact on DMPs. In Chapter 4, we provide a summary of this part and conclude.



## **Chapter 2. Review of Data Management Platform: Structure & Business Model**

### **2.1 Data Management Platform Structure**

Data management platforms in the online advertising process, collect and store data from various different sources including service providers, proprietary data and third party companies. The depth and breadth of having data from multiple sources helps with the diversity and reduction in corrupt data since DSPs perform validation checks of the data when processing. An analytics processor receives this data to provide analytics to companies using their services on, segmentations and classification of online customers using runtime profiles in a nesting-aware, SQL query language and along with a library of data mining methods, machines learning models, all in real time (Chen et al., 2013).

DMPs can be classified into two different user categories: for marketers and for publishers. Marketers use it to market their products while publishers use it to target specific audiences and improve the efficiency of marketer' advertising campaign running on their site. DMPs offer many types of services or functionalities to client companies, some of which extend to the management of prospects and advertising audiences in a PRM (prospect relationship management) logic. Part of the ROI related to setting up a DMP can potentially be achieved through data activation (Bathelot, 2017).

For marketers (including agencies), one of the trickiest things is improving the accuracy of targeted online advertising and campaign. DMPs are able to help marketers tackle their most pressing challenge that is ad blindness. At their core, the Data Management Platforms provide services for advertiser and agencies regarding taking control of their own first-party data, processing data, comparing it to third-party data, to make better decisions on media buying and campaign planning. Moreover, they

can also have the insights about ROI each campaign contributed for each segment.

DMPs offer a full-featured set of components that allow advertisers and agencies to make better use of their first-party data to have more insights of their target and make more accurate media buying. They also use first or third-party data to determine customized content in websites for different audience, alongside comparing third-party data sources to gain additional information about specific customer to increase conversions. These techniques help marketers achieve improved ROIs in the long run (Bluekai, 2011). DMPs offer tag management, users segmentation, media integration, campaign analytics and users analytics.

- **Tag management:** This feature help advertisers and agencies to set tags in their websites for monitoring and collecting data. Advanced tag management also enables marketers to comply with the current privacy regulation and control measures for data access and sharing, as well as provide the ability to categorize and assign varying levels of rights to advertising.
- **Users segmentation:** DMPs allow marketers to classify their first-data of users by taxonomy, segment, campaign and /or ROI outcomes compared against third-party An advanced segmentation can create a large numbers of highly-relevant clusters within the DMP to reach users with the right promotion at different stages of the purchase funnel.
- **Media integration:** DMPs help marketers share their users segments with ad networks, trading platforms, portals and DSPs to serve targeted ads, perform programmatic buying and reach users real Consequently, one of the most critical business of DMPs is integrating the media resources across different channels.
- **Campaign analytics:** DMPs provide easy-to-use tools, which enables marketers to measure and compare campaign

performance for different segments and channels. Thus helping marketers adjust their campaign strategy to make better and accurate.

- **Users analytics:** Apart from analyzing performance of campaign, DMPs also analyze the behaviors of users. They can measure how users interact with campaigns on each channels. So marketers can have insights on which channels deliver the highest ROI for specific.

There are many technological platforms that assist marketers in carrying out advertisement and media campaign in Figure 15. The buyers are advertisers or media agencies, while the sellers are publishers. An ad exchange is a technological platform where buyers make bidding to get ad placement for their media campaign. Ad network is a middle-man that buy ad positions from publishers and sell them directly to advertisers. DSP is an interface which delivers an integration of multiple ad exchanges (i.e. ad position bidding) in a single system. With this interface, advertisers can make programmatic decision for ad positions, buying across several ad exchanges in real time. SSP (Supply-Side Platform) takes inventory and connects to as many ad exchanges and ad networks as possible. It is designed to deliver a platform for publishers to manage and optimize their media advertising placements from one single interface. So multiple players are involved in this online advertising ecosystem, and DMPs build a strong connectivity among these parties.

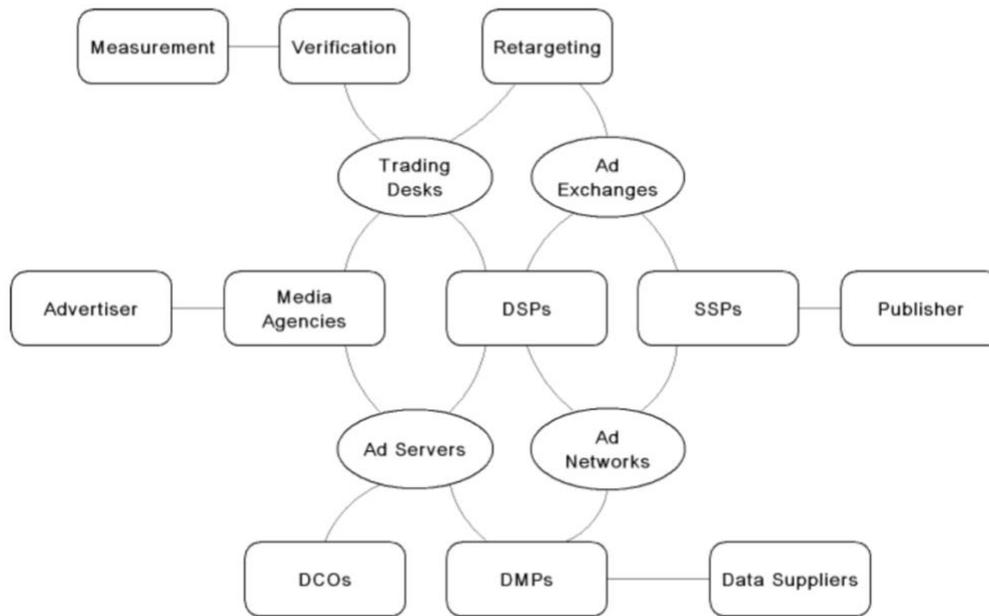


Figure 15 Visual representation of the online display advertising landscape and the key player

## 2.2 Data collection by DMPs

Figure 16 shows how DMPs run business to create actionable insights. Generally, DMP firstly collect data from different sources which can be first-party, second-party and third-party data; then normalize, enrich, analyze these data by using different models and technologies to create and add value to them; finally deploy these processed data to the outside business world to generate profit. As DMP create value through processing data, data collection and analysis is the main part of their business. They work based on three main phases aggregation phase, integration and management phase and the deployment phase. For the aggregation phase, data collection is the very first step and the basis for the whole process. Since DMPs are data experts and can communicate with their clients through data, including marketers and publishers, there are different types of data and different methods for them to collect data (Zawadski, 2016).

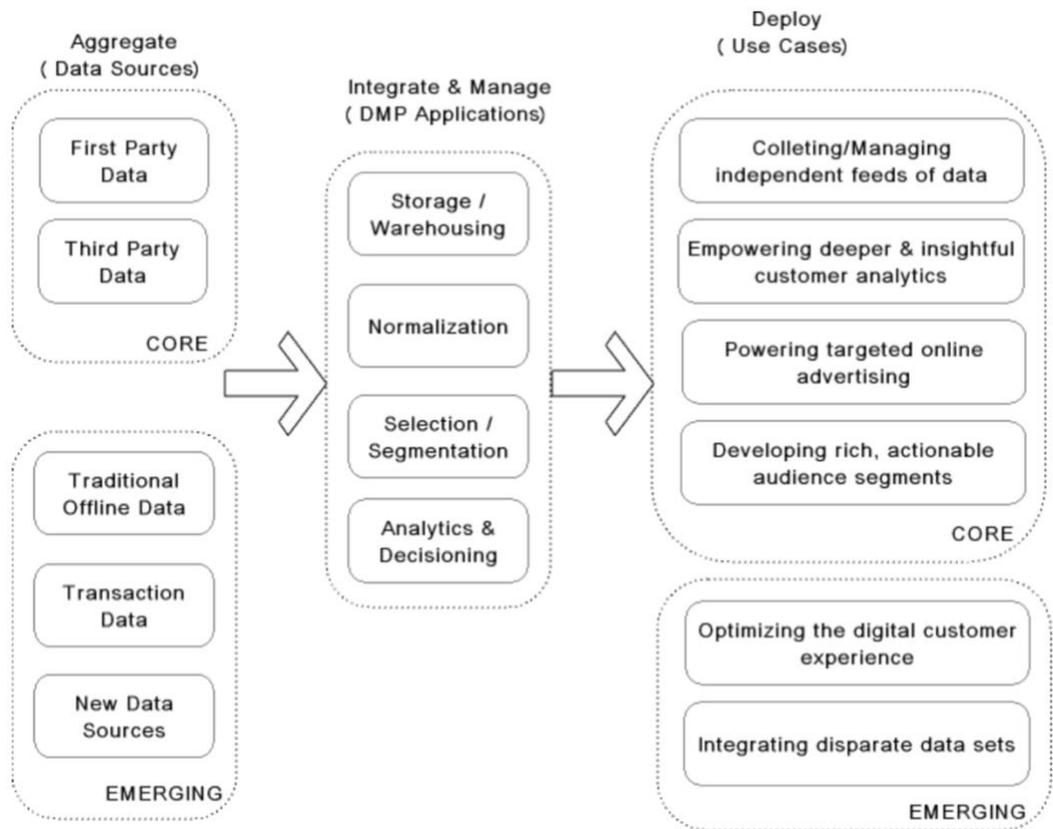


Figure 16 The Data Management Platform Framework



# Chapter 3. General Data Protection Regulation (GDPR) & Its Impact on DMPs

## 3.1 Overview

The General Data Protection Regulations is bringing about a massive change in how companies operate, store and process data. Most private companies including those involved in the business of online advertising are not equipped and ready to comply with the regulations under GDPR. According to GDPR, personal data is any information related to a person, irrespective of their nationality or residence (Regulation 2), who can be identified, directly or indirectly using identifiers (Article 4, 1) such as those provided by their devices including MAC address, Apple ID, Advertising ID, IDs provided by applications, tools and protocols such as internet protocol addresses, location data, cookie identifiers, other online identifiers to one or more factors and radio frequency identification tags (Regulation 30). As defined by the GDPR, this regulation applies to all controllers or processors which provide the means for processing personal data (Regulation 18). Controllers are those who determine the purpose and means of processing personal data (Article 4, 7) while processors are entities which process personal data on behalf of the controllers (Article 4, 8). Both controllers and processors can be public, private, person, agency or a body. Furthermore, processing implies operations performed on personal data (Article 4, 2). This processing is location agnostic and therefore GDPR applies to all organizations including the branches or subsidiaries, irrespective of their physical location in the EU yet offering goods or services to persons in the EU (Regulation 22, 23). For controllers or processors not established in the EU but processing personal data of persons in the EU need to have a designated representative, unless processing is occasional or

not large scale processing of special categories of personal data (Regulation 80).

With regards to data processing, both controllers and processors are subject to the GDPR when monitoring a person' behavior on the internet and to profile a person so as to take decisions concerning them for analyzing or predicting their personal preferences, behaviors and attitudes when they are physically located in EU (Regulation 24). The GDPR defines data used for data processing based on certain criterion; pseudonymous and anonymous data. Pseudonymous data is personal data that can no longer be linked to a person without the use of additional data irrespective of the tools and techniques used. The process of converting identifiable data to pseudonymous data is called pseudonymisation (Article 4, 5). Anonymous data is personal data that can no longer be linked to a person even with the help of external data and does not come under the preview of GDPR (Regulation 26). Data collected from a person should be adequate, relevant and limited to a minimum time period to what is necessary, for the purposes for which they are processed (Regulation 39). In regards to data being processed by controllers including third parties for their own legitimate interests including for direct marketing purposes, it is important that the rights of a person who is a client or in the service of the controller take precedence (Regulation 47). The person should be aware of the existences of such processing operations and their purposes specifically when data is being used for profiling (Regulation 60) including the duration for which the data is being processed, the logic involved in any automatic data processing and the consequences (Regulation 63). When the controller intents to process personal data for purposes for which they were not collected they should notify the person about such activities before further processing of this data (Regulation 61). Where personal data is being processed for purposes of direct marketing, the person should have a right to

object to such processing, including profiling with regards to initial or further data processing (Regulation 70). When processing personal data on the behalf of a controller, processors including third parties at the choice of the controller should return or delete the personal data unless required by law to which the process is subject to (Regulation 81).

GDPR also specifies how consent for data processing can be gathered from a person. Consent for each activity of data processing should be given at the time of collecting this data by a clear affirmative act once the person is informed and unambiguous about how their personal information is going to be utilized. This consent should be in a written statement; electronic or oral, ticking a box when visiting an internet website, choosing technical settings, or other means. Silent, preticked boxes or inactivity should not be considered as consent and the given consent should be for activities carried out for the same purpose as agreed by the person and no other activities that can utilize the data (Regulation 32). Further communications concerning activities for which the data is collected should be easily accessible and easy to understand using simple and plain language at the time of collection of data (Regulation 39). The person should also be informed whether they are obliged to provide personal data (Regulation 60). The controller if asked, should be able to demonstrate that the person has given his consent to specific processing operations where the person was made aware of at least the identity of the controller (Regulation 42). With regards to data processing in direct marketing, the right to object to data processing must be explicitly brought to the attention of the person (Regulation 70).

In view of the regulations related to security, pseudonymization can reduce the risks to personal data to help controllers and processors meet their data-protection obligations (Regulation

28). Cases where a controllers are legally obliged to provide additional security measure to comply with the GDPR, they should not refuse to collect additional information about the person including login information (Regulation 57). This additionally collected information should not be retained for the sole purposes of being able to react to potential future requests and must be treated as temporary information for that specific activity (Regulation 64).

With regards to collected personal data, controllers should provide a mechanism for the person to request, access, rectify and delete such data. Requests should be responded to without delay and within the stipulated period of one month with appropriate reasons (Regulation 59). If additional personal data is collected about the person from other external sources or disclosed to other recipients the person should be notified about this within a reasonable period (Regulation 61). If the origin of such data cannot be provided, general information should be provided (Regulation 61). Cases where the person requests to be forgotten, controllers are responsible to inform processor and third party to erase any links, copies or replication of those personal data (Regulation 66). The person should also have the right not to be subjected to a decision related to measuring and evaluating personal aspects, including profiling to analyze or predict their characteristic, economic situation, health, preferences, interests, reliability, behavior, location or movements based solely on automated processing which directly affects him or her unless consent is given (Regulation 71).

The responsibility and liabilities of the controller should be established. The controller should be obliged to implement appropriate and effective measures to demonstrate compliances of processing activities and effectiveness of the measures (Regulation 74). The risks and liabilities, to the rights and freedoms or to exercising control over personal data of the person are defined when they result in discrimination, identity

theft or fraud, financial loss, damage to reputation, loss of confidentiality, unauthorized reversal of pseudonymization, or any other social or economic disadvantage, revealing of racial or ethnic origin, political opinions, religion or philosophical beliefs, trade union membership, or where other personal aspects are evaluated particularly to analyze or predict performance at work, economic situation, health, personal preferences or interests, reliability or behavior, location or movements in order to create or use personal profiles (Regulation 75). These risks and liabilities should be determined and evaluated based on objective assessment to establish if data processing involves low, medium or high risk (Regulation 76).

### **3.2 Challenges & Future Agenda**

The regulations laid out in the GDPR are in-depth when compared to the archaic Data Protection Directive and so are the penalties. With the high level of complexities involved in the online advertising sector, it might become difficult for publishers, brands and adtech companies to survive if appropriate actions are not taken. These actions go well beyond the normal GAP analysis and security overhaul when compared to other industries in information technology. Therefore, review of some of these deep challenges is equally important as to finding their solution if online advertising business are to sustain (Ryan, 2017).

#### **3.2.1 Transparency into what user data has been collected and processed and for what purpose**

Despite arguments, businesses will need consent from users to capture their personal data (Ryan, 2017) for online tracking (Regulation 32). In other words, users must be given clearly understandable terms for each instance in which their personal data will be used, and each processing activity that uses this data needs to be documented fully and followed precisely given that during consent gathering the user should be aware of how data of his each activity will be used. They will also be asked

to check a box that will give permission to see their data to any data broker (which would open the door to unsolicited offers and online user tracking across devices). This is rather difficult given how dynamically user data is used. Moreover, companies who want to use this data must get separate permission to use users' data for various purpose, such as marketing, maintenance, fraud scrutiny and support. Therefore, although the GDPR creates a very strict definition of uniquely identifiable data, the consent or other specific situations still apply. And companies even need to have detailed documentation that record when that consent was given. These exceptions are of great importance for DMPs, as they rely on sensitive data processing (Zarsky, 2016).

### **3.2.2 Any player involved in data collection and processing must comply with GDPR with no exception**

Users want both self-centered and general brand experiences (Simmons, 2008). The core concept of GDPR revolves around identifying and targeting individual users based on certain behavioral patterns (Article 4,1) (Regulation 24). Self-centered or targeted branding is showing advertisements to a specific segment of relevant users. The core concept here is to increase the brand presence, recall rates and conversions of the advertiser among that segment of identified user. Consider for example, a tennis shoes company that wants to advertise on the website of one or multiple publishers. For the best returns the company would be interested in increase awareness only among people who are interested in tennis shoes. A sports-related website using targeted campaigns (digital advertisements) would be the best t (Chichering and Heckerman, 2003). Supplementing this strategy, the advertiser would also focus on individuals who have shown the intent of purchasing a tennis shoe which is called in-market advertising. In-market audiences are a way to connect with consumers who are in the market and are currently

searching or comparing products and services across various different sites. To categorize an individual as in-market for a specific product or service, DSP including AdXs take into account the various different behaviors shown by the individual including clicks on related ads and subsequent conversions, along with the content of the sites and pages they visit and recency and frequency of visits. This helps DSPs and AdXs to accurately categorize users based on intent to improved your offerings. Unless all parties involved in singling out this user conform to the GDPR, adtech companies might have to revert back to mass media which is against today' trend. Unlike mass marketing one-to-one marketing increases the value of the customer base, increases cross-selling, reduce customer attrition, higher customer satisfaction and reduced transaction cost and faster cycle times (Peppers et al., 1999).

### **3.3 Identified Action Items**

#### 1) Implementation of privacy by design

The most important technology with regards to implementing privacy by design is called Privacy-Enhancing Technologies (PET) e.g. data encryption, protocols for unidentified communication, attribute based credentials and private search of databases. They are well proven based on prior research and in test environments. Unfortunately, PET is still not commonly considered when designing systems. Privacy by design also covers not just technologies but also organizational processes and business models (Danezis et al., 2015). Some classes of privacy enhancing technologies are email, interactive including technologies for instant messaging, internet applications, remote logins, VOIP and games and other communication anonymity and pseudosymmetry systems. PET can include methods like type-0 remailers, anonymizer.com, onion routing, the freedom network, Java Anon proxy, Tor, GNU privacy guard, SSL, TLS, off-the-record messaging, private payments, private credentials and anti-phi-shing tools (Goldberg et al., 2007).

## 2) Online behavioral targeting without personal data

There are certain ways in which users can be shown personalized advertisements without the need for sharing their personal data. One such methods can be the implementation of a browser extension on the user' system. This extension which is capable of processing personal information to create a user persona can also to be used to select the type of ads to display. If the ads are not clicked on, their personal data is never communicated outside of their computer and hence no personal data is reveled. Users can still see ads relevant to their interest and based on their behavior (Toubiana et al., 2010). The basic principle behind this is to move the process and not the data (Armstrong, 2014).

## 3) Increase direct partnership deals with publishers

Web data is the main source of data collection in today's digital age. Therefore, an increase in different players and increasing data collection has led to increased complexity of data structures. Additionally, challenges arise with the scalability of web data management. As amounts of data and the amounts of relationships between different data management companies increase, organizing and locating shared data becomes increasingly complex (Abadi et al., 2007). As data structures become increasingly complex and the addition of the GDPR, companies and especially DMPs are concerned with the identification of data, which users request to be deleted or for which they demand insights. In order for companies being able to track the data and being able to identify the data structure and where it went, DMPs need to increase their relationships with publishers. Improving the management of the relationships helps all players to properly identify and track the use of the users' data in order to comply to the GDPR and accurately identify all of the users' data across all parties involved (Madhavan et al., 2006).

## Chapter 4. Conclusion

This part has reviewed in detail the business model of DMPs from the various different perspectives. In the entire ecosystem, the actors with whom DMPs deal are the advertisers, website publishers, DSPs, SSPs and Adx, who are significantly relevant in possessing data or exchanging data. Internally, DMPs create value and generate profits by processing and analyzing data to segment users, via building a unique profile of every user, and then making them useful to improve the marketing targeting and buying. The whole process involves lots of technologies to collect track, identify and match personal data from all sources. Given how integral the internet has become nowadays and the amount of data individuals generate and share in the virtual world every second, a review of privacy is important. With this privacy in the EU plans to implement the new General Data Protection Regulation from next year (2018). This regulation has strictly defined personal data and has plenty of articles to prevent this personal data from being identified, collected and used in an improper or unconstitutional manner. Facing the upcoming GDPR regulation, the entire business community should change their present way of running businesses as long as their business uses personal data. There is no doubt that the GDPR brings many challenges to DMPs, which can considerably affect a big part of their business. We have identified five main challenges for DMPs to be overcome in order to comply with the GDPR. These challenges range from giving users more insight into their data applications to security and data protection plans to ensure a secure storage of personal information. The GDPR has been enforced in May 2018, which pressures DMPs and many other companies using personal data to adapt their business models and techniques of utilizing personal data.



## References

- Abadi, D. J., Marcus, A., Madden, S. R., and Hollenbach, K. (2007). Scalable semantic web data management using vertical partitioning. In Proceedings of the 33rd international conference on Very large data bases (pp. 411-422). VLDB Endowment.
- Armstrong, R. (2014). Move The Process, Not The Data Accelerating Analytics With In-Database Processing. Retrieved December 19, 2017
- Chen, S., Dasdan, A., Elmeleegy, H., Kolay, S., Li, Y., Qi, Y., ... and Wu, M. (2013). U.S. Patent Application No. 13 /924,343.
- Chickering, D. M., and Heckerman, D. (2003). Targeted advertising on the web with inventory management. *Interfaces*, 33(5), 71-77.
- Danezis, G., Domingo-Ferrer, J., Hansen, M., Hoepman, J. H., Metayer, D. L., Tirtea, R., and Schi ffner, S. (2015). Privacy and Data Protection by Design-from policy to engineering. arXiv preprint arXiv:1501.03726.
- Goldberg, I., Wagner, D., and Brewer, E. (2007). Privacy-enhancing technologies for the Internet III: Ten Years Later. In *Compton'97. Proceedings, IEEE* (pp. 103-109). IEEE.
- Madhavan, J., Halevy, A. Y., Cohen, S., Dong, X. L., Je ffery, S. R., Ko, D., and Yu, C. (2006). Structured data meets the Web: a few observations. *IEEE Data Eng. ,* 29(4), 19-26.
- Peppers, D., Martha R., and Bob D. (1999). Is Your Company Ready for One-to-One Marketing? *Harvard Business Review*, 15160.
- Ryan, J., Dr. (2017). The 3 biggest challenges in GDPR for online media & advertising. Retrieved December 04, 2017.
- Shah, V., Mao, Y., Chen, S., Bennett, D., and Shao, X. (2011). U.S. Patent Application No. 13 /206,416.
- Simmons, G. (2008). Marketing to postmodern consumers: introducing the internet chameleon. *European Journal of Marketing*, 42(3 /4), 299-310.
- Toubiana, V., Narayanan, A., Boneh, D., Nissenbaum, H., and Barocas, S. (2010). Adnostic: Privacy preserving targeted advertising. *Proceedings Network and Distributed System Symposium*.
- Yuan, Y., Wang, F., Li, J., and Qin, R. (2014). A survey on real time bidding advertising. In *Service Operations and Logistics*,

- and Informatics (SOLI), 2014 IEEE International Conference on (pp. 418-423).
- Zarsky, T. Z. (2016). Incompatible: The GDPR in the Age of Big Data. *Seton Hall L. Rev.*, 47, 995.
- Zawadzki, M. (2016). How Does Data Collection Work in a DMP?
- Zhou, W., & PIRAMUTHU, S. (2015). Information relevance model of customized privacy for IoT. *Journal of business ethics*, 131(1), 19-30.
- Zhou, W., & PIRAMUTHU, S. (2013). Technology regulation policy for business ethics: An example of RFID in supply chain management. *Journal of business ethics*, 116(2), 327- 340.

# Conclusion

This part presents a summary of the research study on sharing economy including the main findings and contributions. In the first section, an overview of the research background is presented to describe the current research gap and questions. In the second section, the key findings are summarized to answer the research questions. In the third section, the contribution of this thesis and its managerial implications are provided. The limitations of the research is presented in fourth section. Lastly, the interesting future research directions are described in the fifth section.

## Overview of the Research

According to the research gaps in the extant literature, the motivation of this thesis is to develop the advanced understanding of the sharing economy both theoretically and practically. The objectives of the studies in this thesis is to fill up these gaps by proposing new theoretical models and variables to study the new competition form and characteristics of sharing economy. Therefore, the findings are valuable to guide the strategy and behavior of the participants in the sharing market.

In this thesis, I have studied the sharing economy from the perspective of consumers, retailers and manufactures. For the consumers, we find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting insights to today's sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness. For the retailers, we consider the buyers' holding costs, transaction costs, and

income from sharing. We identify the market equilibrium of this two-period game. We provide managerial implications for two different and representative types of product markets that include automobile (with value depreciation) and real estate (with value appreciation). Our findings show the dynamics of two-stage price/quantity equilibrium in these two market setups. For the manufactures, we find that the car subscription service is indeed a rising alternative to the traditional automobile contract options. We also identify the optimal car contract option for a specific car model, given certain characteristics that vary among the three contract offerings and consumers' choices. We propose car manufacturers and rental platforms could offer the expensive financing options of luxury cars, at a cheaper rate, under a subscription contract. We believe that the subscription model will enter lower market segments in the future. This thesis has addressed the research problems and achieved the research goals. The findings not only illustrate the uniqueness and property of sharing economy, but also provide managerial and operational implications for the sharers and manufacturers.

## **Research Findings**

Three studies are conducted to investigate the parameters, model, competition and behaviors related to sharing economy. The game theory, consumer evaluation model and discrete choice model are applied to these studies. The first research question "*How does the consumer behave to participate in the sharing economy?*" was answered by the first and second works, and the second research question "*How does the manufacturer behave to deal with the impact of sharing economy?*" was answered by the second and third studies. The detailed process of these researches are presented in Part I, II and III. I also conduct a qualitative research to investigate the impact of new regulation GDPR on sharing economy in Part IV. In the following, the research findings in this thesis can be summarized from two perspectives: analytical results and managerial implications.

## **Analytical Results**

In the first study, we make a simplified definition by considering individual consumption as a special case of collective consumption when only the owner utilizes the good/service during the ownership period. By considering all the factors that influence the decision making, with general rationality, the owner is more willing to keep the ownership when the future income and the value exceed the costs of holding it. When the holding cost is significantly high, the owner would be more likely to transfer the ownership. There should exist an equilibrium where the owner is indifferent of sharing, giving, or reselling. The indifference point is further adjustable by the sharing network, charity organizations, the taxation policy, and by resale marketplace.

In the second study, we consider the co-existence of new, used, and shared products in a sharing-economy market. We study a producer's pricing decisions and decode the economic rationality and marketplace mechanisms in the ever booming new/used/shared product networks. We find that in the depreciation market:

- Decreasing product residual value decreases the first period new product price.
- If the product residual value is equal to the original value in the second period, used product from the first period enter the second period as perfect competition with the second period's new product.
- If the residual value of the product equals zero in the second period, first- and second-period new product prices are the same.

On the other hand, in the appreciation market, when the residual value of the product increases, the quantity of shared used product increases. Potential sharers from the second period are more inclined to invest in the first period, creating an arbitrage opportunity.

In the third study, when the information of the existing contracts is determined, we compare the upper-level probabilities among the three contract decisions based on different individuals' choices. We find that when income level increases, the probability of financing increases significantly after an income of 4,000 USD. Especially in an income level range of 4,000 to 10,000 USD the customer is indecisive between financing and subscribing. While the indifference curve of subscription is going close to 0 at 10,000 USD, financing increases to a probability close to 1. Thus, the graphs of financing and subscription are inversely related. Also, leasing marginally increases until an income level of 8,000 USD. However, the probability of leasing is all time fairly low, whilst probability of subscription and financing are significantly high. We investigate, for a given consumer, how to improve the attractiveness of a contract by adjusting the alternative-specific factors in the contract. Since the case-specific factors is fixed, we start with checking the lower-level probabilities among the subscription contract from different providers for the same model. We can observe that there exists the optimal contract which has higher probability than others. Taking the model 2019 530e from BMW as an example, the manufacturer BMW provides financing, leasing and two subscribing contracts for it. There are also three automobile s platform, namely Drive Flow, Prime Flip and Drive Germain, providing subscription contracts for this model. The results show that the contract provided by Drive Flow received the highest probability, which is 39%, among 5 subscription contracts. It provides the most variety of cars with lowest price, which leads to its advantages. For the manufacturers, although they do not set the limitation on mileage, they usually ask for a higher price and provide less models for car swap compared with subscription platforms. This shortcoming may come from the high cost of manufacturers.

Furthermore, we examine the upper-level as well as the lower-level probability and study the effect of a change in the contract settings on the optimal contract choice. In particular, we observe the change in the optimal choice by altering the price level to figure out the optimal price. For example, we select the model AMG GLE 63 for a consumer with a monthly income of around 5,000 USD. The price provided by Mercedes Benz and Drive Germain is 2,090 USD and 2,013 USD, respectively. Further, Drive Germain requires a mileage limitation of 21,000 miles a year and offers 16 different car models for consumers. Mercedes Benz provides its customers with a subscription contract that includes unlimited mileage and a platform with nine different car models. We also find that when the price set by the subscription platform is 2,113 USD, a customer would intend to decide on buying the subscription offer from Mercedes Benz directly if the price is below 2,500 USD. However, if the price that Mercedes Benz offers exceeds 6,000 USD, which is around triple the price provided by Drive Germain, the customer would choose the subscription contract from the car rental platform. When the price set by Mercedes Benz is 2,090 USD, the subscription contract from a rental platform will lose advantages when its price is higher than triple that provided by the manufacturer. As a result, the perfect choice of the consumer would shift, ending up buying from a rental platform.

### **Managerial Implications**

From the perspective of the owner of the good, the higher  $\sigma_t$  would bring higher income but the high income would discourage the owner to give the good as a gift according to our results. However, the high  $\sigma_t$  would also make the good less competitive at the same time. As the result of that, there is an equilibrium in the price setting for the sharer to obtain the maximum income and meanwhile it wouldn't eliminate the possibility for the gift giving.

From the perspective of government, to increase the reward by enhance the tax deduction is a good method to encourage people to give the good away as soon as possible. But it's impossible to promote the tax deduction without limiting cap, which is the most common current practice. As it can be seen from our results, the game between the sharing income and gift economy reward would play a key role in the owner's decision. Adjusting the tax deduction corresponding to the price of sharing market would make the reward more effective.

From the perspective of firms that promote gift economy, normally these firms are considered non-profit. There exist many challenges that they have to overcome, such as the lack of supply, the increasing demand of charity, the lack of understanding of both donors and receivers, and sometimes the financial difficulties to operate the platform and to reduce the transaction cost. Our result shows that by reducing the transaction cost, the time for people to give the good as gift would be brought forward, which means the platform would receive the goods earlier. Even for those who will not donate the goods, the reduced transaction cost and increased rewards would give them the motivation to donate. Our results also shows that today's ever booming sharing and resale economy, because of the reduced transaction cost to share and to resell along with increasing sharing and resale income thanks to the Internet, actually shrink the already small market size for the gift economy. We prove that in order to boost the spirit of good-will in our society, the government and the charity organizations must come up with new models or effective taxation incentives to struggle with the increasing income of sharing or reselling in order to encourage the gift giving, like revising the tax deduction corresponding to the price of sharing market.

From the perspective of the sharing or reselling platform, reducing the transaction cost by new technology would help them receive more goods from the owner. And the goodwill for their

efficiency like well distribution of the goods would attract more people to share or give their goods because they may believe that platform could help them fulfill their purpose. In that way, owing to the double-sided model, platform would benefit from the increasing sharer/donors by attracting more receivers, which would in turn enhance the volatility of the platform. Nevertheless, transaction cost is the profit of platform, which means the transaction cost would not decrease without limit. Compared with that in gift economy, our results shows that the difference between two kinds of transaction cost could be utilized by government or charity organizations to encourage people to give their good as a gift.

From the perspective of manufacturer of depreciated products, new car sellers are always subject to higher competition on price and quantity with the existence of used and shared product markets. At certain rate of depreciation, there exist car models that consumers prefer to sell in the used-product market. If the residual value holds well, the used-product price may exceed its new-product price in the second period. Lastly, the co-existence of new/used/shared product markets does not change the price elasticity of the new product market in both periods when the value depreciates.

From the perspective of manufacturer of appreciated products, in an area where the value of housing increases over time,  $q_{1n}^*$ ,  $q_{2n}^*$ ,  $p_{1n}^*$  and  $p_{2n}^*$  increase. On the other hand, when the housing price is stable or slightly decreases, both  $q_{1n}^*$  and  $p_{1n}^*$  decrease. Property owners are more willing to keep their properties than reselling the product with an increasing value. In an area where property price decreases, the property owners are more inclined to sell than to keep them or to share them. When property price increases, more owners are inclined to offer sharing services in the used product market, and keep the new property purchases as an investment decision. The co-existence of new/used/shared

product markets does not change the price elasticity of the market in both periods when the value increases.

For the retailers, we assess the contract options that render the highest impact on the probability of choice for a specific car model. By understanding the utilities of the consumers, managerial insights derived from this research can help the marketers improve their contract design and product offerings.

First of all, our findings indicate that, for each model, there exists an optimal subscription contract that significantly outperforms the others. Marketers should focus on these optimal contracts because they have the highest probability of choice. We also find that a change in pricing alters a consumers' choice regarding the subscription provider. Hence, for manufacturers and rental platforms it is crucial to be aware of the offering of competitors as consumers' perfect choice is strongly affected by the price. As the result, currently car manufacturers offer a more attractive upfront payment and mileage budget in their contracts compared to car subscription platforms. However, the contracts they provide seem less cost efficient than that of subscription platforms. In order to improve the service level of their contracts, they could consider to redesign models targeted for subscription option especially with lower cost and expand the variety of models.

Secondly, we find that if the consumer has a high level of income, such as more than 10,000 USD per month, financing a car is a preferred choice. Therefore, we recommend contract providers to target people with a lower car budget for the subscription offering. Furthermore, people with lower income, which is less than 4,000 USD per month, should be the core of potential consumers for the subscription contract. The consumers with income level between 4,000-10,000 USD should be targeted from both options, since a consumer is indecisive between both, meaning financing and subscription, at that point. An aggressive marketing strategy or a more appealing offer could be relevant

for marketers to attract more customers. Leasing, however, shows a reasonably low probability compared to the other two choices. For luxurious car manufacturers, these insights show that subscription provides the opportunity of reaching a new customer segment. The subscription model in particular could partly substitute the leasing option.

Furthermore, the research shows that subscription is an important ownership method next to leasing and financing and has to be regarded as a new competing factor. As discovered, if the value to the consumer of a subscription contract is increased, the subscription contract is more likely to be chosen than the conventional ownership methods. Thus, we advise marketers to include subscription in their portfolio next to the traditional options.

However, facing the upcoming GDPR regulation, the entire business community should change their present way of running businesses as long as their business uses personal data. There is no doubt that the GDPR brings many challenges to DMPs, which can considerably affect a big part of their business. We have identified five main challenges for DMPs to be overcome in order to comply with the GDPR, which range from giving users more insight into their data applications to security and data protection plans to ensure a secure storage of personal information. Lots of DMPs and many other companies are suffering the pressures caused by the GDPR from May 2018 to adapt their business models and techniques of utilizing personal data.

## **Research Contributions**

The contributions of this thesis to the academic and practical world are highlighted in the next two sub-sections. According to the research objectives, the contributions mainly focus on fulfilling the research gaps and generating applicable implications to the practice. The distribution of the research's findings was achieved by the publication and presentation of several peer-reviewed international conferences and well-

reputed journal. For example, the first study was presented in a ranked conference ICIS and get published in the Lecture Notes of Business Information Processing. The second work is now under review by Management Information Systems Quarterly. The feedbacks has been collected from the various reviews of journals and conferences and addressed in this thesis. The fourth work is published on the webside of Management & Datascinece. The List of Publication summarizes the detailed information about my publications during the author's PhD period.

### **Theoretical Contributions**

In the first study, we consider the non-linear properties and boundaries in the three forms of sharing, gift, and resale economy. We decode the economic rationality and marketplace mechanisms in today's ever booming sharing/gifting/reselling networks. We contribute to the fundamental economics literature by decomposing a good into two parts: the ownership good and the detached good. The ownership good can be utilized or shared by the owner. The detached good can either be given as a gift or be resold for an income. The separation is bounded by considering the estimated finite life of the good and a future time stamp of detachment. We study the temporal factors including the inventory holding cost, the potential collaborative income, and individual utility from consumption with various time stamps. We define the temporal ownership boundary as the limit when the owner is indifferent of transferring the ownership from its current in usage or sharing status. We base our analysis on two variations of substitute modeling and consider the properties of social welfare by incorporation the utility functions of different players. We find that there exists various conditions when this boundary may lean towards sharing, gift giving or reselling. We show that both individual utility and total social welfare can be optimized by adjusting the incentives, the transaction costs, and eventually the time of ownership transfer of the goods. Our results bring meaningful and interesting

insights to today's sharing, gift, and resale platform companies on how to improve the efficiency and competitiveness.

In the second study, we consider the co-existence of new, used, and shared products in a sharing-economy market. We study a producer's pricing decisions and decode the economic rationality and marketplace mechanisms in the ever booming new/used/shared product networks. We contribute to the economics of information systems literature by considering a two-stage game where a producer of durable goods sells new products to the market in the first stage, and in the second stage used products may enter the market in the form of used or shared products. We consider the buyers' holding costs, transaction costs, and income from sharing. We identify the market equilibrium of this two-period game. We provide managerial implications for two different and representative types of product markets that include automobile (with value depreciation) and real estate (with value appreciation). Our findings show the dynamics of two-stage price/quantity equilibrium in these two market setups.

In the third study, we analyze the conventional automobile contract options and investigate subscription as a newly emerging option. It is a new business model in the automobile industry that provides great flexibility and an all-inclusive service package with insurance, maintenance, taxes, exchange of cars, and a concierge service included in a monthly fee. In this research, we focus on identifying the optimal car contract option for a specific car model, given certain characteristics that vary among the three contract offerings and consumers' choices. We adopt the characteristics of past research that studied conventional ownership methods and adjust them accordingly so that it meets all three methods analyzed in this study. With the discrete choice model and a nested logit structure, we have analyzed the options and arrived at several important findings.

## **Practical Contributions**

According to the consumer's decision to enter the sharing market, we propose several implications from the perspective of owner, government, company, and sharing platform. Our results also indicate that governmental and marketplaces' incentive policies play an important role when consumers make decisions among the three economic forms and consequently adjusting the total social welfare. To be more specific, we model both individual utility and the social welfare by considering sharing, gift, and resale to be substitutes. We show that the total social welfare can be increased by fine-tuning the incentives and the various adjustable transaction costs.

The managerial implications from our findings are relevant to the real world. Airbnb and Uber, the epitomes of the sharing economy, are often thought to follow the same business logic. However, our model shows that due to intrinsic differences in holding costs and depreciation/appreciation rates, competition can be markedly different in these two markets.

Our findings cover a wide range of industries and applications. Some of the results can be extended for empirical verification. For example, we find that used product price can exceed new product price when the product's residual value increases. It's also an interesting finding that certain product types have higher probability to enter the used- and shared-product market. We also find that if the sharing income is significant, new product price is higher in the first than in the second period. The findings in the change of price elasticity of supply over the two periods may be another interesting point for future research.

Our study also reveals that the car subscription service is indeed a rising alternative to the traditional automobile contract options. Car manufacturers manage to provide a contract with a more attractive upfront payment and no limitations on the annual mileage allowance, which is a competitive advantage over

the offer from car rental platforms. Further, the research indicates that customers are inclined to choose financing over subscribing if the dedicated income of a car purchase exceeds 10,000 USD. Therefore, car manufacturers and rental platforms could offer the expensive financing options of luxury cars, at a cheaper rate, under a subscription contract. It allows the marketers to target a new customer segment that otherwise could not afford the car through a leasing or financing method. Moreover, we observe that subscription shows a potential to substitute the leasing offer. It is more attractive to some consumers as it offers more flexibility and a greater service at a lower price.

## Research Limitations

Although this thesis investigate the sharing economy from a comprehensive perspective, it's unavoidable that there should be several limitations regarding to the study under the consideration of academic rigor. The limitations are mainly related to the assumptions about the model development, simplifications in the numerical analysis and the scope of the dataset.

In the first research, we assume that the sharing income is a linear function of time, which is the simplest form of income. However, the expression of sharing income actually is more complicated and probability problem should be taken into consideration because of the uncertainty in sharing market. As the result of that, we will consider combining other income function with the probability theory in order to get more accurate results in our future research. Moreover, reward of giving a gift could also become a variable instead of a constant, which would be an unprecedented work, so different models for reward would also be focused on in our future research. We expect that there exists a optimal model for reward and in that case, we could give an effective suggestion to the government and we hope our efforts could make sense in the future. Last but not

least, we will also make an effort to collect related data and to use some empirical methods on the data to test our model further.

For the second study, we assume the transfer ratio is exogenous, which is a strong assumption. In the future work, we need to figure out this ratio with the help of empirical analysis, which would also contribute to the sharing literature. Besides, we assume only the individual sharers exist in the sharing market instead of differentiating the sharing company from the individual sharers. The model can be developed to include more participants in the further study. Lastly, in the numerical analysis, the residual value of products is assumed to be changed linearly with time, which is a kind of simplification. And the reference for the transfer ratio is not precious enough, which needs more results generated from data analysis to support the value of transfer ratio.

One of the limitations of the third study is that we only had market data available and that we decided to use estimates for the parameters and coefficients. Immediate future research should consider collecting customer data to examine the parameters and to get more grounded estimates of the coefficients. The current development stage of car subscription offerings is quite early. Especially in the U.S., several providers are available, but many of them are still in a prototype or small roll-out phase. More data is becoming available in the upcoming years, offering better research base. With regards to the case-specific factors, having information from the individual customer on the desired flexibility or income level could lead to crucial findings for the companies.

As for the last study, one limitation is that the size of references is not large enough, which is caused by the limited literature about GDPR. As a result, we mainly focus on the data management platforms (DMP) in general, instead of the sharing platforms in specific. With the strict application of GDPR, more

studies can be conducted in the future to study the impact of GDPR in sharing economy with data analysis.

## **Future Research**

There are numerous questions regarding to sharing economy remaining undiscovered. Sharing economy is a heated-discussed topic and blue-ocean field nowadays. This thesis provides a solid foundation for the further study about sharing economy with several research topics. These interesting topics are related to interdisciplinary studies, such as supply chain management, operations research, information systems, and sustainable development. For the future study, I plan to continue studying the sharing economy from the perspective of sustainable development and supply chain coordination. They are described in details in the following.

### **Sustainable Development**

The electric cars are green to the environment and they can be promoted with the help of sharing market. According to the government policy, many car manufactures, such as Renault, decides to fully replace the fuel cars with the electric cars by providing the sharing service. So, it's important and urgent for them to determine the optimal strategy for this replacement plan, which includes the price, the quantity, the selling channel, and the products, etc.. On the other hand, in order to promote the electric cars to the people, the government has to design the suitable policy to regulate the cars in the market, which includes the punishment on the fuel cars' users, the reward for the electric cars' users, the benefit for the electric cars' producers, etc.. Therefore, for the future study, the study about promoting the electric cars with sharing market should have the potential in both theoretical and practical contributions.

Since many manufacturers start their own sharing service, the corporation between sharing platform, producers and government becomes possible. I'm interested in the game between sharing

platform, producers, government and consumers and curious about whether there exists a strategy which leads to a win-win equilibrium. If it's possible, people's life becomes more sustainable.

### **Supply Chain Coordination**

As for the sharing service provided by the manufacturer, we suggest collecting individual data and study the impact of individual-related factors on the contract choice designated to a car ownership. Also, the importance of the flexibility factor, including the variety of swaps as well as the short-term usage and other significant factors, should be analyzed in subsequent studies. Another future topic can be how to help car manufacturers polish their contracts from the perspective of operations, such as product design and product management. It's tough to figure out the equilibrium of cost and profit in this complicated competition for manufacturers. Last interesting topic is to study the difference between subscription with car-subscription. It might provide essential insights on how the car market and the ownership of a car could evolve in the future for both car manufacturers and car rental platforms. Analyzing how car manufacturers and car rental platforms intervene and transform the mobility sector is important.

Moreover, if the products are only for the sharing like electric cars, they could redesign the products with different characteristics, such as recyclability and durability, to decrease the production cost and R&D cost. In that case, a qualitative research is needed for analyzing consumer's preference for shared products, which should be different from that for purchased products.

Last but not least, it's also interesting to study the effects of remanufacturing in the sharing economy. We consider the different generations can also be reentered the sharing market and participate the competition in the whole market, which is complicated but close to the reality.

## Concluding Remarks

As is known to all, sustainable development is a global trend nowadays and in the future. We believe that sharing economy is one of the most green economic form in the world and it would permeate into each individual's cognition and lifestyle. As the lifestyle of consumers' shifts, their way of owning or using a products changes. As a result, production style and economic form should adapt and update to this trend as well.

Current literature lacks a deep understanding and description about the essential characteristics of sharing economy. There are still lots of research gaps and implication potentials in the application of sharing economy. The results of this thesis provides a novel perspective, model, and concept to identify the uniqueness of sharing economy and expand its positive impact, which builds a fundamental cornerstone for the future research. We believe that more interesting and valuable studies about sharing economy would be conducted to benefit people and the world.



# Bibliography

- Aakhus, M., Ågerfalk, P. J., Lyytinen, K., and Te'eni, D. (2014). Symbolic action research in information systems. *MIS Quarterly*, 38(4), 1187-1200.
- Abadi, D. J., Marcus, A., Madden, S. R., and Hollenbach, K. (2007). Scalable semantic web data management using vertical partitioning. In *Proceedings of the 33rd international conference on Very large data bases* (pp. 411-422). VLDB Endowment.
- Aguirregabiria, V., and Mira, P. (2010). Dynamic discrete choice structural models: A survey. *Journal of Econometrics*, 156(1), 38-67.
- Ainscough, T. L., Trocchia, P. J., and Gum, J. R. (2009). Consumer rental car choice: Price, agent, and brand effects. *Journal of Business & Economics Research*, 7(7).
- Aizcorbe, A., and Starr-McCluer, M. (1997). Vehicle ownership, purchases, and leasing: Consumer survey data. *Monthly Lab. Rev.*, 120, 34-40.
- Anderson, S. P., and Victor A. G. (1994). Price discrimination via second-hand markets. *European Economic Review* 38.1: 23-44.
- Andrikopoulos, A., and Markellos, R. N. (2015). Dynamic interaction between markets for leasing and selling automobiles. *Journal of Banking & Finance*, 50, 260-270.
- Armstrong, R. (2014). *Move The Process, Not The Data Accelerating Analytics With In-Database Processing*. Retrieved December 19, 2017
- Attanasio, O. P., Koujianou Goldberg, P., and Kyriazidou, E. (2008). Credit constraints in the market for consumer durables: Evidence from micro data on car loans. *International Economic Review*, 49(2), 401-436.
- Ausubel, L. M., & Cramton, P. (2004). Vickrey auctions with reserve pricing. *Economic Theory*, 23(3), 493-505.
- Bapna, R., Gupta, A., Rice, S., and Sundarajan, A. (2017). Trust and the Strength of Ties in Online Social Networks: An Exploratory Field Experiment. *MIS Quarterly* 41(1), 115-130.

- Bapna, R., Wolfgang J., and Galit S. (2008). Consumer surplus in online auctions. *Information Systems Research* 19(4), 400-416.
- Bass, F. M. (1969). A new product growth for model consumer durables. *Management science*, 15(5), 215-227.
- Becker, H., Ciari, F., and Axhausen, K. W. (2017). Comparing car-sharing schemes in Switzerland: User groups and usage patterns. *Transportation Research Part A: Policy and Practice*, 97, 17-29.
- Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, 67(8), 1595-1600.
- Botsman, R., & Rogers, R. (2011). *What's mine is yours: how collaborative consumption is changing the way we live*. London: Collins.
- Bulow, J. I. (1982). Durable-goods monopolists. *Journal of political Economy*, 90(2), 314-332.
- Chasin, F., von Hoffen, M., Hoffmeister, B., and Becker, J. (2018). Reasons for Failures of Sharing Economy Businesses. *MIS Quarterly Executive* 17(3), 185-199.
- Cheal, D. (2015). *The gift economy*. Routledge.
- Chen, J., Susanna E., and Matthew S. (2013) When do secondary markets harm firms?. *American Economic Review* 103(7), 2911-34.
- Chen, S., Dasdan, A., Elmeleegy, H., Kolay, S., Li, Y., Qi, Y., ... and Wu, M. (2013). U.S. Patent Application No. 13 /924,343.
- Chen, Y., Anandhi B., and Khim-Yong G. (2017) An Empirical Analysis of Intellectual Property Rights Sharing in Software Development Outsourcing. *Mis Quarterly* 41(1).
- Chevalier, J., and Austan, G. (2009). Are durable goods consumers forward-looking? Evidence from college textbooks. *The Quarterly Journal of Economics* 124(4), 1853-1884.
- Chian T., Felix, T., Cahalane, M., Tan, B., and Englert, J. (2017) How GoGet CarShare's Product-Service System is Facilitating Collaborative Consumption. *MIS Quarterly Executive* 16(4).
- Chickering, D. M., and Heckerman, D. (2003). Targeted advertising on the web with inventory management. *Interfaces*, 33(5), 71-77.

- Cohen, B., & Kietzmann, J. (2014). Ride on! Mobility business models for the sharing economy. *Organization & Environment*, 27(3), 279-296.
- Constantiou, I., Attila M., and Virpi K. T. (2017) Four Models of Sharing Economy Platforms. *MIS Quarterly Executive* 16(4).
- Cusumano, M. A. (2015). How traditional firms must compete in the sharing economy. *Communications of the ACM* 58(1), 32-34.
- Danezis, G., Domingo-Ferrer, J., Hansen, M., Hoepman, J. H., Metayer, D. L., Tirtea, R., and Schiffrer, S. (2015). Privacy and Data Protection by Design-from policy to engineering. arXiv preprint arXiv:1501.03726.
- Dasgupta, S., Siddarth, S., and Silva-Risso, J. (2007). To lease or to buy? A structural model of a consumer's vehicle and contract choice decisions. *Journal of Marketing Research*, 44(3), 490-502.
- Desai, P., and Purohit, D. (1998). Leasing and selling: Optimal marketing strategies for a durable goods firm. *Management Science*, 44(11), 19-34.
- Dhebar, A., and Oren, S. S. (1985). Optimal dynamic pricing for expanding networks. *Marketing Science*, 4(4), 336-351.
- Einav, L., Chiara F., and Jonathan L. (2016). Peer-to-peer markets. *Annual Review of Economics* 8, 615-635.
- Fishman, A., and Rafael, R. (2000). Product innovation by a durable-good monopoly. *The RAND journal of Economics*, 237-252.
- Fraiberger, S. P., and Arun S. (2015) Peer-to-peer rental markets in the sharing economy. NYU Stern School of Business research paper (6). Available at SSRN: <https://ssrn.com/abstract=2574337>
- Frey, A., Manuel T., and Daniel V. (2019). Three Differentiation Strategies for Competing in the Sharing Economy. *MIS Quarterly Executive* 18(2).
- Fruchter, G. E., and Rao, R. C. (2001). Optimal membership fee and usage price over time for a network service. *Journal of Service Research*, 4(1), 3-14.
- Fruchter, G. E., Rao, R. C., and Shi, M. (2006). Dynamic network-based discriminatory pricing. *Journal of optimization theory and applications*, 128(3), 581-604.

- Fudenberg, D., and Jean T. (1998). Upgrades, trade-ins, and buybacks. *The RAND Journal of Economics*, 235-258.
- Garratt, R., & Thomas T. (2006). Speculation in standard auctions with resale. *Econometrica*, 74(3), 753-769.
- Ghose, A., Michael, D. S., and Rahul T. (2006). Internet exchanges for used books: An empirical analysis of product cannibalization and welfare impact. *Information systems research* 17(1), 3-19.
- Goldberg, I., Wagner, D., and Brewer, E. (2007). Privacy-enhancing technologies for the Internet III: Ten Years Later. In *Comcon'97. Proceedings, IEEE* (pp. 103-109). IEEE.
- Goldberg, P. K. (1995). Product differentiation and oligopoly in international markets: The case of the US automobile industry. *Econometrica: Journal of the Econometric Society*, 63 (4) 891-951.
- Gong, J., Brad N. G., and Yiping S. (2017). Uber might buy me a mercedes benz: An empirical investigation of the sharing economy and durable goods purchase. Available at SSRN 2971072.
- Greenwood, B. N., and Sunil W. (2017). Show Me the Way to Go Home: An Empirical Investigation of Ride-Sharing and Alcohol Related Motor Vehicle Fatalities. *MIS quarterly* 41(1), 163-187.
- Hamari, J., Sjoekint, M., & Ukkonen, A. (2016). The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science and Technology*, 67(9), 2047-2059.
- Horton, J. J., and Richard J. Z. (2016). Owning, using and renting: some simple economics of the "sharing economy". No. w22029. National Bureau of Economic Research.
- Huang, K., InduShobha C., and Alain P. (2019). Sharing Is Caring: Social Support Provision and Companionship Activities in Healthcare Virtual Support Communities. *MIS Quarterly* 43(2).
- Jiang, B., and Lin T. (2016). Collaborative consumption: Strategic and economic implications of product sharing. *Management Science* 64(3), 1171-1188.
- Johnson, J. P. (2011). Secondary markets with changing preferences. *The RAND Journal of Economics* 42(3), 555-574.

- Johnson, J. P., Schneider, H. S., and Waldman, M. (2014). The role and growth of new-car leasing: Theory and evidence. *The Journal of Law and Economics*, 57(3), 665-698.
- Johnson, K. W. (2000). Credit Constraints, Consumer Leasing and the Replacement Decision. working paper, Federal Reserve Board.
- Kim, K., and Hann, I. (2017). Housing prices, collateral, and online crowdfunding. Robert H. Smith School Research Paper. Available at SSRN.
- Kuruzovich, J., Siva V., and Ritu A. (2011). Seller search and market outcomes in online auctions. *Management Science* 56(10), 1702-1717.
- Loideain, N.N. (2019). A port in the data-sharing storm: the GDPR and the Internet of things. *Journal of Cyber Policy*, 4(2), pp.178-196.
- Lyu, L., Chau, S.C.K., Wang, N. and Zheng, Y. (2020). Cloud-based privacy-preserving collaborative consumption for sharing economy. *IEEE Transactions on Cloud Computing*.
- Madhavan, J., Halevy, A. Y., Cohen, S., Dong, X. L., Jeffrey, S. R., Ko, D., and Yu, C. (2006). Structured data meets the Web: a few observations. *IEEE Data Eng.* , 29(4), 19-26.
- Malhotra, A., and Van Alstyne, M. (2014). The dark side of the sharing economy and how to lighten it. *Communications of the ACM*, 57(11), 24-27.
- Mannering, F., Winston, C., and Starkey, W. (2002). An exploratory analysis of automobile leasing by US households. *Journal of Urban Economics*, 52(1), 154-176.
- Marcoux, J. S. (2009). Escaping the gift economy. *Journal of Consumer Research*, 36(4), 671-685.
- Martin, E., Susan A. S., and Jeffrey L. (2010). Impact of carsharing on household vehicle holdings: Results from North American shared-use vehicle survey. *Transportation Research Record* 2143(1), 150-158.
- Mas, A. (2008) Labour unrest and the quality of production: Evidence from the construction equipment resale market. *The review of economic studies* 75.1: 229-258.
- McFadden, D. (1978). Modeling the choice of residential location. *Transportation Research Record*, 673.

- Melville, N. P. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly*, 34(1), 1-21.
- Menon, S., and Sumit S. (2016). Privacy and Big Data: Scalable Approaches to Sanitize Large Transactional Databases for Sharing. *MIS Quarterly* 40(4).
- Mesak, H. I., and Darrat, A. F. (2002). Optimal pricing of new subscriber services under interdependent adoption processes. *Journal of Service Research*, 5(2), 140-153.
- Mocker, M., and Nils O. F. (2017). How AUDI AG is Driving Toward the Sharing Economy. *MIS Quarterly Executive* 16(4).
- Moorthy, K. S. (1984). Market segmentation, self-selection, and product line design. *Marketing Science* 3(4), 288-307.
- Moraga-Gonzalez, J. L., Sndor, Z., and Wildenbeest, M. R. (2015). Consumer search and prices in the automobile market.
- Mussa, M., and Sherwin R. (1978). Monopoly and product quality. *Journal of Economic theory* 18(2), 301-317.
- Nunnally, B. H. and Plath, D. A. (1989). Leasing Versus Borrowing: Evaluating Alternative Forms of Consumer Credit. *The Journal of Consumer Affairs*, 23(2), 383-392.
- Parmer, L., and Dillard, J. (2015). The relationship between personality and consumer behavior buying patterns within the automobile industry. *International Journal of Management and Marketing Research*, 8(1), 1-13.
- Peppers, D., Martha R., and Bob D. (1999). Is Your Company Ready for One-to-One Marketing? *Harvard Business Review*, 15160.
- Perktold, F., and von Racheck, M. (2019). PSS Design in Practice-How a Choice Experiment Can Help Configuring a New Subscription Offer. The Case of Care by Volvo's Used Car Subscription Offer.
- Phillips, M. (2018). International data-sharing norms: from the OECD to the General Data Protection Regulation (GDPR). *Human genetics*, 137(8), 575-582.
- Purtova, N., (2018). Between the GDPR and the Police Directive: navigating through the maze of information sharing in public-private partnerships. *International Data Privacy Law*
- Robinson, B., and Lakhani, C. (1975). Dynamic price models for new-product planning. *Management science*, 21(10), 1113-1122.

- Rust, J. When is it optimal to kill off the market for used durable goods?. *Econometrica: Journal of the Econometric Society*, 65-86.
- Ryan, J., Dr. (2017). The 3 biggest challenges in GDPR for online media & advertising. Retrieved December 04, 2017.
- Schor, J. (2016). *Journal of Self-Governance and Management Economics*, 4(3), 7-22.
- Seamans, R., and Feng Z. (2013). Responses to entry in multi-sided markets: The impact of Craigslist on local newspapers. *Management Science* 60(2), 476-493.
- Shah, V., Mao, Y., Chen, S., Bennett, D., and Shao, X. (2011). U.S. Patent Application No. 13 /206,416.
- Shiraishi, S., Kim, B., and Yamaura, M. (2019). Subscription-based safety features in car sharing. U.S. Patent 10,346,765.
- Simmons, G. (2008). Marketing to postmodern consumers: introducing the internet chameleon. *European Journal of Marketing*, 42(3 /4), 299-310.
- Sundararajan, A. (2016) *The sharing economy: The end of employment and the rise of crowd-based capitalism*. Mit Press.
- Sundararajan, A. (2013). From Zipcar to the sharing economy. *Harvard Business Review* 1(1), 1-2.
- Szamatowicz, M., and Paundra, J. (2019). Access or Ownership? The effect of car attributes and collective psychological ownership on the preference for car subscription services. *Psychological Research on Urban Society*, 2(1), 44-58.
- Tiwana, A., Konsynski, B., and Bush, A. A. (2010). Research commentary—Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics. *Information Systems Research*, 21(4), 675-687.
- Toubiana, V., Narayanan, A., Boneh, D., Nissenbaum, H., and Barocas, S. (2010). Adnostic: Privacy preserving targeted advertising. *Proceedings Network and Distributed System Symposium*.
- Train, K. E., and Winston, C. (2007). Vehicle choice behavior and the declining market share of US automakers. *International economic review*, 48(4), 1469-1496.

- Trocchia, P. J., and Beatty, S. E. (2003). An empirical examination of auto-mobile lease vs finance motivational processes. *Journal of Consumer Marketing*, 20(1), 28-43.
- Urban, T., Tatang, D., Degeling, M., Holz, T. and Pohlmann, N., 2020, October. Measuring the impact of the gdpr on data sharing in ad networks. In *Proceedings of the 15th ACM Asia Conference on Computer and Communications Security* (pp. 222-235).
- Verboven, F. (2002). Quality-based price discrimination and tax incidence: evidence from gasoline and diesel cars. *RAND Journal of Economics*, 33(2), 275-297.
- Waldman, M. (2003). Durable goods theory for real world markets. *Journal of Economic Perspectives* 17(1), 131-154.
- Watson, R. T., Boudreau, M. C., and Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. *MIS Quarterly*, 23-38.
- Weber, T. A. (2016). Product pricing in a peer-to-peer economy. *Journal of Management Information Systems* 33(2), 573-596.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. (2010). Research commentary—the new organizing logic of digital innovation: an agenda for information systems research. *Information Systems Research*, 21(4), 724-735.
- Yuan, Y., Wang, F., Li, J., and Qin, R. (2014). A survey on real time bidding advertising. In *Service Operations and Logistics, and Informatics (SOLI), 2014 IEEE International Conference on* (pp. 418-423).
- Zarsky, T. Z. (2016). Incompatible: The GDPR in the Age of Big Data. *Seton Hall L. Rev.*, 47, 995.
- Zawadzki, M. (2016). How Does Data Collection Work in a DMP?
- Zervas, G., Proserpio, D. and Byers, J.W. (2017) The rise of the sharing economy: Estimating the impact of Airbnb on the hotel industry. *Journal of marketing research*, 54(5), 687-705.
- Zhang, C, Kolte, P., Kettinger, W. J., and Yoo, S. (2018). Established Companies' Strategic Responses to Sharing Economy Threats. *MIS Quarterly Executive* 17(1).

- Zhou, W., & PIRAMUTHU, S. (2013). Technology regulation policy for business ethics: An example of RFID in supply chain management. *Journal of business ethics*, 116(2), 327- 340.
- Zhou, W., & PIRAMUTHU, S. (2015). Information relevance model of customized privacy for IoT. *Journal of business ethics*, 131(1), 19-30.



# Appendix

9.  $p_{2n}$  :

$$\begin{aligned}
 p_{2n} &= p_{2u} + (1 - \omega_t)(1 - Q_{2u}) \\
 &= \omega_t(1 - Q_{2u} - Q_{2n}) + (1 - \omega_t)(1 - Q_{2u}) \\
 &= \omega_t(1 - Q_{2u}) + (1 - \omega_t)(1 - Q_{2u}) - \omega_t Q_{2n} \\
 &= 1 - Q_{2u} - \omega_t Q_{2n}
 \end{aligned}$$

10.  $\Pi_{1n}$  :

$$\Pi_{1n} = (p_{1n} - c_{1n})Q_{1n} + (p_{2n} - c_{2n}^*)Q_{2n}^*$$

where

$$\begin{aligned}
 (p_{1n} - c_{1n})Q_{1n} &= (p_{2u} + 1 - Q_{1n} - c_{1n})Q_{1n} \\
 &= \left[ \omega_t \left( \frac{3}{4} + \frac{\omega_t Q_{2u}}{4} - Q_{2u} \right) + 1 - Q_{2u} - c_{1n} \right] Q_{2u} \\
 &= \left( 1 - c_{1n} + \frac{3}{4} \omega_t \right) Q_{2u} - \left( \omega_t + 1 - \frac{\omega_t^2}{4} \right) Q_{2u}^2
 \end{aligned}$$

$$\begin{aligned}
 (p_{2n} - c_{2n}^*)Q_{2n}^* &= \left[ \frac{3}{4}(1 - \omega_t Q_{2u}) - \frac{1 - \omega_t Q_{2u}}{2} \right] \frac{1 - \omega_t Q_{2u}}{4} \\
 &= \frac{1}{4}(1 - \omega_t Q_{2u}) * \frac{1 - \omega_t Q_{2u}}{4} \\
 &= \frac{(1 - \omega_t Q_{2u})^2}{16}
 \end{aligned}$$

$$\begin{aligned}
 \frac{\partial \Pi_{1n}}{\partial Q_{2u}} &= 1 - c_{1n} + \frac{3}{4} \omega_t - \frac{\omega_t}{8} \\
 &\quad - \left[ 2 \left( \omega_t + 1 - \frac{\omega_t^2}{4} \right) - \frac{\omega_t^2}{8} \right] Q_{2u} = 0
 \end{aligned}$$

and we get:

$$Q_{2u}^* = \frac{1 - c_{1n} + \frac{5}{8} \omega_t}{2\omega_t + 2 - \frac{5}{8} \omega_t^2}$$

11.  $\mathbb{C}_{1n}$  :

We set  $X = 1 + \frac{5}{8} \omega_t$  and  $Y = 2\omega_t + 2 - \frac{5}{8} \omega_t^2$ , then

$$\mathbb{C}_{1n} = c_{1n}Q_{1n} + c_{2n}^*Q_{2n}^*$$

where

$$c_{1n}Q_{1n} = \frac{\left(1 + \frac{5}{8}\omega_t\right)c_{1n} - c_{1n}^2}{2\omega_t + 2 - \frac{5}{8}\omega_t^2}$$

$$= \frac{Xc_{1n} - c_{1n}^2}{Y}$$

$$c_{2n}^*Q_{2n}^* = \frac{1 - \omega_t Q_{2u}}{2} * \frac{1 - \omega_t Q_{2u}}{4}$$

$$= \frac{1}{8} \left[ 1 - \omega_t \frac{X - c_{1n}}{Y} \right]^2$$

$$= \frac{1}{8} \left[ 1 - 2 \frac{\omega_t(X - c_{1n})}{Y} + \frac{(X - c_{1n})^2 \omega_t^2}{Y^2} \right]$$

From the above, we find that:

$$\frac{\partial C_{1n}}{\partial c_{1n}} = \frac{X}{Y} + \frac{\omega_t}{4Y} - \frac{\omega_t^2}{4Y^2} + \left[ \frac{\omega_t^2}{4Y^2} - \frac{2}{Y} \right] c_{1n} = 0$$

Which results in:

$$c_{1n}^* = \frac{4XY + Y\omega_t - X\omega_t^2}{8Y - \omega_t^2}$$

$$= \frac{128 + 240\omega_t + 56\omega_t^2 - 45\omega_t^3}{256 + 256\omega_t - 96\omega_t^2}$$

12.  $\bar{p}_{2n}$  :

$$\bar{p}_{2n} = \bar{p}_{2u} + (1 - v_t + C_t)(1 - \bar{q}_{2n})$$

$$= (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n}) + (1 - v_t + C_t)(1 - \bar{q}_{2n})$$

$$= (v_t - C_t)(1 - \bar{q}_{2n}) + (1 - v_t + C_t)(1 - \bar{q}_{2n}) - (v_t - C_t)\bar{Q}_{2u}$$

$$= 1 - \bar{q}_{2n} - (v_t - C_t)\bar{Q}_{2u}$$

13.  $\Pi_{2u}$  :

$$\Pi_{2u} = (\bar{p}_{2n} - p_{2n})\bar{q}_{2n} + \bar{Q}_{2u}\bar{p}_{2u}$$

where

$$(\bar{p}_{2n} - p_{2n})\bar{q}_{2n} = [1 - \bar{q}_{2n} - \bar{Q}_{2n}(v_t - C_t) - p_{2n}]\bar{q}_{2n}$$

$$= -\bar{q}_{2n}^2 + \bar{q}_{2n}[1 - \bar{Q}_{2n}(v_t - C_t)$$

$$- \frac{3}{4}(1 - \omega_t Q_{2u})]$$

$$\bar{p}_{2u}\bar{Q}_{2u} = (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n})\bar{Q}_{2u}$$

$$= -(v_t - C_t)\bar{Q}_{2u}\bar{q}_{2n} + (v_t - C_t)(1 - \bar{Q}_{2u})\bar{Q}_{2u}$$

$$\frac{\partial \Pi_{2u}}{\partial \bar{q}_{2n}} = -2\bar{q}_{2n} + \left[ 1 - (v_t - C_t)\bar{Q}_{2u} - \frac{3}{4}(1 - \omega_t Q_{2u}) - (v_t - C_t)\bar{Q}_{2u} \right] = 0$$

and we get:

$$\begin{aligned} \bar{q}_{2n}^* &= \frac{1 - 2(v_t - C_t)\bar{Q}_{2u} - \frac{3}{4}(1 - \omega_t Q_{2u})}{2} \\ &= \frac{1 - 8(v_t - C_t)\bar{Q}_{2u} + 3\omega_t Q_{2u}}{8} \end{aligned}$$

14.  $\Pi_{1n}$  :

$$\Pi_{1n} = Q_{1n}(p_{1n} - c_{1n}) + \Pi_{2n}^*$$

where

$$\begin{aligned} Q_{1n}(p_{1n} - c_{1n}) &= Q_{1n}(p_{2u} + 1 - Q_{1n} - c_{1n}) \\ &= -Q_{1n}^2 + Q_{1n}\left[1 - c_{1n} + \omega_t\left(1 - Q_{2u} - \frac{1 - \omega_t Q_{2u}}{4}\right)\right] \\ \Pi_{2n}^* &= \left(\frac{1 - \omega_t Q_{2u}}{4}\right)^2 \\ &= \frac{1 - 2\omega_t Q_{2u} + \omega_t^2 Q_{2u}^2}{16} \end{aligned}$$

From the calculations above, we get:

$$\begin{aligned} \frac{\partial \Pi_{1n}}{\partial Q_{1n}} &= -2Q_{1n} + 1 - c_{1n} + Q_{1n}\left[-\omega_t k_2 + \frac{\omega_t^2}{4}k_2\right] \\ &\quad + \frac{3}{4}\omega_t + \left[\frac{\omega_t^2}{4} - \omega_t\right]Q_{2u} + \frac{\omega_t^2}{8}k_2 Q_{2u} - \frac{\omega_t}{8}k_2 = 0 \end{aligned}$$

resulting in:

$$Q_{1n}^* = \frac{1 - c_{1n} - \frac{(k_2 - 6)}{8}\omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{8}Q_{2u}}{2 + \omega_t k_2 \left(1 - \frac{\omega_t}{4}\right)}$$

15.  $\mathbb{C}_{1n}$  :

$$\mathbb{C}_{1n} = c_{1n}Q_{1n} + c_{2n}^*Q_{2n}^*$$

which makes:

$$\begin{aligned} \frac{\partial \mathbb{C}_{1n}}{\partial c_{1n}} &= \frac{-2c_{1n} + 1 + \frac{(k_2 - 6)}{8}\omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{8}Q_{2u}}{2 + \omega_t k_2 \left(1 - \frac{\omega_t}{4}\right)} \\ &= 0 \end{aligned}$$

As the result of that,

$$c_{1n}^* = \frac{1}{2} - \frac{(k_2 - 6)}{16} \omega_t + \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{16} Q_{2u}$$

16.  $\Pi_{1u}$  :

$$\Pi_{1u} = (\bar{p}_{1n} - p_{1n})\bar{q}_{1n} + \Pi_{2u}^*$$

where

$$\begin{aligned} (\bar{p}_{1n} - p_{1n})\bar{q}_{1n} &= [\bar{p}_{2u} + 1 - \bar{q}_{1n} - (A + BQ_{2u})]\bar{q}_{1n} \\ &= \bar{q}_{1n}^2 + \bar{q}_{1n}[1 - A - BQ_{2u} + (v_t - C_t) \\ &\quad * (1 - \bar{Q}_{2u} - \frac{1 - 8(v_t - C_t)\bar{Q}_{2u} + 3\omega_t Q_{2u}}{8})] \end{aligned}$$

$$\begin{aligned} \Pi_{2u}^* &= \bar{q}_{2n}^*(\bar{p}_{2n} - p_{2n}) + \bar{p}_{2u}\bar{Q}_{2u} \\ &= \frac{1 - (v_t - C_t)(4\bar{Q}_{2u} - Q_{2u})}{4} [1 - \bar{Q}_{2u} - \omega_t \bar{Q}_{2u} \\ &\quad - \frac{1 - (v_t - C_t)Q_{2u}}{4}] + \bar{Q}_{2u}(v_t + C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n}) \end{aligned}$$

$$\begin{aligned} \frac{\partial \Pi_{1u}}{\partial \bar{q}_{1n}} &= -\bar{q}_{1n}\{2 + B\bar{k}_2 + (v_t + C_t)\left[\bar{k}_1 + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}}\right] \\ &\quad + 1 - A - BQ_{2u} + (v_t - C_t)[1 - \bar{Q}_{2u} - \bar{q}_{2n}]\} \\ &\quad + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}} \left[1 - \bar{q}_{2n} - \omega_t \bar{Q}_{2u} - \frac{1 - (v_t - C_t)Q_{2u}}{2}\right] \\ &\quad + \bar{q}_{2n} \left(1 - \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}} - \omega_t \bar{k}_1 + \frac{(v_t - C_t)}{2} \bar{k}_2\right) \\ &\quad + (v_t - C_t)(1 - \bar{Q}_{2u} - \bar{q}_{2n})\bar{k}_1 - (v_t - C_t)\bar{Q}_{2u}(\bar{k}_1 + \frac{\partial \bar{q}_{2n}}{\partial \bar{q}_{1n}}) \\ &= 0 \end{aligned}$$

and we get:

$$\bar{q}_{1n}^* = \frac{1 - A - BQ_{2u} - C \frac{(v_t - C_t)(4\bar{k}_1 - \bar{k}_2)}{4} + D\bar{Q}_{2n} - E}{2 + B\bar{k}_2 + (v_t - C_t)(\bar{k}_1 + \frac{(v_t - C_t)(4\bar{k}_1 - \bar{k}_2)}{4})}$$

among which,

$$A = \frac{1}{2} - \frac{(k_2 - 6)}{16} \omega_t$$

$$B = \frac{\omega_t(\omega_t k_2 - 8 + 2\omega_t)}{16}$$

$$C = \frac{1}{2} - 2\bar{Q}_{2n} - \omega_t \bar{Q}_{2u} - \frac{1 - \omega_t}{2} Q_{2u}$$

$$D = 1 - \omega_t \bar{k}_1 + \frac{1 - \omega_t}{2} Q_{2u}$$

$$E = (v_t - C_t)[(1 - \bar{Q}_{2n} - \bar{Q}_{2u})(1 - \bar{k}_1) + \bar{Q}_{2n}\bar{k}_1]$$

## RESUME DE LA THESE EN FRANÇAIS

Facilités par diverses plates-formes en ligne, les coûts de transaction de partage et de vente de produits d'occasion sont devenus presque nuls et ce phénomène a créé une nouvelle forme économique, une concurrence et un service. Ma recherche sur l'économie du partage peut être envisagée sous quatre angles: les consommateurs, les fournisseurs, les modèles commerciaux et la politique des données. La recherche axée sur le consommateur examine la limite temporelle de propriété qui existe dans l'économie du partage en tenant compte de la durée de l'engagement, du revenu potentiel et du coût de détention pendant la possession. Nous décomposons une marchandise en deux produits de substitution et constatons qu'il existe diverses conditions dans lesquelles cette frontière peut tendre vers le partage, le don ou la revente. La recherche basée sur les fournisseurs étudie le résultat économique de l'auto-concurrence d'un producteur monopolistique entre les anciennes et les nouvelles générations de produits. Nous considérons un jeu en deux étapes dans lequel un producteur vend de nouveaux produits sur le marché aux deux étapes et des produits usagés peuvent entrer sur le marché sous la forme de biens partagés et usagés dans la deuxième étape. Nous identifions l'équilibre de marché de ce jeu en deux étapes et fournissons des implications managériales dans différents types de marchés de produits qui sont représentés par les automobiles (avec dépréciation de la valeur) et les biens immobiliers (avec appréciation de la valeur). La recherche par modèle économique étudie le contrat d'abonnement fourni par les constructeurs automobiles et étudie l'attractivité de ce nouveau contrat avec modèle de choix discret. Avec les données collectées auprès des constructeurs automobiles et des plates-formes de location, nous constatons que le modèle d'abonnement a un grand potentiel pour annuler les méthodes conventionnelles de

possession de voitures et détient un avantage concurrentiel par rapport aux plates-formes de location de voitures. La recherche basée sur la politique des données examine le problème de la protection des données et de la vie privée engendré par l'économie du partage.

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#### ABSTRACT OF THE THESIS IN ENGLISH

Facilitated by various online platforms, transaction costs of sharing and selling used products have become almost zero and this phenomenon has created new economic business form, competition and service. My research on the sharing economy can be considered from the four perspectives : consumers, providers, business models, and data policy. The consumer-based research investigates the temporal ownership boundary that exists in the sharing economy by considering the engagement duration, potential income and holding cost during the ownership. We decompose a merchandise as two substitute goods and find that there exists various conditions when this boundary may lean towards sharing, giving or reselling. The supplier-based research investigates the economic outcome of a monopolistic producer's self-competition between old and new generations of products. We consider a two-stage game in which a producer sells new products in the market in both stages and used products may enter the market in the form of shared and used goods in the second stage. We identify the market equilibrium of this two-stage game and provide managerial implications in different types of product markets that are represented by automobiles (with value depreciation) and real estates (with value appreciation). The business-model-based research studies the subscription contract provided by car manufacturers and studies the attractiveness of this new contract with discrete choice model. With the data collected from car manufacturers and rental platforms, we find that the subscription model has great potential to overrule the conventional methods of car ownership

and holds a competitive advantage over car renting platforms. The data-policy-based research examines the data protection and privacy issue brought about by the sharing economy.