ABSTRACT

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Two-sided markets have become a major topic of an academic discussion in the past two decades. This discussion is fueled by the growing importance of the two-sided market platforms in the economy. The ongoing growth of these platforms has sparked multiple models and point of views in the academic discussion. Thus, there are overlapping models and definitions for this phenomenon.

This study introduces the reader to the subject. It does this by starting from the foundations of the two-sided market literature and from previously established network effect literature which has later influenced the development of two-sided market literature. The study then finds a suitable definition for the phenomenon. The thesis then introduces some key pieces of the current literature regarding two-sided markets. It analyzes different theories and draws connections between them. The main focuses in the analysis, are to find suitable definitions for the phenomenon and to explore different competition situations and dynamics.

The study also finds and presents suitable empirical examples for the presented theories. The examples are mainly from previous studies. There are two key points in presenting the examples. First, to draw the connection between the presented theory and empirical examples. And second, present and analyze possible effects that the two-sided markets have on their surrounding economies.

Key words	Two-sided market, network effect, platform competition
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Two-sided market eli vapaasti suomennettuna kaksipuoleinen markkina on taloustieteen ilmiö, joka on viimeisen kahdenkymmenen vuoden aikana noussut akateemisen keskustelun aiheeksi. Tämä johtuu paljolti siitä, että niin sanotut kaksipuoleiset markkina alustat (two-sided market platforms) ovat kasvaneet suuriksi toimijoiksi yritys maailmassa. Tämä menestys on saanut aikaan akateemista pohdintaa aiheen ympäriltä ja artikkeleja aiheesta on kirjoitettu monelta kantilta taloustieteestä kilpailulainsäädäntöön.

Kenties johtuen aiheen tuoreudesta sekä useista näkökulmista, ei kaksipuoleiselle markkinalle ole löytynyt täysin kattavaa määritelmää. Tämä artikkeli avaa aiheen lukijalleen. Aiheen avaaminen tapahtuu esittelemällä sen tärkeimmät teoriat sekä kaksipuoleisiin markkinoihin kiinteästi liittyvien verkostovaikutusten perusteoriat. Näiden avulla esitellään hyväksyttävä kaksipuoleisten markkinoiden määritelmä sekä opitaan tuntemaan aiheen tärkeimpiä teorioita. Näitä teorioita tarkastellaan lähemmin ja niiden esittämiä malleja analysoidaan.

Mallien analysointi tapahtuu paitsi avaamalla niitä matemaattisesti, myös etsimällä niihin soveltuvia empiirisiä esimerkkejä. Empiiriset esimerkit esitellään ja niitä analysoidaan suhteessa läpikäytyihin malleihin. Empiirisiin esimerkkeihin liitetään myös pohdintaa liittyen niiden kansantaloustieteellisiin vaikutuksiin.

Asiasanat	Two-sided market (kaksi puoleinen markkina), network effect (verkostovaikutus), platform competition (alusta kilpailu)
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TWO-SIDED MARKETS

Competition of marketplaces

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1 INTRODUCTION

Most of the fundamental economic theories are based on the assumption that there is a functioning market, where buyers and sellers are efficiently able to match and trade goods or services. However, there are phenomena like stock exchange, booking agents, shopping malls and so forth, where there controversially exists a third party that sets up a platform or a location for trade. Those markets function just as the regular ones where operating sets of agents match each other and trade or get some other benefits that exceed the cost of participating in the platform. These sorts of platforms set by a third party are generally accepted in literature as two-sided market platforms and are sometimes referred as two-sided markets or just platforms.

Often the value of these platforms can be solely attributed to the amount of user base they have managed to attract. If there would be a new credit card that no merchant accepts, it would have no value and no one would want to own one. On the other hand, if nobody used the credit card no merchant would probably accept it. Still, Visa Inc. is currently valued at over 280 billion dollars in the stock market generating over 17 USD billion revenue in 2017 (Visa Inc. Annual report 2017, 122). Somehow, it was able to attract the users turning something that had no value for its first users into a multi-billion business and into a most normal payment method.

Platforms must get both buyers and sellers simultaneously on board. In fact, there were multiple tries on launching the first credit card before BankAmericard, ancestor of Visa managed to establish a successful widely used network of buyers using the card and sellers accepting it (Nocera 1994, 23).

This idea of two-sided markets brings a new fascinating point of view into economic discussion where market can be sometimes created and made to function. Then these market platforms can compete with one another as their own entities. Interestingly, quite different economic laws apply to the competition between these markets as compared to regular economic laws. They for instance, can apply negative prices to their users for an indefinite time period. Sometimes the demand curve seems to be almost flat, while at the same time the platforms' marginal costs can be close to zero creating some very interesting competition situations that would be quite unusual in a normal economic environment.

Internet has brought these platforms significantly more potential. It has made participation in two-sided markets much easier by removing the geographic obstacles. Thus, companies like Amazon, Uber and Airbnb have challenged traditional industries by connecting the buyers and sellers together without owning books, cars or taxis. Simultaneously, increased computing power and more sophisticated software has automated many previously human tasks. This also adds to the potential of the two-sided market platforms and now, for instance, intermediary platforms like travel agents are exponentially more efficient as one webpage can connect millions of travelers with flights or hotels with minimal operative staff. (Zervas & Proserpio & Byers 2016, 687).

While the technological advances have brought many possibilities for this kind of platforms to emerge, the platforms are often facing fierce competition as well. This has caused two-sided market platforms to develop interesting strategies to win the competition. Adequate pricing model and advertising of the platforms are key strategies in expanding and maintaining their market share (Evans 2003, 238).

In order to enter the market, platforms might need to adapt pricing strategies that can be considered predatory by antitrust laws (Evans 2003, 238). However, pricing strategies of two-sided market platforms can be peculiar regardless of the competition. For instance, price discrimination is very common and even imposing a negative price can be optimal strategy for a platform to maximize their profit. Finally, as a result of the peculiar pricing, the consumer welfare does not always follow the traditional laws of economics. This article will demonstrate how optimal pricing of the platforms service is complex and strikingly different to pricing in many usual economic theories. Additionally, it is possible that multiple openly competing platforms can controversially lower the consumer welfare instead of increasing it (Caillaud & Jullien, 2003, 323).

Although there are some old examples of two-sided markets such as market squares or stock exchanges, the topic of this article is relatively new with first references to the subject dating back not more than twenty years. Still, recently there have been multiple publications on the topic as it has been popular in the past 10 – 15 years, not only in academic circles, but in business world as well. Most well-known theoretical groundwork include, for instances, “Chicken & Egg; Competition Among intermediation service providers” (2003) by Caillaid & Jullien and series of articles by Rochet & Tirole starting in (2003) with an Article “Platform competition in Two-sided markets”. Other authors that have been active in developing the theory of this subject are, for instance Rysman and Armstrong who both have multiple articles on the subject. There are other authors on theory side and most of them are basing their models on the Rochet & Tirole’s article which seems to be the cornerstone of the two-sided market theory.

There have been also some different perspectives on two-sided markets and some empirical studies on the topic. Emch & Thompson take an anti-trust perspective towards the competition between the platforms while Bilotkach & Rupp's (2014) empirical study on online travel agents provides empirical evidence on pricing systems in a competition situation between two-sided market platforms. Some articles also focus on two-sided market platforms competing against traditional industries. Zervas & Proserpio & Byers (2016) made a study on how traditional hotel industry can compete against a platform company and how consumers benefit from this new competition. Literature used in this article also includes some older articles on network effects, a topic that is critically related to two-sided markets and sometimes even considered an umbrella subject for the two-sided markets. Hence, there is even some literature that analyzes two-sided markets without using the terminology. One of them is Yannis Bakos, who discusses many of the two-sided market aspects already in 1998 in his paper "The Emerging Role of Electronic Marketplaces on the Internet". Even though the paper did not take a very deep look at the theory behind the phenomenon it is very well known for being ahead of its time. The reason is that Bakos managed to understand most of the key concepts of the two-sided markets and based on his understanding managed to identify many industries that would be deeply affected by the rise of the internet marketplaces.

1.1 Goal and the structure of this article

I have several main goals in this article. First, I try to clarify the notion of two-sided markets. I do this by introducing the reader into the subject and by finding some adequate definition and characteristics for the phenomenon. This goal is mainly achieved in the chapter two, where I will study the literature of the subject and define the phenomenon of two-sided market.

Defining the phenomenon seems appropriate as the literature of the subject is relatively new and overlaps with the literature of network effects. Additionally, the current definition of two-sided market is very wide. While the wide definition might not be a problem it can be useful to divide two-sided markets in sub categories. Thus, second chapter not only tries to find the definition but also divides two-sided markets into two different types. Finding the definition and dividing it in two helps to limit the scope of this article. This is also reasonable as there are multiple very different types of two-sided markets and the relevant models can be more suitable for some cases than to others.

Second goal of this article is to go through and analyze some of the main competition theories related to the subject and describe how they fit into the definition of the two-sided markets. When analyzing the theories one key point is to note differences to regular competition theories. This is not only interesting but helps in for further developing the definition. Another essence in analyzing the competition theories is to start developing an understanding on which empirical examples would be the most relevant with which specific models. This also further advances the development of the definition and helps in understanding the models. The chapters two, three and four will explain the main theories of the two-sided markets and why these theories are relevant. The chapters will open the models so that they are easier to understand. In these chapters, I will also start to build a connection of the models to real-world examples. However, the examples will be discussed more in detail in later chapters as the chapters two to four are more focused on the models and theory.

The chapter number three will go through three models from three different articles. One of them is from the article by Rochet & Tirole (2003) and the rest of them are based on the model presented in that article. However, while they use the theoretical base, the articles have very different perspectives on the topic. They also manage to bring different ideas on into the theory.

The first sub-chapter of chapter three presents a basic a monopolistic competition model. The chapter is written from anti-trust perspective towards payment cards and refers to articles treating the subject from that point of view. The second part of the chapter analyzes monopoly situation when the two-sided markets are essentially matching tools. It bases again the fundamental theory on the Rochet & Tirole article but analyses it in a situation that is perhaps more suitable for internet matching platforms than for payment card industry as the model in the previous chapter. The third subchapter discusses a situation where there are two competing platforms in the market.

Chapter four brings up a different angle on the competition between the two-sided markets. Besides the Rochet & Tirole's model, there is another famous article on the two-sided market competition by Caillaud & Jullien (2003). It has a rather different view on how the competition works. Nevertheless, it should be recognized as one of the two main articles on the topic and thus, is analyzed in this study. First subchapter of this chapter has a look on a situation where the services are exclusive meaning that the users of the platforms can only register into one platform at a time while the second subchapter views a situation where platforms are nonexclusive and where multi-homing is possible. Both subchapters also analyze strategies that platforms adopt to be competitive in the market. These strategies are often seen in the real-world examples of two-sided markets, as well. The third subchapter has a quick look on the implications of the model regarding who wins when platforms are competing.

The third goal is to draw a line between the theory and the practice. This is achieved by introducing empirical examples and analyzing them thoroughly. This, will not only help in understanding the theory but sheds some light on the definition of the two-sided market, as well.

The fifth chapter provides a set of empirical examples of two-sided markets in the real world. In the chapter, I draw connections between the examples and the relevant theories studied in this article and try to analyze, which of the theories fits the best to the example. I will go through the difficulties of becoming competitive in the market. There is critical amount number of users in both sides of the platform that should be attracted to use the service for it become valuable. This can cause problems even if there is no competition. The first subchapter provides an empirical example of the problem and solutions to it. The second subchapter will jump into a situation where there already is competition between two-sided market platforms. The subchapter discusses strategies used by the platforms to compete with one another and capture market. These strategies can involve for instance pricing or advertising. The third subchapter discusses how a platform coming into a market can have a large effect on practices in the whole industry and what kind of competitive advantages a platform can have in the market. The fourth subchapter discusses a bit more in detail the competitive advantages of the platforms and who can best benefit from them. The final part of the chapter takes the opposite view on the subject. It analyses the subject from the point of view that who loses when a platform comes into a market. The sixth chapter is reserved for the conclusions of this article followed by the references.

Lastly this article wants to further promote research on the two-sided markets. This is achieved by presenting current literature and suggesting interesting topics for further research within the subject. Of course, all the chapters are meant to contribute to this goal. However, in the conclusion chapter there are some suggestions for further research on the topic.

1.2 Methodology

In this study methodology consist of two sections the literature review and, to support it, the empirical section with examples. The literature section is again divided in three chapters two, three and four. The main goal of the chapter two is to find an adequate definition for the phenomenon. There is no comprehensive literature of this subject as it relatively recently became a subject of scientific discussion.

However, there is a collection of articles that try to establish an accepted definition that can be used in this study. Rochet & Tirole "Platform competition in Two-sided markets" (2003) and their continuation on this subject "Two-Sided Markets: A Progress Report" (2006) have laid a great ground work on the theory of two-sided markets. Apart from Rochet & Tirole, for instance Mark Rysman has made important contributions towards the definition of the two-sided markets with two articles. First, "Competition Between Networks: A Study of the Market for Yellow Pages" (2004) and second "The Economics of Two-Sided Markets" (2009).

There are also a number other articles help in finding an acceptable definition. For example, Armstrong (2006) and Evans (2003) have provided to the frame work. In addition, there are attempts to create a definition to two-sided markets from an antitrust point of view. Market definition in Two-Sided Markets: "Theory and Practise, by Filistrucchi. Geradin, Van Damme & Affeldt" (2014) tries to find a definition for the phenomenon that would be useful for the competition law officials. Moreover, when discussing the definition of the two-sided markets, it is appropriate to study network effects. The discussion on network effects started already in 1985 with article by Katz & Sapiro: "Network Externalities, Competition and Compatibility". However, it should be noted when discussing articles prior to 2001 that the term of two-sided markets had not appeared yet.

The second goal of the literature review is to discuss the current theory on the competition between two-sided market platforms. There are number of articles discussing the theory on how the competition differs from competition that is generally discussed in the economic field. Besides the efforts of Rochet & Tirole, there is for instance: Caillaud & Jullien‘s "Chicken & egg: competition among intermediation service providers" (2003). There also exists relevant theory on the subject even prior to the discovery of the definition of two-sided markets. "The Emerging Role of Electronic Marketplaces on the Internet" (1998) an article by Yannis Bako discusses the very subject of two-sided marketplaces while never mentioning the term. However, the article manages to find many key industries that quickly saw a spurt of two-sided market platforms entering into the market. It also treats the subject in a different way than the network effect literature and is thus a bit hard to simply lump with research made prior to the first articles mentioning the definition ‘two-sided markets’.

In the section of examples, I will use a wider range of sources. It will include some studies from completion law point of view as it is often relevant in the platform economy. I will also include articles with empirical examples from different industries but most from the travel industry where the usage of different two-sided market platforms has been wide spread for over a decade. I will also use some publications by companies such as their annual reports, as well as some internet-based sources in the empirical section in chapter five. This chapter includes more of my own analysis and logical reasoning as a form of discussing the subject further and linking the theory from chapters two, three and four to the examples in chapter five.

2 THE DEFINITION OF A TWO-SIDED MARKET PLATFORM

Although, there are number of articles discussing two-sided markets and platform economy, there seems to be no widely accepted definition of what a two-sided market is. As mentioned in the previous chapter, no author has taken up to make a comprehensive book on this subject. Therefore, it seems appropriate to start this study with a look of multiple definitions written previously of the subject to find a more comprehensive definition for this phenomenon. Two-sided market, two-sided market platform and sometimes just platform are used quite synonymously in literature and in this article. However, when talking about the concept I will use the term "two-sided market" and when talking about a specific subject, I will use the term "two-sided market platform" or just "platform". To notice, the example platforms can sometimes also multi-sided but in this article. However, the theory behind multi-sided platforms is very limited and thus I try to limit the multi-sidedness out of discussion.

Most of the articles take a network benefits approach to the phenomenon and point out that there are at least two characteristics that are in place in every two-sided market. First there needs to be a third party that sets up a platform for two or more sets of agents to operate. Second, the decisions of each set of agents influence the outcome of the other set of agents. Marc Rysman, in his article "The Economics of Two-Sided Markets" takes this approach to the question. "Broadly speaking, a two-sided market is one in which 1) two sets of agents interact through an intermediary or platform, and 2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality."

The role of the intermediary is often a crucial aspect to distinct a two-sided market from a one-sided market. Both can have intermediaries but in a one-sided market they actively participate in selling or buying goods whereas in a case of a two-sided market the intermediary acts more as a platform that facilitates the trade between sides of the market. However, this definition is broad and not exclusive. Multiple industries that do not seemingly use platforms such as car manufacturing would fall under the definition of two-sided markets. Car manufacturers need to obtain both car owners of their specific brand and mechanics with knowledge to repair the specific brand to have competitive network. If they succeed, they in fact, also bring utility to both sides and thus, facilitate the trade between them. (Rysman 2009, 127). The wide definition might not be a problem.

Even if almost all industries have aspects of a two-sided market, the aspects are often not significant Rysman (2009, 127).

2.1 Network externalities

To define the phenomenon of two-sided market, it may be necessary to examine the situations where they emerge, to understand what utility they bring to the sides of the market. The network effects are often discussed in the literature about two-sided markets. In fact, the definitions are very similar and closely related to each other. In both cases the demand of a good depends on the accessibility of the complementary good which demand, in turn, depends of the amount of the original good. Two-sided market literature can be sometimes treated as a subset of network effect literature (Rysman 2009, 127).

Since the two definitions are so closely related, it is important to briefly study the literature of network effects. The network effect was introduced in literature by Katz and Shapiro in their article “Network Externalities, Competition and Compatibility” (1985). In their study, they found that the number of users having a compatibly equipment can influence the value of other compatibly equipment. They focused on goods that need a post purchase network to operate such as hardware/software. The users of a specific hardware would benefit from the number of software producers and vice versa. This idea leads into inverse demand curves where the number of software producers depend on the usage of the consumers and demand of the consumers to use the platform depend on the number of the software producers on that specific platform.

The hardware software thinking can be expanded to other industries as well. The network effect has a key role in the usage of yellow pages and they have similar characteristics as the software platforms or hardware (Rysman, 2004, 484). However, unlike using software where some hardware is always needed, in the case of yellow pages the platform seems be only a facilitator of the trade between sellers and buyers. Therefore, the fundamental utility to the consumers seems to lie only in the network benefits. On the other hand, it could make sense for a hardware producer to produce software if the sellers are not plenty enough to satisfy the demand.

The rise of internet has made these aggregators, where the value is defined by the amount of usage, very relevant in many industries. It is not a surprise that Yellow pages have been completely replaced by similar internet-based platforms for instance Fonecta Finder and of course, search engines such as Google or Yahoo.

2.2 Centralized matching market and search theory

In the case of hardware software industries, it is very easy to understand why two-sided platforms exist as for instance it is impossible to play a game without a console. However, in the cases of yellow pages, payment cards or online shopping platforms such as eBay, the reason for two-sided platforms to emerge, is different. There is no requirement for a buyer and a seller to trade on the platform provided by service and they could instead match each other in other way. Nevertheless, centralized matching markets have been around for a long time, for instance, in forms of stock exchanges and labor agencies. Therefore, a facilitated matching clearly brings enough utility for the agents so that they choose to participate in the platform and are even willing to pay a fee to get an access to it if necessary.

Often buyers face a significant search cost when looking to purchase a product. Sellers are thus, able to exploit this search cost by setting monopolistic prices in the market. Electronic marketplaces and intermediary platforms can lower the cost of search for the consumer, and in the process, lower the ability of the seller to implement monopolistic pricing strategies, as well. The intermediary platform can steer the market to became more competitive as more information is available and thus, increasing the welfare of the consumer and the total welfare. The intermediaries often try to facilitate the trade between parties to make their service more attractive which of course is positive for the welfare in general. (Bako 1998, 40 – 41).

One of the two-sided markets' main function can be considered internalizing and sharing the otherwise non-internalized network benefits. This means, that the failure of Coase theorem is a necessary condition for the existence of two-sided markets. However, it is not a sufficient condition (Rochet & Tirole 2006, 649). Coase argues in his paper "The Problem of Social Cost" (1960) that even in the presence of externalities, with tradable property rights, with perfect information and with close to zero transaction costs, the negotiating parties will always reach a Pareto efficient outcome. If this theory holds, clearly no matching platform is needed or that it could be organized by either the buyers or the sellers in a such way that they share the network benefits amongst them. In two-sided markets, the volume of the trade depends on both the price level and the structure whereas if Coase theorem holds, it depends only on the price level (Rochet & Tirole 2006, 649).

However, Coase theorem can fail and often does for reasons that are not related to presence of two-sided markets. Coase theorem can fail due to a presence of asymmetric information and it usually just results in lower amount of trade.

In practice, many of the two-sided markets aim to alleviate problems that prevent markets from reaching optimal conditions. Many online shopping sites like Amazon, eBay or any flight search engine fall in the category of an intermediary that lowers search cost and brings information for the consumer. Even the example of the yellow pages mentioned in the previous chapter could be included as this type of intermediary. These two-sided markets clearly differ from hardware platforms as their key function is to alleviate market frictions and their benefits solely rely on network effects. Another clear difference between matching platforms and hardware platforms is the exclusivity. When platforms are not exclusive either consumers or producers can engage in multi-homing which means that they participate in two or more platforms simultaneously. (Callaud & Julien 2003, 315). From the buyer side hardware tend to be more exclusive as they often have a cost of buying the platform, for instance a gaming console, whereas matchmaking platforms usually do not have ex ante cost.

2.3 Intermediary role

A two-sided market is a firm that acts as a facilitating platform for trade (Evans 2003). The role of the intermediary, as a third party setting up a platform for trade, is the prime distinction between the literature of network effects and the literature of two-sided markets. The emphasis is on strategies studied. The literature of two-sided markets focuses more on pricing strategies and how a platform can maximize its revenues, while the literature of network effects is discussing the optimal network sizes and how the consumers tend to adopt the new technologies. (Rysman 2009, 127).

Most definitions of the two-sided markets include intermediaries in them. The clearest examples of two-sided markets are media markets, payment card markets and online intermediaries (Filistrucchi, Geradin, Van Damme & Affeldt 2014, 297). However, there are reasons not to limit the intermediaries to online. For example, shopping malls or stock exchange could also be considered as two-sided markets based on many of their properties. For example, there are clearly network effects in a shopping mall and they are not internalized by the buyer and the sellers. A shopping mall would also follow the typical pricing structure of the two-sided markets that will be briefly presented in the next sub-chapter and analyzed later more throughout.

One key point in the intermediate role is that it helps in internalizing the network benefits created by the sides of the market. This is where the Coase theorem fails and leaves a room for the two-sided market to surge. In some cases, it can even be able to return the network benefit specifically to the agent that generates it. For instance, a very popular seller can negotiate a better contract with the platform than a less popular one.

1.Figure: Two-sided market

The two-sided markets have often sub-categories depending on the role of the intermediary and the nature of the market, as well. One common categorization is whether the markets are transactional or non-transactional. A transactional market would be for instance eBay while non-transactional market could be a media house or google where ads generate the revenue. (Filistrucchi, et al. 2014, 298). In some empirical examples, these two can often overlap as a platform can collect revenue from both transactions and advertising. Then the market can be considered multi-sided.

However, in this article the multi-sidedness is left without further analysis as often one of these revenue streams is more important for the platform than the other and it is easier to analyze a platform as a two-sided market than a multi-sided one.

Another potential division for two-sided markets is the usage of hardware in relation to the intermediary role. If there is some hardware or other necessary tool for the usage of the end product, the platform has some advantages compared to a pure intermediary platform. Consider Apple or Microsoft compared to a flight search engine or eBay. While Apple and Microsoft now also have intermediate roles as connecting software creators with their customers, they both initially had separate core businesses as making of the software usage possible. On the other hand, eBay or flight search engines directly started as two-sided platforms and their values lie strictly in the numbers using them.

Now, a platform providing hardware or other necessary tool for the usage of an end product has less worries of their customers leaving them for a competing provider as all their users have sunk costs in form of already bought software. Later in this study it is observed how affects the users' ability to multi-home. In addition, these platforms have other advantages. Apple for instance, always has an option to code and sell its own software but for example Trivago cannot really operate as an airline. This advantage is useful especially if there is a problem of getting one side to use the platform which is a common problem.

Often an intermediary role of a new two-sided market platform can be something that has existed before in some form as an intermediary but a new technology has made it possible to create a two-sided market platform as a new and a more efficient business model to compete with the older ones and often drive them out of business. The advantages of the new technologies are often related to lower marginal cost, more efficient matching and wider reachability of customers. Examples, where this change from small scale intermediary to a platform or a two-sided market, are found for instance in travel agent and travel booking industry or in dating industry. In general, those industries where intermediary services were performed by labor but can now be automated by an algorithm may provide these examples.

In this study, I will present theories that are suitable for both types of the two-sided markets. However, in my examples I mainly focus on platforms whose primary business is to facilitate the trade between buyers and sellers and try to identify their typical characteristics. I will thus, not provide clear examples of industries that focus on hardware as a platform even if the network externalities are strong in the industry. However, it seems to be a clearer example of a two-sided market when a platform is only setting up the market and facilitating the trade. In the case of two-sided markets with strong presence of hardware, the platform is often selling their own applications through the platform, as well. The threat of newcomers in the industry is also significantly lower and more attributed to the technology behind the platform than the brand recognition. Consider an eCommerce site versus a gaming console as example of this.

2.4 Buyer and seller demand curves and pricing structure

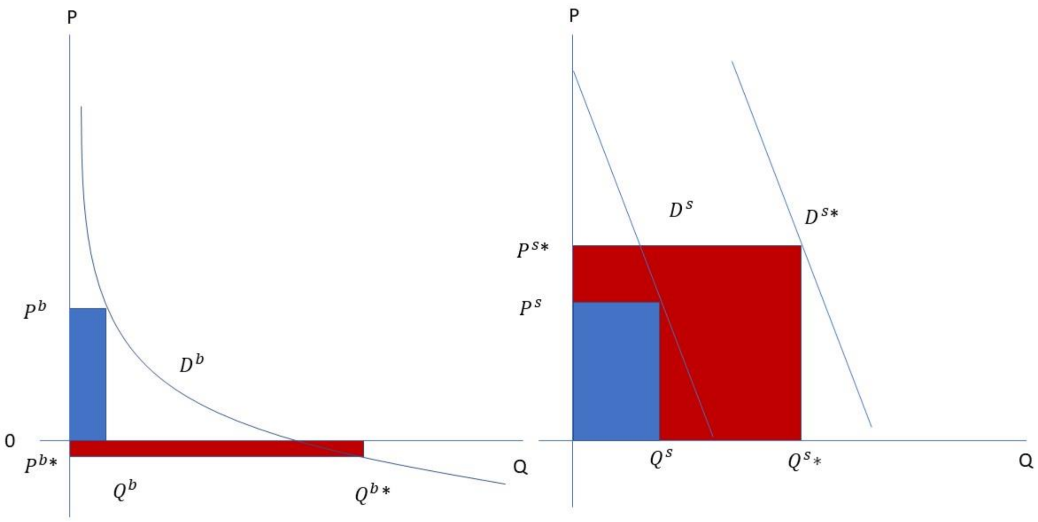
In some literature on two-sided markets, the fees that platform collects from the participating agents, have a link to the definition of two-sided market and therefore it is important to discuss this on the definition chapter of this article. Two sided markets have a peculiar pricing system compared to one-sided markets. The subject will be analyzed more in detail on later chapters but to reach a sufficient definition for the two-sided market, a general discussion of the pricing and demand curves is needed.

As discussed in the chapter on network effects, the demand curves of using the platform for the both sides of the platform depend on the number of users on the other side. This means that there are non-internalized externalities for end users. (Rochet & Tirole 2003, 991). The fact that the demand curves for both sides of the platform depend on each other encourages the platform to practice price discrimination. If the two sides have different price elasticity on the use of the platform, the owner of the platform can use this to charge only one side of the users. In a case of a shopping mall it would be extremely unusual to charge consumers for entering the mall.

The price discrimination is a key characteristic for a two-sided market. In fact, part of the definition of two-sided market is that the pricing of both sides should affect the volume of trade separately. (Rochet & Tirole 2003, 1018). It can be shown as following. Volume of the trade Q depends on the price $\mathrm{P} = P_a + P_b$. If the market is two-sided the Q depends on both P_a and P_b individually and changes if either P_a or P_b changes while P is constant. On the other hand, if Q only depends on the total price P the market is one-sided.

A clear example of a one-sided market is a bilateral electricity trading with injection and withdrawal charges. The consumption of the electricity only depends on the total price of the transmission including charges on both sides but not on the decomposition of the price. (Rochet & Tirole 2006, 648).

The cross-network combined with the independent demand functions can cause peculiar pricing structures. The following picture illustrates how a two-sided market platform increases its profitability by setting a negative price for the buyer side of the market.



2.Figure: Demand pricing dependence

$P^b, P^s old\ and\ P^{b*}, P^{s*} new\ prices\ for\ buyers\ and\ sellers$

$D^b, D^s, old\ and\ D^{s*} new\ demand\ curves\ for\ buyers\ and\ sellers$

$Q^b, Q^s, old\ and\ Q^{b*} Q^{s*} new\ quantities\ for\ buyers\ and\ sellers$

In the figure, at the starting point, platform imposes same positive prices P^b, P^s for both sides of the platform. However, now the platform decides to change its pricing structure by lowering its fees for buyer while increasing it to the sellers. It imposes a negative price for the buyers. This can be for example a gift for joining the platform. It can be seen how the negative price P^{b*} set by the platform towards the buyers, results in increase in quantityQ^{b*}. This increases the demand for the product on the other side of the market which, in turn shifts the whole demand function towards rightD^{s*}resulting in higher quantity Q^{s*} with higher priceP^{s*}.

Thus, the platform can increase its profits simply by changing the price structure. It does so by taking advantage of cross-network effects as sellers' demand dependent on the buyers' demand for the platforms service. The optimal price structure can sometimes include even negative price towards one side of the platform. These pricing strategies will be discussed more in later chapters of this article.

2.5 Proposed definition of two-sided market for this thesis

As discussed in this work there is hardly an accepted definition for the two-sided market. However, there are some key characteristics associated with the two-sidedness of a market that have arisen in this chapter. For this article and further consideration, I propose the following characteristics for the two-sided market:

1) *Failure of the Coase theorem:*
   a) *Uninternalized network benefits*. Agents on the platform are not able to internalize the network benefits of the platform. A necessary condition for a two-sided market to emerge.
   b) *The two sides of the market are not able to bargain the network benefits themselves.* This one is a weak condition as to some extent, it can be bent. Hence, the price discrimination within a side can be beneficial for the platform.
2) *There is a third party that sets up the platform for trade or somehow facilitates the trade between the sellers and buyers*. The important part is that it is a third party making the trade neutral for the two sides. If the platform would not be neutral it would fall more into either monopoly category or monopsony category in a one-sided market depending on which side has set up this platform.
3) *The volume of trade is dependent of the individual pricing for both sides of the platform*. This is a necessary condition as it is something that clearly separates the two-sided markets from one-sided markets. The difference is of course, that in one-sided market the volume of trade depends solely on the total cost of using the platform.
4) *Distinction in platforms:*
   a) *A transaction platform or a non-transaction platform.* The difference on business model separates platforms like Google from such as Trivago. This definition is argued to be a very relevant difference in antitrust policies.
   b) *Necessary platform and a facilitating platform*. Both can be two-sided market but, in some cases, such as hardware the platform is a requirement to use the end product. A necessary platform could often also very well fill the gap for the seller side themselves and are often partially doing it. If filling the gap for sellers is heavily used then some of the other conditions automatically become under question for instance neutrality condition (2) and the independent pricing condition (3).

These characteristics are based on previous studies except for the number 4 b which, while not a condition for two-sidedness of a market makes a clear distinction between the types of platforms. If the platform is not required to use the end product they always face competition or threat of upcoming competition even if they are the only platform proving the service. The necessary platforms might also have some stronger measurements of keeping users from changing the platform. For instance, if the user has a collection of software for an operating system they might be unwilling to change platform if they are forced to buy the same software again. If the platform is purely a trade facilitator, there is often little to lose when changing the platform.

3 COMPETITION BETWEEN TWO-SIDED MARKETS IN GENERAL

This chapter in general discusses competition between two-sided market platforms. The competition differs quite extensively from a traditional competition between firms and therefore, it is important to explore multiple theories on this subject. The two-sided market competition models vary depending on the conditions of the market, for instance, market power and the heterogeneity of the users. In addition, the models can be solely applicable for a certain industry as the characteristics between industries differ to an extent (Rochet & Tirole, 2003, 994). For instance, a game console platform has very little similarities with a shopping mall, while both can still be considered two-sided markets. One characteristic that is often prevailing in all the models is imperfect competition between the platforms. This is largely due to increasing benefits in economics of scale and inverse network benefits on the both sides of the platform.

This chapter will go through some key models in different kind of industries. It starts with simple monopoly model as it is the simplest while surprisingly common in many industries. After that I present two relevant models. One has characteristic where the value of the platform is created by the service it is proving and second where the value comes solely from matching the agents. First could be relevant for instance in gaming console industry while second could be a flight booking service in the internet. I then take a look at some models where there are more than one players involved and take a bit deeper look towards the pricing systems.

3.1 Monopoly situation in a two-sided market

As mentioned in the introduction the monopoly can be a very relevant situation when the market is dominated by two-sided platforms. For example, the 5 largest companies in the world by market value in 2017 are one way or other platform economies. The list is consisting tech giants that offer advertising platforms like Google and Facebook as well as companies like Apple and Microsoft that have previously focused on hardware and software but have created their own platforms on top of them (Taplin, “Is It Time to Break Up Google?”, The New York Times, 22.4.2017) Out of these, at least the main service of Google, the search engine, could be considered almost a monopoly as it faces very little competition. If someone is an Apple user they face a monopoly when purchasing apps and same applies to Microsoft users to some extent.

The competition law agencies have taken a strong interest towards platforms as they grow the importance in the economy. However, the power of the two-sided market platforms was noticed by the competition lawyers a lot before tech giants became the most valuable companies in the market. Eric Emch and Scott Thompson wrote an article "Market Definition and Market Power in Payment Card Networks" (2006) about power of the two-sided market platforms.

They wrote an article after serving US department of justice in a case of "United States v. Visa USA, Inc., Mastercard International, Inc., and Visa International, Inc., and United States v. First Data Corporation and Concord EFS, Inc." The article analyzes the theory of prices set by the monopolist and tries to find a test to the monopolist's market power. The model in this chapter, follows the model from the article by Emch and Thompson (2006). As stated in the introduction to this chapter, creating a universal model for that could capture all the possible industries would be impossible, thus this article will present somewhat specific as an example for this study. However, the model behind the example, is originally derived from Rochet & Tirole's (2003) article and it is widely applicable for other industries.

Assume a situation where a monopolistic two-sided market platform is a payment card network that has two sides. One of sides are the merchants accepting the card and other one the issuers, the issuing banks that eventually represent the consumers in the markets they pass every fee down to the consumer. The card, which is equivalent to the platform, is set up by the card brand. Demand for the two-sided market platform's services will then depend on three different prices set by the payment card platform. There are two switch fees, one for the both sides of the platform and an interchange fee paid generally from the merchant to the card issuer. The prices in this chapter are denoted as p_m for the merchant switch fee, p_i for the issuer switch fee and X as the interchange fee. In the early days of the payment card industry, the interchange fee was paid from the issuers to the merchants but now the situation is reversed. (Emch & Thompson 2006, 48). Since the interchange fee is now reversed, all the prices can be assumed positive although negative interchange fee would not disrupt the model.

Now, the total prices for the merchants P_m and the issuers P_i are respectively the following:

1. $P_m = p_m + X$
2. $P_i = p_i + X$

Therefore, it can also be observed that the total fees collected by the platform per transaction are $p_m + p_i$ and as the switch fee X is not collected by the platform but by the issuer, it is equivalent to $P_m + P_i$. Now, assume that the there is a marginal cost c for each transaction arranged by the platform. Thus, the total profit R for the platform per transaction is:

3. $R = P_m + P_i - c$

From the equations (1) and (2), it can be noticed that P_i can possibly be negative and that it will be the merchants who would end up paying the negative price as a form of the interchange fee X. A subsidize in a form of a negative price is something very characteristic of a two-sided market as it was noted in the first chapter.

The network faces a demand for the service that is dependent on the total prices (P_m, P_i) separately. The demand can be taken from the equations 1 and 2:

4. $Q = (P_m, P_i)$, or
5. $Q = Q(p_m + X, p_i - X)$

Other key characteristic of the two-sided market is the demand that depends on both prices separately. They might face competitive products on either side of the market, in this case for example cash. It is assumed that the demand curve is a downward slope respect to each price. If the P_i is negative the demand increases as P_i. This can in fact be very relevant in the payment card industry as with a negative price towards the card issuer, the platform can make sure that the issuer promotes the cards to all their customers meaning the consumers who will ultimately use the card. This can lead to a situation where the platform is acting more like a monopsony rather than a monopoly. Emch & Thompson 2006, 48).

The payment card network must think how do merchants response when setting the pricing, P_m. The merchants can simply not accept the card and decline the transaction. Although, it should be noted that the merchants could in theory always accept the card provided that it remains profitable to sell their product. This can be sometimes seen as some merchants, (not in Finland though), do not accept a card transaction for small purchases. Another way the merchants might react to the changes in P_m is to steer away customers towards cash or other payment methods, for instance with a cash discount.

(Emch & Thompson 2006, 49). It is important to note, however, that often the merchants are not allowed to choose different prices when a customer decides to pay with a payment card and thus, users' surplus of using the payment card is independent of the prices chosen by the platform and merchants (Rochet & Tirole 2003, 995). A recent lawsuit ended up giving the merchants a possibility to choose different prices for different form of payments but with a set of restrictions. (Mandelbaumaug, "Visa and MasterCard Settle Lawsuit, but Merchants Aren't Celebrating" The New York Times, 8.8.2012).

For the monopolist, the most important aspects in this model is, the impact that a change in the price structure has on the total number of transactions. This is since the demand ultimately is dependent only on the two net prices P_m and P_i that are linear combinations for,p_m, p_i and X. Therefore, the monopolist is solving a maximizing problem of:

6. $\max_{P_m, P_i}(P_m + P_i - c)\mathrm{Q}(P_m, P_i)$

Or in the form of:

7. $\max_{p_m, \mathrm{X}}(p_m + p_i - c)Q(p_m + X, p_i - X)$

If it can be assumed that there is an internal solution to this problem, the first order conditions can be and they are the following:

8. $\frac{dQ}{dP_m} - \frac{dQ}{dP_i} = 0$
9. $Q(p_m + p_i - c)\frac{dQ}{dP_m} = 0$

From the equation seven it can be seen how the monopolist will choose a price level that maximizes the demand for the service at any given level of prices. The monopolist thus, chooses the interchange to a level that is efficient given the total price: $P_m + P_i$. (Emch & Thompson 2006, 50). This is interesting due to the nature of monopolies in economics as they are normally considered relatively inefficient and are expected to choose a quantity significantly lower than a competitive market.

Now, the equation (9) can be re-written as following:

10. $\frac{P_m}{P_i} = \frac{\varepsilon_m}{\varepsilon_i}$, where $\frac{\varepsilon_m}{\varepsilon_i}$ is the relation between the elasticities of demand of merchant and issuer respectively.

So, in a sense, the platform's job is to balance the relation of the elasticities with the relation of the prices to maximize the number of transactions. Here, it is important to notice that the elasticity for the card issuer can have positive values. This happens if P_i is nega-tive which happens if the interchange fee is greater than the price towards the issuer $X > p_i$. An option for a platform to use negative price towards on side of the platform is a key characteristic of a two-sided market and a payment card network can very well impose this concept.

The second first order condition, equation number (9), can be reformatted into a following equation:

11. $(p_m + p_i - c) = -\frac{1}{\varepsilon_m}$

This equation greatly resembles the Lehner's condition for a monopolist in a normal one-sided market. This is illustrated more clearly as:

12. $p_m + p_i - c = p_m + c_m,$

where c_m would the marginal cost of platform per transaction or:

13. $c_m = c + X$, in algebraic notation.

The monopolist will choose the total price towards the merchants as the market was one-sided towards the merchant regardless of the value of the switch fee X. The conclusion from the equations above is that the monopolist's possibility to use its power is dependent on the merchants' inverse elasticity with respect to the merchant price or in algebraic notation simply $\frac{1}{\varepsilon_m}$ (Emch & Thompson 2006, 51). However, in the two-sided market model in payment card industry, it is generally the case that the price structure is dependent on the elasticities of demand, equation (10), as also mentioned earlier in the chapter. (Rochet & Tirole 2003, 997)

To conclude this monopoly example of a two-sided market in payment card industry, it can be noted that the total price level of a platform is given by the standard Lehners formula and dependent on the inverse elasticities. Moreover, often the total price is solely dependent on the inverse elasticity of the merchant side instead of both the merchant's and the issuers' elasticities. However, the structure or how the total price is divided between the two sides of the market is dependent on the ratio of the elasticities.

In the lawsuit against Visa and the Master card, in 2012, the card providers ended up agreeing to pay 7.3 billion USD to 7 million merchants who sued them. Moreover, the merchants are now allowed to charge additional fees for card purchases. However, there are some restrictions in this freedom. The merchants cannot discriminate against some cards but are forced to charge all the forms of electronic payment equally. Therefore, it is unclear if the merchants are in fact able to fully use this option of steering the customers towards cash payments. (Mandelbaum, "Visa and MasterCard Settle Lawsuit, but Merchants Aren't Celebrating" The New York Times, 8.8.2012). Interestingly, it seems very clear that the merchants are not happy with the wide spread usage of the cards while they still have to participate in the platform in order to stay in business. The subject of who loses in the platform economy will be also discussed later in this article.

3.2 Matching platform models and within-group negative externalities

In a case of a platform that provides matchmaking services the utility for the users forms differently to the card industry and thus, I start the model with different premises. In the card industry, the utility comes from the usage of the card for both sides of the platform meaning and often the customer has already made decision to use a specific seller and just prefers to use the card as a method of transaction. This means that the usage of the card was the source of utility for the buyer. On the other hand, in the matchmaking service the main utility of the platform comes from increased chance of finding a trading partner. Platforms can also create utility by providing an assurance that the trade happens and neither party is being cheated. However, while it can be important service by a platform it is discussed in very different literature involving concepts like moral hazard and thus, is less discussed in this article.

In many cases, the value of the platform, solely depends from the number of the options on the other side of the two-sided markets (Filistrucchi, et al. 2014, 298 – 299). There are multiple platforms that have this model as a base for their service. For instance, hotel and flight booking aggregators in the internet such as Trivago or Booking.com. A shopping mall could be also considered this type of a two-sided market since the main value the mall brings is an increased demand and supply in a concentrated area. As already mentioned the cross-network effect is crucial in the matchmaking platform and the value of the platform is solely dependent on the number of users on the other side of the platform. The network effect was of course true in the case of the credit card as well but in the matchmaking case there is also the possibility for a negative network effect which arises if there are too many agents of similar type on one side of the platform. One clear example of this would be a hetero dating club where both sexes would be happy to see lower number of people of their own sex present. (Chen & Huang 2012, 627). These externalities are in this article called negative within-group externalities. While taking the negative network effect into account and having the cross-network effect as the main value of the platform to its users, this subchapter presents a different model to describe these type of two-sided market platforms.

The model in this subchapter is again based on the groundwork theory by Rochet & Tirole and it borrows greatly from Armstrong (2006) as well. However, it follows more closely a model from Chen & Huang's (2012) article. The article presents a model with negative within-group externalities and is thus, chosen as an addition to existing models in this chapter.

The model starts from an assumption that there are two sets of homogeneous agents, buyers and sellers. The buyers are denoted as b and sellers as s. They represent the two sides of the platform and are interested in trading with each other. It is assumed that the chance of finding a trading partner without using this hypothetical monopoly platform close to zero.

The platform has an efficient matching mechanism. Thus, number of buyers N_b and sellers N_s choose to enter to a platform to trade. If they enter they pay fees of F_b and F_s to the platform regardless if they find a trading partner. It is also assumed that while the agents are homogeneous in regard of valuing the good they are heterogeneous regard the cost of entering to the platform. The homogeneity towards the good is captured by the value parameter V_b that is equal for all the consumers. Similarly, for the seller the value of the good is captured in V_s. The heterogeneity of the cost is denoted with parameters X_b, X_s that intervals uniformly between 0 and 1. This way, the model is following the article by Armstrong (2006). In addition, this model adds a sensitivity for buyer towards the cost of entering to the platform this is denoted with T_b, and with T_s for sellers. Thus, the total "cost" that the buyers and sellers are considering are respectively $T_b * X_b$ and $T_s * X_s$ while making the decision of entering to the platform, where X_b is the actual cost. Thus, the expected utility (U_b, U_s) is captured in following the utility functions for the users on the sides of the market:

1. $U_b = V_b - p - F_b - X_b * T_b$, if a buyer enters tor the platform and finds a match where p is the price agreed with the seller.
2. $U_b = -F_b - X_b * T_b$, if a buyer enters to the platform and does not find a match
3. $U_b = 0$, if a buyer does not enter to the platform

And, for sellers:

4. $U_s = \mathrm{p} - V_s - F_s - X_s * T_s$
5. $U_s = -F_s - X_s * T_s$
6. $U_s = 0$

Platform has a cost for serving its clients the buyers and the sellers and costs are denoted as $C_b$and C_s respectively. Both C_b and C_s can be assumed to be non-negative. The platforms profit maximization function is the following:

7. $\max_{F_b,F_s} \pi = (F_b - C_b)N_b + (F_s - C_s)N_s,$

Here it is assumed that the matching will involve costs (C_b and C_s) for the platform regardless whether there is a match or not.

The time in the model is divided in stages. In the first stage the platform decides the cost of entering to the platform with setting the entrance fees F_b and F_s. The buyers and sellers then simultaneously decide if they want to pay the fee and enter to the platform. The F_b and F_s thus, determinate the N_b and N_s. In the second stage the buyers and sellers now use the services of the platform trying to find a match. First the sellers post their prices simultaneously when entering the platform.

The equilibrium for each stage will be found with a backward induction. Frictional matching stage presented by Burdett, Shi & Wright (2001) serves as the premise of solving the demands N_b and N_s.

With N_b buyers and N_s sellers engaging in trade via a platform, in a symmetric equilibrium every byer has a probability of $\frac{1}{N_s}$ of visiting a specific seller. This causes that all the sellers announce same price p for their goods:

8. $p = \frac{V_b\left(1-\left(1+\frac{N_b}{N_S-1}\right)\left(1-\frac{1}{N_S}\right)^{N_b}\right)+Vs(\frac{N_b}{N_S})\left(1-\frac{1}{N_S}\right)^{N_b}}{1-\left(1+\frac{N_b}{N_S(N_S-1)}\right)(1-\frac{1}{N_S})^{N_b}}$, where $V_b - p$ is the buyer's surplus and $p - V_s$ seller's surplus. (Burdett et al. 2001, 1068).

Next equation (9) represents the expectation on the number of matches:

9. $M(N_b, N_s) = N_s(1 - (1 - \frac{1}{N_s})^{N_b}$

The price p can be rewritten as:

10. $p = zV_b + (1 - z)V_s$,

where z is:

11. $z = \frac{\left(1-\left(1+\frac{N_b}{N_s-1}\right)\left(1-\frac{1}{N_s}\right)^{N_b}\right)}{1-\left(1+\frac{N_b}{N_s(N_s-1)}\right)(1-\frac{1}{N_s})^{N_b}} \in (0\,,1)$

Each match will provide a total surplus based on the different valuations of the good:

12. $V = V_b - V_s$

And, the values for the buyer and seller are:

13. $V_b - p = (1 - z)V$
14. $p - V_s = zV$

Here it can be seen that the term z determinates the value for the seller from a successful match. The z is a function of N_b and N_s, and as it falls between $(0\,,1)$ it can be deducted that the share of the surplus depends on the relative numbers of both the buyers and sellers on the platform. (Chen & Huang 2012, 632). In some two-sided market cases this is very logical as it can greatly affect the bargaining positions of the sides of the market. The surplus share is determinate in changes of the price p of the goods. It can be shown from equation 4 that if V_s is held constant, the rise in the number of the sellers N_s compared to buyers N_s would lower the price p. The opposite would apply in case the number of buyers would rise compared to the number of sellers. This can be demonstrated by taking the derivatives of the function. The negative externalities to agent's own side makes sense in some examples. For instance, in a public auction it is logical that a high number of sellers (items) would lower the prices if there were only a few interested buyers.

Now, this model takes a closer look at some properties that the number of agents have towards the price of the goods and the number of successful matches. There is an expected number of matches $M(*)$ which is dependent on the N_s and N_b. It is obvious that if the matching mechanism is efficient the number of agents on the opposite side of the platform will increase the chances of finding a suitable match while the number of agents on the same side of platform decreases the $M(*)$. The expected number of matches for the buyers and sellers can be taken from the matching function equation (9), by taking the first order conditions:

15. $M_b = \frac{dM}{dN_b} = (1 - \frac{1}{N_s})^{N_b} \ln(1 - \frac{1}{N_s})^{-N_b}$
16. $M_s = \frac{dM}{dN_s} = 1 - (1 + \frac{N_b}{N_s - 1})(1 - \frac{1}{N_s})^{N_b}$

It can be noted that both first order conditions are positive as long as N_b and N_s are greater than zero. All the second order conditions (M_{bb}, M_{ss} and M_{bs}) are positive as well. The changes in $M(*)$ for the sides of the platform are noted on this study with notation K_i, also called arrival rate. It is a function of the expected matches $M(*)$ with respect to the number of the agents N_b and N_s such as:

17. $K_i(N_b, N_s) \equiv \frac{M(*)}{N_i}$, where $i = b, s$

Now by combining the previous equations (1),(2),(4) and (13), the expected V_b and V_s of the buyers and sellers in $V_b(*)$ and $V_s(*)$can be captured respectively:

18. $V_b(*) = (V_b - p(N_b, N_s)K_b(N_b, N_s)$
19. $V_s(*) = (p(N_b, N_s) - Vs)K_s(N_b, N_s)$

The expected values determinate the agents' willingness to participate in the platform.
Then, the expected values can be added to the utility functions of the buyers and sellers to capture this information:

20. $U_b = V_b(*) - F_b - N_b X_b$
21. $U_b = V_s(*) - F_s - N_s X_s$

These two utility functions now take in account both the positive cross-network effects and the negative within-group network effects. With the positive and negative externalities, the platforms' task to set the fees is more complicated than when the negative externalities are absent.

Now, that the demand functions for the agents are defined, the platforms pricing problem can be more closely analyzed. The agents will join the platform if the utility:

22. $V_i(*), i = (b, s)$

is greater than the cost:

23. $F + T_b X_b$.

If the agents were homogenous regards joining the platform, the crucial utility would simply be $V_i(*) = F$. However, that would not be "realistic", at least in this model, as then there would exist a fee F such that suddenly every agent would simultaneously join the platform while with too large F none would do that. As it is assumed that the X is distributed between 0 and 1, there must exist an $X_b(*)$ so that:

24. $V_b - p - F_b = T_b X_b(*)$

so that the utility is zero, and an equivalent X_s for the sellers' side:

25. $p - V_s - F_s = T_s X_s(*)$

Then those agents, whose X_i is lower than $X_i(*)$ the cost would join the platform while those with higher would not. This means that the number of agents on the sides N_b and N_s are dependent on the prices respectively:

26. $N_b = \Pr(X_b(*) \leq X_b)\, N = X_b N = \frac{V_b(*) - F_b}{T_b} N$
27. $N_s = \Pr(X_s(*) \leq X_s)\, N = X_s N = \frac{V_b(*) - F_b}{T_b} N$

Now, the functions 18 and 19 can be modified to be with the subject of the entry fees F_b and F_s such that the profit maximization function can be rewritten as:

28. $\max_{F_b, F_s} \pi = (F_b - C_b) N_b(F_b, F_s) + (F_s - C_s) N_s(F_b, F_s),$

Then the platform maximizes its entry fees with:

29. $F_b = C_b + \frac{Tb}{N} N_b - (V_{bs}(*) N_s + V_{bb}(*) N_b)$
30. $F_s = C_s + \frac{Ts}{N} N_s - (V_{sb}(*) N_b + V_{ss}(*) N_s)$

Where $V_{bi}(*) = \frac{dV_b(*)}{dNi}$ and $V_{si}(*) = \frac{dV_b(*)}{dNi}$ $, i \in (b, s)$. They represent the derivatives of the utilities of the buyers and seller with respect to the number of participants in the platform. In the equilibrium, the number of participants and matches will be:

31. $VM_b = C_b + 2\frac{T_b}{N} N_b(*)$
32. $VM_s = C_s + 2\frac{T_s}{N} N_s(*)$

$Where\ N_i(*) = N_s(F_b(*), F_s(*), i = (b, s)\ M_b = \frac{dMb}{dNb} > 0, M_s = \frac{dM}{dNs} > 0$

In comparison, Armstrong (2006) has the equilibrium fees of

33. $F_b = C_b + \frac{T_b}{N} N_b - a_s Ns\ , a_s > 0$
34. $F_s = C_s + \frac{T_b}{N} N_s - a_b Nb\ , a_b > 0$

where a_s and a_b are parameters for cross-group externalities. However, the model by Chen and Huang (2012) that is followed here, captures not only the cross-group positive externalities but the negative within-group externalities, as well.

With negative externalities taken into the account, the entry fees on one side are higher than with only positive externalities accounted. Adding the negative within-group externalities can make sense. The higher entry fees would scare away the competition from agent's own side of the platform. It is also consisted with the fact that if there are any subsidies from the platform towards either side of the platform, it is almost always the buyers that are subsidized with zero to negative entry fees. It is logical in many scenarios as a buyer would not often care if there are other buyers in the platform as the changes in demand does not significantly change price and thus, the buyers have low to none negative within-group externalities. For instance, not many people are avoiding a mall even if there are a lot of people shopping. However, a specialized shop might choose not to open there if they know that there is a lot of competition already. This means that the subsidies towards one side of the market could be also explained with the negative within-group externalities, or more precisely, with the lack of them.

However, the model may not often be applicable. The assumption of a complete homogeneity towards the goods within the sides of the market narrows out a lot of empirical examples. At least when the buyers are consumers it would rarely be a relevant case. However, with a pure B2B platform this might be possible. An example would be for instance esteel.com where agents can trade raw materials via a platform. The standard explanation where the side with higher elasticity towards the entry fee is subsided is still valid and would also apply in the same cases. It remains as a more relevant explanation although and can always coexist with the negative within-group externalities.

3.3 Two competing two-sided market platforms

In the previous chapters, I analyzed two cases of monopoly platforms. First a model that would be suitable for instance to credit card industry, while the second one would be relevant for a matchmaking service. I will now look at a situation where there are two competing two-sided platforms. This is a more relevant case in the real world. There is often at least some competition even if one platform is very dominant and very close to a monopoly. For example, Google, with all its dominance as an online search tool, it still has some smaller competitors. Also, the platforms can often create local monopolies but still face competition. For example, a shopping mall could often have a local monopoly while at the same time compete with other distant malls for the customers that live between them.

In most cases there is at least some competition between different platforms. In an early phase of adapting a new technology or an innovation which facilitates a platform to operate, there can be a fierce competition between the upcoming platforms. One example would be the online booking agents. During the last decade there have emerged tens of platforms and vast amounts of resources have been put into the advertising by the biggest platforms. Strategies of the competition are discussed more in detail later in this article but first it is reasonable to analyze a model of the competition. This subchapter will have a look on a model of platform competition. All the models in this chapter are derived from the theory in the article by Rochet & Tirole (2003). The first two models were based on articles that used Rochet & Tirole as a base with either new ideas or point of views added to the previous work. The main source for the model in this subchapter however, is the actual Rochet & Tirole's (2003) article.

The model in this subchapter would likely be most suitable for a case where there are some chances for multi-homing which means registering in more than one platform. However, there are expectations of some sort of cost or other disincentive for multi-homing. Goods or services sold through the platform would likely be somewhat heterogeneous even if it is not a strict requirement. Perhaps a most suitable example would be a proprietary platform like an operating system for a computer and the software sold through it. However, the implications of this benchmark model are wider as it is shown with the examples in the chapter five.

The first subchapter was ended on the notion that the price structure in a monopoly case is dependent on the elasticities of the sides of the platform:

$$1. \quad \frac{P_m}{P_i} = \frac{\varepsilon_m}{\varepsilon_i}$$

By the end of this subchapter it will be shown that the structure will stay almost the same even if competition is introduced. However, depending on the type of competition some additions come to the price structure. The premise for this competition is a proprietary platform competition. A competition between proprietary platforms can often be observed in the modern economy. For example, the competition between operating systems on computers can be considered one. There are a few operating platforms which compete with one another and give software developers a possibility to create and sell software to the buyers on the other side of the platform. Another example of such a situation would be the competition between gaming consoles. It is worth noting that in both scenarios the likelihood for the buyer side to participate in multiple platforms or to multi-home is relatively low. Understandably there is a little reason to have two operating systems or two gaming consoles and thus, it would be much more likely that the sellers engage in multi-homing instead by creating different versions of their software suitable for other platforms.

In the proprietary platform competition, Rochet & Tirole 2003 reached the following price structure:

2. $\frac{P_b}{P_s} = \frac{\mu_\theta^b}{\mu^s/\sigma}$, where P_b and P_s are again the platform's fees for the buyer and sellers similarly to the monopoly example.

The other side of the equation is different as there is competition between multiple platforms. The reason for this lies again mainly in the network effects and in the possibility for multi-homing both by the buyers and the sellers. Multi-homing means that an agent registers with more than one platform.

The symbol σ is an independent variable between (0,1) that indicates the likelihood of a user to be loyal to one platform. The users that are registered with only one platform are single-homing. Thus, from now on, the term σ is called single-homing index and it derives from a demand function:

3. $\sigma_i = \frac{d_1^b + d_2^b - D_i^b}{d_1^b}$, where $i = 1,2$

Where the terms satisfy:

4. $d_i^b \leq D_i^b \leq (d_1^b + d_2^b)$, where D_i^b represents the part of the buyers who trade on the platform i when their “preferred” seller trades there and d_i^b represents the group of buyers who trade on the platform when their seller multihomes.

If σ is 1 then all the consumers are using only one platform and would not start using the other one even if their platform would cease to exist. Of course, some platforms might have higher loyalty while some others would lose customers quickly. Thus, there could be multiple different single-homing indexes in the real-world.

In the sellers' case, the model to measure multi-homing is more precise. Their index is dependent on the amount of demand in the platforms and on the buyers' single-home index σ. If the σ is low it means that a high percentage of the buyers multi-home and thus the sellers don not need to multi-home to get trading partners. This means that the sellers have no independent variable for the single-homing but they are neutral to it and base their decisions on the buyers' decisions on multi-homing.

In a case where the prices in both platforms are symmetric and have demand from the buyer's side, the sellers will participate in both platforms or neither of them. Also, if the prices between the two platforms were equal, for instance in case of a joint ownership platforms the situation would correspond the previously presented monopoly situation. (Rochet & Tirole 2003, 1000).

If the platforms differ in pricing it results in three different types of sellers:

5. $U_s \geq \mathbb{P}_{12}$
6. $\mathbb{P}_{12} > U_s \geq P_1$
7. $U_s < P_1$ where U_s is the sellers' utility from a platform they choose to trade in, P_1 is the price for the cheaper one. $\mathbb{P}_{12}$ is the point where the tradeoff between trading only in one platform and with both is zero.

The sellers who satisfy the equation (5), will trade on both platforms. The sellers whose utility correspondence the equation (6) will trade only on the cheaper platform. The sellers from the equation (7) will not trade at all.

The $\mathbb{P}_{12}$ is a key point in this model. It is the point where the sellers with greater utility will multi-home and those with lower will trade in only one platform or neither of the platforms depending if their utility is also below the cheaper platform. It comes from the following equation:

8. $\mathbb{P}_{12} = \frac{P_2^s * d_2^b - P_1^s(D_1^b - d_1^b)}{d_2^b - (D_1^b - d_1^b)}$, where P_1^s and P_2^s are the platforms prices towards the sellers

Remembering the equation (4), $d_i^b \leq D_i^b \leq (d_1^b + d_2^b)$, the terms represent buyers' likelihood being loyal towards a platform or a specific seller. Thus, the term $\mathbb{P}$ is reflecting on the buyers' willingness to use different platforms when the seller they like is using another one. Now, taking take the first order conditions from the function 4 results in the following:

9. $\frac{d\mathbb{P}_{12}}{dP_2^s} = \frac{d_2^b}{d_1^b + d_2^b - D_1^b} > 0$
10. $\frac{d\mathbb{P}_{12}}{dP_1^s} = \frac{d_1^b - D_1^b}{d_1^b + d_2^b - D_1^b} < 0$

From the first order conditions with respect the sellers' fees collected by the platforms, it can already be determined that when the more expensive platform rises it prices, the parameter $\mathbb{P}_{12}$ rises causing more sellers to choose to trade only on platform number one. On the other hand, when the lower priced platform one rises its fees, more sellers start participating in both platforms instead of just stopping the trading all together.

The derivative with respect to D_1^b gives the following:

11. $\frac{d\mathbb{P}_{12}}{dD_1^b} = -\frac{P_1^s}{d_1^b + d_2^b - D_1^b} + \frac{d_2^b * P_2^s - P_1^s(-d_1^b + D_1^b)}{(d_1^b + d_2^b - D_1^b)^\wedge 2} = \frac{d_2^b(-P_1^s + P_2^s)}{(d_1^b + d_2^b - D_1^b)^\wedge 2} > 0$

Now it can be seen that the first order condition is clearly positive which is logical if the buyers are willing to trade on the seller's preferable platform the sellers have less need to multi-home and thus, the parameter $\mathbb{P}_{12}$ rises. Now the rest of the first order conditions have interesting properties as well:

12. $\frac{d\mathbb{P}_{12}}{dd_1^b} = \frac{d_2^b(P_1^s - P_2^s)}{(d_1^b + d_2^b - D_1^b)^\wedge 2} < 0$, unless $D_1^b = (d_1^b + d_2^b)$
13. $\frac{d\mathbb{P}_{12}}{dd_2^b} = -\frac{(P_1^s - P_2^s)(d_1^b - D_1^b)}{(d_1^b + d_2^b - D_1^b)^\wedge 2} < 0$, unless $D_1^b = d_1^b$

Now, it is possible to see from the first order conditions that they are both generally negative, meaning that if the buyers trade with sellers who multi-home the value of $\mathbb{P}_{12}$ goes down as it is beneficial to multihome. Logically, if multi-homing gets the sellers more matches they are likely to practice it. Interestingly the equation 12 shows how no seller would multi-home if the buyers are as willing to trade in the sellers' preferable platforms as they are with the ones who multi-home. The second equation number 13 shows that if those buyers who prefer the cheaper platform are as willing to use the sellers' preferable platform, the $\mathbb{P}_{12}$would go to zero and all the sellers that trade would multi-home.

Now, to find a pricing equilibrium, it is necessary to first define the platform's profit structure. The assumption here is that both platforms have a universal cost for serving clients and they can post fees for the buyers and sellers who enter the platform. Therefore, platforms' 1 and 2 have the following profit functions:

14. $\pi_1 = \left(P_1^b + P_1^s - c\right)Q_1$
15. $\pi_2 = \left(P_2^b + P_2^s - c\right)Q_2$

The total price charged by a platform is $P_i^b + P_i^s = P_i$ and the first order conditions of the demand with respect the prices for the platform 1 are:

16. $\frac{dQ_1}{dP_1^b} = \frac{dQ_1}{dP_1^s} = -\frac{Q_1}{P_1^b + P_1^s - c}$

To construct the pricing the platforms, the demand functions for the both platforms must be analyzed. In the proprietary platform case, the demand functions for the platform 1 and 2 are respectively the following:

17. $Q_1 = d_1^b\left(P_1^b, P_2^b\right)D^s(\mathbb{P}_{12}) + D_1^b\left(P_1^b\right)\left(D^s(P_1^s) - D_s(\mathbb{P}_{12})\right)$
18. $Q_2 = d_2^b\left(P_1^b, P_2^b\right)D^s(\mathbb{P}_{12})$

When looking the scenario where $P_1 < P_2$, the functions for the platforms 1 and 2 yield the following equations:

19. $Q_1 = d^b(P^b)D^s(\mathbb{P}_{12}) + \mathbb{D}_1^b\left(P_1^b\right)\left(D^s(P_1^s) - D^s(\mathbb{P}_{12})\right)$
20. $Q_2 = d^b(P^b)D^s(\mathbb{P}_{12})$

Here the term $\mathbb{D}^b$ is an equilibrium point for D_i^b. In symmetric pricing situation $D_1^b = D_2^b = \mathbb{D}^b$ and also, $\sigma_1 = \sigma_2 = \sigma = 2 - \frac{\mathbb{D}^b}{d^b}$.
If the prices were to be symmetric: $P_i^s = P^s$, $P_i^b \equiv P^s$, the demand would simply be:

21. $Q_i = d_i^b(P^b, P^b)D^s(P^s)$

And its first order condition with respect to P_i^b would then be:

22. $\frac{dQ_1}{dP_1^b} = \frac{dd_1^b}{dP_1^b}(P^b, P^b)D^s(P^s)$

The situation of a symmetric prices equilibrium, where $P_1^s = P_2^s = P^s = \mathbb{P}_{12} = \mathbb{P}_{21}$, is also differentiable. The first order conditions of Q_1 with respect to P_1^s are:

$$23. \frac{dQ_1}{dP_1^s} = (D^s)' \frac{d\mathbb{P}_{12}}{dP_1^s}(d^b - \mathbb{D}^b) + (D^s)'(\mathbb{D}^b)$$
$$24. \frac{dQ_1}{dP_1^s} = (D^s)' \frac{d\mathbb{P}_{21}}{dP_1^s} * d^b$$

While $\mathbb{P}_{12}$ and $\mathbb{P}_{21}$ with respect to P_1^s are:

$$25. \frac{d\mathbb{P}_{12}}{dP_1^s} = \frac{d\mathbb{D}^b - d^b}{2d^b - \mathbb{D}^b}$$
$$26. \frac{d\mathbb{P}_{21}}{dP_1^s} = \frac{d^b}{2d^b - \mathbb{D}^b}$$

Combining functions 25 and 26 with 23 and 24 results in:

$$27. \frac{d\mathrm{Q}_1}{dP_1^s} = (D^s)' \left(\frac{\left(d\mathbb{D}^b - d^b\right)^2}{2d^b - \mathbb{D}^b} + \mathbb{D}^b\right) = (D^s)' \frac{(d^b)\hat{}2}{2d^b - \mathbb{D}^b}$$

Now, by using the functions 16, 22 and 27, the first order condition is resolved for a symmetric equilibrium as:

$$28. \frac{dd_i^b}{dP_i^b} D^s = (D^s)' \frac{(d^b)\hat{}2}{2d^b - \mathbb{D}^b}$$

Which, in turn, can be rearranged to:

$$29. \left(\frac{2d^b - \mathbb{D}^b}{d^b}\right)\left(-\frac{\frac{dd_i^b}{\mathrm{d}P_i^b}}{d^b}\right) = -\frac{(D^s)\prime}{D^s}$$

As it is a symmetric equilibrium, the first term from left of the function (29) $\left(\frac{2d^b - \mathbb{D}^b}{d^b}\right)$ is the same as the single-homing index $\sigma_i = \frac{d_1^b + d_2^b - D_i^b}{d_1^b}$. In the equilibrium, the second term of the equation (29), is the ratio of the brand elasticity of demand for the buyers μ_θ^b which was first presented at the start of this subchapter. The last term in the equation is the ratio of elasticity of demand on the sellers' side of the market. Now, all this results in following price structure:

$$30. \frac{P^b}{P^s} = \frac{\mu_\theta^b}{\mu^s/\sigma} = P^b + P^s - c$$

As it can be seen, the price structure in the platform competition model is strikingly similar to the monopoly situation on the credit card market. However, it takes into the consideration the buyers' loyalty towards the platforms and towards the specific sellers operating in the platforms. It can be also considered that the monopoly platform of buyers' elasticity μ^b would consist the terms $\mu_\theta^b * \sigma$ making it the total buyer's elasticity (of course it is derived differently in competing model) and would then achieve the already presented:

31. $\frac{P^b}{P^s} = \frac{\mu^b}{\mu^s}$, where $\mu^b = \mu_\theta^b * \sigma$

A platform economy competition of proprietary platforms would fit well in the technology industries like game consoles or operating systems. The payment card industry could also have a similar price structure as the competing proprietary platforms have. This makes sense, even if the card users have lower single-homing index, it is not nearly as low as for instance with internet matching platforms like online travel booking sites where it is almost costless to use multiple platforms. Also, a cashless buyer probably has zero loyalty towards shops in a special platform and would probably always go to the next shop instead of looking for an ATM when possible. This leaves the sellers in the situation where they must multi-home as ended up happing in the proprietary platform model.

The credit card industry example was introduced in the first subchapter and the only difference in the price structure was the introduction of the switch fee:

32. $R = P_m + P_i - c$, where R is the total profit and
33. $P_i = p_i - X$
34. $P_m = p_m - X$, where X is the switch fee

However, the extra fee does not change the price structure. The symmetric equilibrium stays the same and results in:

35. $\frac{P^b}{P^s} = \frac{\mu_\theta^b * \sigma}{\mu^s}$, where P^b and P^s are equivalent to P_i and P_m respectively

What is important to notice on the model in this subchapter, is the buyers' possible preference on a certain platform and their preference on a certain seller. Those are the key concepts compared to the monopoly case that will have effects on how the platforms compete as well as how the sellers behave in the real world. The fact that some sellers can be more popular than others will lead into a situation where the platforms are especially interested to get those popular ones to use their platform. This can often lead to in price discrimination directed to one side of the platform only, the sellers' side. It works in the way that the platform subsides some popular sellers in expense of the others. Controversially, the non-subsided sellers may benefit as well if the demand towards the platform then rises from the buyers' side with the new popular sellers on board.

What is especially interesting here is that the platform is, in a sense, helping in internalizing the network benefits according to how much network benefits each seller brings in to the table. This was brought up in the chapter two when considering the properties of two-sided markets. One necessary condition was failure of the Coase theorem. Now, when a platform is helping in internalizing the cross-network effects, the Coase theorem has clearly failed. Consider a shopping mall as an example. If a new cinema is built inside a mall it can draw a lot of new customers that will benefit the rest of the shops, as well. If the rent was the same for all the sellers in the mall the cinema owner might consider not to start there at all. However, as the mall helps the owner to internalize some of the benefits in a form of a targeted discount rent, the cinema owner now wants to build the cinema in to that very mall. In the end, the cinema owner's decision will result in more customers and increased demand for the rest of the sellers as well.

4 COMPETITION BETWEEN INTERNET PLATFROMS

The model of Rochet & Tirole applies many industries but there is another model that can be considered relevant for multiple cases especially those of the internet-based match making platform. These internet platforms that offer services like flight or hotel search are likely to have an experience of a situation where buyers, loyalty to a seller is practically zero meaning that all the sellers must multi-home. Also, the buyers would have almost infinite elasticity towards pricing as you never see these search engines charging the buyer side. This means that the sellers end up paying the whole cost of their platform usage while they still must multi-home to stay competitive. Also, with matchmakers, and sometimes with other internet platforms, the marginal cost of serving a new customer can be very close to zero. These characteristics combined can change the situation of how the platforms are competing. Thus, it is appropriate to discuss the other models there are for the two-sided markets that can be also relevant, particularly the model by Caillaud and Jullien (2003).

4.1 Internet platforms under exclusive services

The model analyzed in this chapter, is a Bertrand game which means that the platforms are essentially competing by choosing the prices instead of the quantity. In modern economics, Bertrand game is rarely considered a valid model. However, with a specific combination of a close to zero marginal cost by the firms and a close zero loyalty by the consumers it can be very much valid to consider the situation a game where the game starts with the firms choosing the price instead of the quantity. This is good to remember when looking at the model, and when later, analyzing why that kind of approach can be viable for analyzing this kind of intermediate markets.

The model starts from the premises where there are two sets of agents that represent the sides of the market. Without an intermediary platform, the agents have close to zero chance of finding a suitable trading partner. (Caillaud and Jullien 2003, 311). The model assumes that there is a unique trading partner on the other side, with whom, the trading is profitable for both agents. This could be, for instance, Alibaba or eBay type of service or perhaps a hotel search engine. The agents are homogenous and are denoted as $i = 1,2$. If two agents are matched they then progress in to a bargaining stage where they decide the price of the transaction. The transaction has a net surplus U that is shared between the agents. Their individual shares are denoted as u_1, u_2. The agents have following bargaining positions:

1. $u_2 \leq {}^{1}\!/_{2} \leq u_1, u_1 + u_2 = 1$

The gross surplus $U = 1$ is the trade surplus between the trading partners minus the possible fees charged by the platform from the traders. (Caillaud and Jullien 2003, 311).

As stated above an agent has close to zero chances of finding a trading partner without the help of a platform. The platforms in this model offer matching services that increase the chance of finding a trading partner to $\gamma \leq 1$, assuming that both sides of the match are registered in the service otherwise the chance is 0. Therefore, by using a platform's matching service an agent has a chance of $\gamma n_i, i \in (0,1)$ to find a suitable trading partner, where γ efficiency of the platform's matching technology while the n_i is the number of the agent type-i using the platform. The chance for the user to find a trading partner is dependent on the matching technology and the number of users on the other side of the market.

It is assumed here that there are two matchmakers providing the service. The platforms are denoted as I and E. Their ability to find matches is equal $\gamma \leq 1$, but the resulting matches may differ.

It is assumed that there exists a cost for serving the agents type-i c_i. For the model to work it must be that the service is efficient:

2. $\gamma > C = c_1 + c_2$

The matchmaking platforms notices whenever a transaction is processed. They can also verify the types of users that register to the platform. This leaves them two pricing tools they can use in the price discrimination. They can set a registration fee p_i^k where $k \in (I, E)$ that is not restricted to be positive. In fact, as it has been stated earlier, often there can be a negative fee for users entering to the platform. These gifts are directed towards one side that is seen more valuable for the platform which is the side whose cross-network effects are stronger.

Sometimes it is possible that the transaction fees can be hard to implement. The agents can often handle the transaction via some other medium after a successful matching process. (Caillaud and Jullien 2003, 322). Platforms can try to avoid this by giving security of payment for the buyer. They can also create systems where sellers' previous transactions are visible for the buyers to create trust for them and an incentive not to bypass the platform. For instance, Alibaba and Upwork are using these systems. With the implemented transaction fees, the total surplus between the trading partners becomes:

3. $U = 1 - t^k \geq 0$

It is obvious that the transaction price would not be negative or otherwise even the non-matched agents would choose to trade in the platform. The model assumes that the value of trade between specific partners remains constant and that it is common knowledge for everyone.

In the model, there must exist an equilibrium where the prices $P^k = (p_1^k, p_2^k, t^k)$ satisfy:

4. $\gamma u_i(1 - t^k) - p_i^k \geq 0, i = 1,2$

Now, the model continues in two-phases, where in the first phase, the platforms set prices P simultaneously. The platforms are restricted from cooperation and neither has better knowledge of the other's intentions. The pricing $P = \{P^I, P^E\}$ is public knowledge. In a second phase, the users (buyers and sellers) must simultaneously choose which matchmakers to register with. There is of course a possibility that some user will not register in either of the platforms.

This subchapter will analyze a situation where the services are exclusive in a way that an agent can only register with one platform or none while the next will focus on a situation where multi-homing is possible. With exclusive services, there is a following distribution of agents across the matchmakers:

5. $N = (n_i^I, n_i^E), i = 1,2$, where n_i^k represents the proportion of agents registered with k

Now, the utility function U can be drawn as following:

6. $U_i(P, k, N) = n_j^k \gamma u_i(1 - t^k) - p_i^k, when\ j \neq i$

Of course, if a user registers with no platform then simply: $U_i(P, 0, N) = 0$. The matchmakers profit function looks following:

7. $\pi^k(P^k, N) = \sum_{i=1,2} n_i^k \left(p_i^k - c_i\right) + \gamma n_1^k n_2^k t^k$

As the agents on both sides of the market are a continuous distribution, the situation does not exactly correspond a game. However, it is possible to obtain some subgame-perfect equilibriums.

When a type-i agent decides to register with platform k, it means that they must be at least as well off than if they had registered with the other matchmaker or if they had decided not to register at all. When there is a situation where $n_i^k > 0$ then, following (Caillaud & Jullien 2003, 313) it is possible to find an equilibrium distribution N for a pricing system, P for all $k \in (I, E, 0)$:

8. $U_i(P, k, N) = \max_{h \in (I,E,0)} U_i(P, h, N)$

There can be multiple different allocations but the model rules out all the ones with increasing demand functions to keep the amount of equilibriums somewhat reasonable. Meaning that if $N(\cdot)$ is monotone $\forall k, n_i^k(P^k, P^{-k})$ is non-increasing in P^k. The monotonicity however, is not restrictive. For instance, there is no restriction when the platform employs price discrimination towards its users. Thus, there is no monotonicity when P_1^k increases P_2^k and decreases.

The monotonicity is there mainly to restrict the users into Pareto non-dominated allocations. The equilibrium in this model is constructed by the price and the user distribution $(P^*, N(\cdot))$. The equilibrium user distribution $N(\cdot)$, is a monotone market allocation. The equilibrium price P^* on the other hand, is a Nash equilibrium of reduced pricing game of the $N(\cdot)$ allocation with profits $\pi^k(P, N(P))$ (Caillaud & Jullien 2003, 314).

So, the equilibrium is formed from a set of prices charged by the matchmakers and of a formula describing how the users make choices among them. The user allocations create a sort of a demand functions for each platform. After this the model develops into a classical price setting game or a Bertrand game. In the model, it is assumed that all the users act rationally and have rational expectations on how the others will allocate themselves. This, of course, has a great impact on the model making the resulting equilibrium most likely more efficient. However, it would be very complex to create a model where not all the users act rationally. It is also important to remember that the general result of the Bertrand pricing game is that products and services are sold at the marginal cost.

In a competition situation with exclusive services, a high concentration of users towards one platform can be expected. Since the users can register with maximum one platform, the only efficient allocation would require everyone to register with the same matchmaker. In the article, Caillau & Jullien come to the conclusion that in the competition between exclusive services all equilibria are efficient and only involve one platform. This afore described dominant firm equilibria in the price system (P^I, P^E) is maintained by a pessimistic market allocation against P^E which means that the users expect no other users to register with *E*.

9. $\gamma u_i(1 - t^I) - p_i^I \geq -p_i^E \; i = 1,2$

The model assumes that the cost c_i is related to the service in general rather than to the transaction.

The model is created with assumption that the agents may have pessimistic beliefs towards one platform. Now, no user will join the platform E when there are pessimistic expectations towards it and will instead choose platform I. This means that in a dominant firm equilibrium, there can thus be only one firm that operates with profit, and if no pricing strategy is used then one firm is not active as all the users see the other one as the dominant.

However, the platform E can adopt some tactics in order to change the situation. The platform E can start subsidizing the i-users such that:

10. $p_i^E < p_i^I - \gamma u_i(1 - t^I) \leq 0, i = 1,2$

Now, all the i-type users will register platform E and it can set the pricing for the j-users so that it is beneficial for them to trade in the platform:

11. $p_j^E + \gamma u_j t^E < \gamma u_j + (p_j^I, 0)$

The i-type users will now want to collect the registration subsidy and as j-type users know that all the i-type users will register to the platform E, they will also register with the E as it is cheaper to trade there. The platform can maximize the transaction fee from the i-type users as that does not appear in the equation $t^E = 1$.

However, the platform I can use the same pricing to stop the platform *E's* tactics. Therefore, it is now possible to determinate the only equilibrium with exclusively services. The platform, that has the positive expectations, will capture all the users and charge maximal transaction fees $t^k = 1$ while subsidizing the registration making no profit:

12. $(p_1^k + p_2^k) = c - \gamma.$

The reason for zero profit is following. A non-dominant platform could always offer the users a registration subsidy a bit bigger than their utility on the dominant platform conquering all the users and becoming the dominant platform. Thus, in the equilibrium the dominant matchmaker must return all the surplus to its users normally through the registration subsidy. This can also be shown mathematically. Assume two firms, E and I, in an equilibrium with surplus:

13. $s_i = \gamma u_i(1 - t^k)n_i^k - p_i^k$

for i-type users. With this equilibrium, the firm's profits are:

14. $\pi^k = \gamma n_1^k n_2^k - \sum_i (c_i + s_i)n_i^k \geq 0$

Now firm *k* could use a subsidy and capture the whole market with a profit of:

15. $\gamma - c - s_1 - s_2 - \sum_i \gamma u_i(1 - t^k)n_j^{-k} \leq \pi^k$

This means that there is no possibility for a platform to make a constant profit in the market. It also means that almost always there is only one active platform in the market. The only other equilibrium is $n_i^k = {}^1/_2, t^I = t^E = 0, p_i^E = p_i^I, p_1 + p_2 = c$ where there is still no profit and the equilibrium is inefficient, as well. This would mean that all the users are split the same way and exactly half and half. The idea here is that now there should be no pessimistic beliefs towards either compared to the other.

Although, the situation of exclusive services is hard to find in the real world, characteristics where one platform is thriving with a majority market share while being weary of new comers is common. Many Internet platforms do not charge the buyers at all and sometimes even subsidize them. It has also been seen how users tend to gravitate towards the expected winner platform. For instance, MySpace was quickly abandoned in favor of Facebook ten years ago even though the service was very similar. Years after, Google, with all their resources, has not been able to popularize its own Google+ service.

Sometimes the platform might require exclusivity from the seller side meaning that the buyers are able to multi-home but sellers not. This is possible when there is for instance intellectual property that can be licensed. One example would be the streaming services such as Netflix, Hulu or HBO not selling some of their content to their competitors and thus requiring exclusivity on the seller side. However, it is not clear that these streaming services are in fact two-sided markets, although they are often lumped with them in non-scientific publications. The reason is that they buy the services from the sellers and fund their sellers' production instead of just acting as an intermediary.

4.2 Competition with Multi-homing possibilities

As stated earlier, it is hard to find an industry where there would be a complete exclusivity for the intermediation platforms. Thus, it is important to see a situation, where users on either side of the market can register with multiple platforms and use them simultaneously. A situation where multi-homing is possible was already analyzed in the chapter 4 about platform completion. That model mirrored a model by Rochet & Tirole where there was a multi-homing index that measured the overall likelihood in that market for multi-homing. In the model by Caillaud & Jullien, the proportion of multi- and single-homers is also present. The model puts more focus on the question when it is efficient for the agents to multi-home. This subchapter will present some equilibriums and strategies that might occur in the platform competition in Caillaud & Jullien's model.

The model itself derives from the previous model. The setup is the same with rational agents on both sides of the platform looking for a unique trading partner from the other side. Two platforms are competing with one another and the equilibriums are results of a pricing game such as before.

It is important to understand why and when the user registers with more than one platform. Even if a user-i expects all the j-users to engage in multi-homing, the user type-i will have still have an incentive to do so, as well. They increase their chances of finding a match by $(1-\gamma)\gamma$. This is the result of the fact that the matching is not perfect and thus, one platform can fail to find a match while the other one succeeds. The additional benefit of registering in multi-homing is that in case of a double match γ^2 the user can choose on which platform conduct the trade and possibly then get a lower transaction price. Between these two there is an important difference that the first one adds value into the economy as whole by increasing the trade, while the second does not have any impact on the efficiency and is merely increasing the agents' surplus by taking it from the platforms.

In this model, there are two types of efficient market allocations. The first one where it is beneficial to register with a second platform after having registered with one, and another market allocation where single-homing is efficient. Now, the market allocation is defined as:

1. $N = (n_i^I, n_i^E, n_i^m)$, where n_i^I, n_i^E are the users single-homing while the n_i^m are the users that engage in multi-homing.

The outcome depends on the cost c relation to the improved matching efficiency: $(1-\gamma)\gamma$.

2. When $(1-\gamma)\gamma < c$ the efficient allocation requires single-homing, where all i will choose one platform with positive expectations, in this case → $n_i^I = 1$.
3. On the other hand, if $(1-\gamma)\gamma > c$ the efficient equilibrium requires global multi-homing, where all i register with both platforms $n_i^m = 1$.

There are two kinds of outcomes in this model, the pure equilibrium outcomes where the agents register deterministically with one or both platforms and mixed equilibriums where some agents can make different choices ex ante and ex post.

To start it is best to continue with the same premises that were exposed in the previous subchapter. Accordingly, there is a pessimistic market allocation against the platform E meaning that users are expected to register with I. In this scenario, the best strategy for E is to use a divide and conquer strategy to gain market share by subsidizing the i users. Divide and conquer strategy or DC strategy is a term that comes from the article by Caillaud & Jullien 2003. The idea is simply to subsidize a one side to get the other side too and, it is basically what the platform E was applying in the previous subchapter when trying to win the competition.

The structure on the model is the same as in the exclusive model so the maximum revenue that can be earned from the users type-i is:

4. $r_i^k = p_i^k + \gamma u_i t_i^k$ where p_i^k is the registration fee for i-type users and $\gamma u_i t_i^k$ is the probability of a profitable match for a user i.

Now, as the assumption is that the platform I is the preferred one the users will always register with it. If the registration fee is more zero $p_i^E > 0$, the users will only register with the I. To change this situation, the platform E can lower the price so that $p_i^E < 0$. Then, all the users i will register with platform E to collect the subsidy while at the same time they maintain their registration with platform I. They will not cancel yet their registration with the I, as they do not know if the users from group j will follow them. If this happens, the platform E will still not make any profit as it cannot process the match or collect any fees from the j-type users. This scenario will happen if:

5. $r_j^E \geq r_j^I$ or if
6. $r_j^E \geq \gamma(1-\gamma)u_j + \gamma^2 u_j \max(t^I, t^E)$.

In the first scenario, the j-users will not register with E because the total fees with the platform I are lower. In the second case (6), the users will not multi-home because the expected utility of multi-homing is lower than the cost of registration with the second platform. The both cases lead to a single-homing equilibrium:

7. $n_j^I = n_i^m$, where only one platform is active.

It is important to note how this model does not capture any possible within-group negative externalities like some of the models in the third chapter. There is no benefit of being the only user of certain type in the platform. If there was, it could be assumed that some agents could try to avoid competition and thus, any single-homing equilibriums might not exist and there would be more room for different multi-homing equilibriums.

Generally, divide and conquer strategies are no more available for the platforms as the users do not have to make any decision between the platforms. Thus, in the model the type-i users should register with platform E always if $p_i^E < 0$. However, the maximum profit from type-j users is strictly limited with the conditions 5 and 6 such that:

8. $r_j^E < \max\left(r_j^I; \gamma(1-\gamma)u_j + \gamma^2 u_j \max(t^I, t^E)\right)$

The equation 8 is the maximum when all the i register with the platform I. Depending on j-type users' behavior, the platform E has three different divide & conquer strategies to apply. These strategies to lead in an equilibrium, multi-homing must be efficient. In the first option the platform is looking to be a second source for the users. This situation can occur if the transaction price of the platform E is higher $\mathrm{t^I} < \mathrm{t^E}$, then E only concludes a transaction when the platform I fails the match and its profits are bounded by $(1 - \gamma)\gamma - \mathrm{c}$ as the maximum profit. This is also the surplus generated by multi-homing. Therefore, it is also clear that if multi-homing is not efficient there is no possibility for a second source platform to operate.

The second possible strategy occurs when E has a lower transaction price $\mathrm{t^I} > \mathrm{t^E}$, then, the platform E is a primary source of transactions and conducts the transaction whenever there is a match. This reverses the previous roles if there is a global multi-homing meaning that none of the users type $\mathrm{h} = (\mathrm{i}, j)$ registers with E only:

9. $r_h^I \leq \gamma(1-\gamma)u_h + \gamma^2 u_h \max(t^I, t^E)$ (Caillaud & Jullien 2003, 317)

This means that the platform I has now adopted the role of a second source as the multi-homing continues to be globally efficient.

The third DC strategy is possible if there is a population of users that do not register with I, E acts as the sole platform for these users. The fact that E can act as a sole platform, is also the reason why the primary source example does not include a situation where some users would prefer E over I.

The key to evaluate which one of the DC strategy is viable for a platform in this model depends heavily on the users' minimum surplus they get from the platform acting as a second source. The minimum surplus:

10. $\mathrm{z}^\mathrm{I} \equiv \min\limits_h \frac{\gamma(1-\gamma)u_h+\gamma^2 u_h t^I - r_h^I}{\gamma^2 u_h}$

It is beneficial for the users to multi-home only if $\max(t^I, t^E) \geq t^I - z^I$. In this case E can act as the first source if also $t^I \geq t^E$ which is only possible if $z^I \geq 0$. If $z^I < 0$ the options for the platform E are to act as a second source or to act as the sole source for the population that does not register with I. To sum all this up, there are two scenarios:

11. If $z^I \geq 0$, E can use the first source strategy with $t^I = t^E$or the second source strategy.
12. If $z^I < 0$, E can use the sole source strategy with $t^E = t^I - z^I$ or the second source strategy.

The profit for acting as the first source or as a sole source is:

13. $\pi^F = \gamma(1-\gamma)u_2 + \gamma(u_1 + \gamma u_2)t^E - c$. (Caillaud & Jullien 2003, 317)

The expectation here is that the group 2 is the one that is multi-homing globally. In this model, the expectation is that the users in the better bargaining position will multi-home. And the profit for the second source strategy:

14. $\pi^S = \gamma(1-\gamma) - c$.

As the equations (11) and (12) suggest, a platform has the option to act as a second source with the profit from equation (14) with a slightly negative registration fee and a transaction fee of 1 provided that multi-homing is efficient. (Caillaud & Jullien 2003, 324). It seems that the higher the matching efficiency, the better it is to be the first source compared to the second source.

With the pricing from (13) and (14), the users will always benefit $\gamma u_i - r_i^I \geq 0$ if they all register with both the platforms. In this case, the platform E is clearly a second source. In a situation where $z^I \geq 0$, the expected market allocation is the one, where all the users register with I for all P^E. However, E has an option to act as a first source by setting the prices such that for some $i, t^E < t^I, p^E < 0$, and with revenue capped from j-type users such that:

15. $r_j^E \leq \max\left(r_j^I, \gamma u_j(1-\gamma+\gamma t^I)\right) = \gamma u_j(1-\gamma+\gamma t^I).$

Then, the profits come from equation:

16. $p_i^E + p_j^E + \gamma t^E - c < \gamma t^E u_i + \gamma u_j(1-\gamma-\gamma t^I) - c.$

The optimal pricing is then to set t^E as close as possible to t^I while still maintaining the lower transaction price, $t^E < t^I$. Meanwhile, with the registration fees p_i^E and p_j^E set as large as possible, the maximum profits are very close to:

17. $\pi^F = \gamma u_1 t^I + \gamma u_2(1-\gamma+\gamma t^I) - c, for\ i = 1, j = 2.$

To sum it up, when $z^I \geq 0$, the platform E's profits are equation (14) or (17) depending on which strategy they follow.

In case of $z^I < 0$, the I cannot be a second source for being too cheap with the transaction costs t^I. However, there is still a possibility that E can act as the sole source to a group of users. This requires that:

18. $p_i^E < 0$
19. $r_j^E < \max\left(r_j^I; \gamma u_j(1-\gamma+\gamma \max(t^I, t^E))\right)$

Obviously, it also requires that either some i or j-users do not register with I:

20. $r_i^I > \gamma u_i(1-\gamma+\gamma \max(t^I, t^E))$

or

21. $r_j^I > \gamma u_j(1-\gamma+\gamma \max(t^I, t^E))$

and with a transaction price:

22. $t^E \leq t^I - z^I$.

The profit of acting as a sole source come equation:

23. $p_i^E + p_j^E + \gamma t^E - c < \gamma t^E u_i + \max(r_j^I; \gamma u_j(1 - \gamma + \gamma \max(t^I, t^E))) - c$.

Where the optimal transaction price t^E just below $t^I - z^I$ the profits for acting as the only source for a group of users are:

24. $\pi^L = \gamma u_1(t^I - z^I) + \gamma u_2(1 - \gamma + \gamma(t^I - z^I) - c, for\ i = 1, j = 2$.

The market allocations in this article fall in two kinds of equilibriums depending on how the users act. The first one is a pure equilibrium where all the users from the same groups act in the same way. The other one is a mixed equilibrium where the users make different choices. In the pure equilibrium case, the market allocations are quite straight forward. If the cost serving the users is lower than the value created acting as a second source $\gamma(1 - \gamma) > c$, there will be a global multi-homing $n_1^m = n_2^m = 1$. Otherwise, there is a dominant firm equilibrium $n_1^k = n_2^k = 1$. In the case of the global multi-homing, the two firms have different roles. The first one acts as a second source with high transaction fee and low registration fee while the other is the first source with a primary platform for transactions and high restoration fees. This is an equilibrium that also requires that the matching technology is not efficient $\gamma = 1$. Otherwise, the second platform serves for no purpose.

In a situation of a dominant firm equilibrium, the acting firm will maintain its dominance by setting the transaction fee to zero and making profit with the registrations fees. This makes it impossible for the other platform to enter to the market as $\gamma(1 - \gamma) \leq c$ makes no room for a second source in the market. This also means that the dominant firm cannot make any profit on the market either:

25. $\pi^D = \frac{(\gamma - c)}{u_1 + \gamma u_2}(1 - \gamma)u_1 \leq c$

The dominant firm's profits are capped to zero. The threat of the non-active firm conquering the market is so big that the active platform must make zero profit. While this may seem unexpected, it resembles the situation where the services are exclusives and the profits vanish as well. So, in the pure equilibrium with a dominant firm implies that in a competition between two-sided markets, the monopoly is not always a bad situation for a consumer. This might seem controversial, but it is hard to find examples where platforms try to directly profit from the consumers. Instead they charge fees from the sellers who are unable to pass those fees to their clients. Also, the two-sided markets do not seem have the same monopoly power as one-sided markets. Instead of limiting the quantity, they choose a price to sell the maximum amount of services.

The idea of constant threat of new platforms seems to be real as well. It has been seen that many internet platforms like Uber have yet failed to find a way to make consistent profits as they must constantly undercut the potential emerging competitors. Meanwhile, the consumer benefits from a monopoly as they do not need to register with multiple matching platforms to trade. Of course, this would not directly apply to some platforms where there are big barriers of entry like high fixed cost for example setting up a shopping mall.

In the case of a global multi-homing the profits are shared between the firms according to their contribution to the users. For the second source the profits are simply:

$$26.\ \pi^S = \gamma(1-\gamma) - c,$$

as described in the equation (14). For the first source, it is a bit more as it contributes $\gamma(1-\gamma)$ and the value of the lowered transaction fees in the case of a double match: $\gamma^2(t^E - t^I)$ and thus, the total profit for the first source is:

$$27.\ \pi^F = \gamma(1-\gamma) + \frac{\gamma^2(1-\gamma)u_i}{\gamma u_2 + u_1} - c$$

The both market allocations are efficient. In this equilibrium, the platforms are not directly competing with one another as they have different tasks.

A mixed equilibrium, where the users from the same group make different choices always requires multi-homing. The reason is that the platforms would constantly try to undercut the prices to conquer the whole market and it would always be beneficial for some users to multi-home. In short, there is no equilibrium where no users multi-home and it is not beneficial to try to cut the prices. Still, it can be that only one group is multi-homing in the equilibrium. Assuming the i-users multi-home, the j-users are then single homing on the platform with the lowest total price. This means that in the equilibrium where both the firms are active the prices for the single-homing group are the same. The group that multi-home is the one that gets more value from the trade related to the cost:

$$28.\ \frac{u_i}{c_i} \geq \frac{u_j}{c_j}$$

Neither of the platforms are able to make profit with the single homers with prices of:

$$29.\ p_j^k + \gamma t^k \leq c_j$$

This in turn means that there is no incentive in trying to attract more single-homers. Therefore, the profits for the platform are taken from the group that does multi-home and that is the one benefitting more related to the cost. Implications on this are that the sellers would generally fill this group.

Thus, it seems that no dominant firm equilibrium brings profits for the platforms. Symmetric equilibriums can be profitable. There is a sustainable equilibrium where $p_i^k = 0, p_j^k = \frac{u_j}{2}, t^k = 0, \gamma$ close being to 1, and market is shared evenly between the two platforms. The type-i users are evenly split between platforms and the j-type users choose to multi-home. Neither type is willing to deviate from that equilibrium. However, this still requires coordination as either platform could try to capture all the market by lowering the p_j^k. To prevent this deviation, the platforms can extract less than $p_j^k = \frac{u_j}{2}$ from the multihoming group or price below the marginal cost for the single-homing group $p_i^k < c_i$. (Caillaud & Jullien 2003, 320).

All in all, the article presents multiple different equilibriums but while theoretically possible, not all of them are perhaps realistic. The third subchapter will go through some of the implications of this model and starts a discussion about the model's applications within the empirical examples which is further continued in the following chapter. It will also start the comparison with the models from the chapter three and this comparison continues in the next chapter.

4.3 The equilibriums; profits & consumer welfare

As opposed to Rochet & Tirole's theorem, Caillaud & Jullien's article treat the two-sided market problem as a Bertrand game where there is a continuous demand towards the service of the platform and the platforms are only competing with prices. This leads to low profits in general for the parties participating in the game. In the original Bertrand game equilibrium, the companies will sell the goods at the marginal cost. Every equilibrium of the normal Bertrand game are weak as the firms do not lose anything when they are not making a profit meaning that there is no reason not to deviate from the equilibrium. This is sometimes also called Bertrand paradox, Baye & Morgan (1999). Baye & Morgan also state in their article: “A folk theorem for one-shot Bertrand games” (1999) that there exists a continuum of symmetric equilibriums, where firms make profit with mixed strategies in repeated games.

Interestingly, in this model and in many empiric two-sided market examples, many conditions for a Bernard game are in place. The demand is inelastic to an extent, especially in the buyer side. Marginal cost of serving new clients is zero or close to zero. In the case of intermediary, there is also almost no fixed costs for the platforms. The dominant firm market allocations are non-profitable due to the fear of non-active firm entering the market and thus, the platform operates at a marginal cost.

When there are two active platforms competing in the market, there are only two types of possible profitable allocations. First, there is the situation of an exact split of the market. The second case is perhaps a more probable scenario and can arise when the multi-homing is efficient. Then, two players fill in different roles with other one setting high entry fees and zero transaction fee working as a first source of trade between the sides of the market. The other player uses registration fees slightly below zero to capture high quantity of users and sets a high transaction fee. The second source platform service is used whenever the first source fails the match. When the multi-homing is efficient, the market surplus is high and goes to the platform instead of the sides of the market. However, this is not a traditional Bertrand game as the service offered by the two platforms is in fact different. Thus, it can be expected that now the platforms can and will profit in the market.

Controversially, one platform is in effect better for the consumer than multiple competing ones. In the Caillaud & Jullien model, no strategy with only one active firm would bring any profits as there is always threat of a market capture by the inactive firm. This also means that under exclusivity the consumers enjoy higher surplus than under non-exclusivity. This is especially clear when matching is efficient or close to efficient. Thus, it is important to note that when the matching is efficient an additional market platform does not necessarily produce any new surplus.

However, in their paper, the authors note that the expectations on some platforms’ popularity could make them possible to extract profits in the long term. For instance, the brand’s name can be powerful enough to keep users loyal for a certain platform even if the total price is higher. A great example for this is Amazon, a platform that is now making huge revenue and is very well known, only made their first profitable year in 2003 six years after their IPO. (Amazon annual report, 2003, 27). Airline online booking companies are another one great example of long sustained losses. A German company Trivago was still making loss in 2017, (Trivago annual report 2017, 4) while being established already in 2008 almost ten years earlier, making loss was clearly a part of their strategy to grow and crowd the market. This case will be discussed later.

It is also logical to assume that something as a brand loyalty can be built over the time. It would be hard for any new platform to enter into a market with already very dominant platforms. At least it would require a lot of subsidized selling and continuous advertising by the platform. Entry barriers like this may leave the dominant platform “room” to make profit. These entry barriers will be discussed in the fifth chapter.

In the end, the results and implications of the model are not that far from the ones of Rochet & Tirole. In both the models there are multiple similar ideas. First, for instance being that the competition between platforms is fierce for the users where only few platforms can remain profitable. Secondly, a monopoly situation is not similarly exploited as in the one-sided markets, since one goal is to maximize the volume of the trade and simultaneously beware of new platforms. Thirdly, the pricing structures end up having similarities but for different reasons. While it was the elasticities of demand where the key lied in defining the price structure in the model by Rochet & Tirole, it is the bargaining position that defines it in the Caillaud & Jullien’s model. In both of the models, it often tends to be the seller who is charged more while the buyer side gets a free ride. The next chapter will present some examples to shed more light on the implications of these models.

5 EMPIRICAL EXAMPLES OF TWO-SIDED MARKETS

This chapter will present real-world examples where the two-sided markets can arise either alone or to compete with firms operating as one-sided markets. This chapter will analyze the examples. The goal is to try to analyze if the examples have properties of the models that have been presented in this thesis. Other goal is to figure out which model would be the most suitable for the example. These examples also try to illustrate some unique economic properties of the two-sided markets and their implications to the surrounding economies. The examples are collected from some scientific articles, from magazines and some other publications.

First, I will go through an example of a solution for a typical problem that a new platform faces; how to get the both sides initially on board? In the second subchapter, I will present some evidence on the usage of the buyer's subsidies from another research and introduce some other real-world strategies the platforms may use in the competition. In the following subchapters three, four and five, I will analyze some effects the two-sided markets can have to their surrounding economies. Each subchapter has a different point of view for the subject.

5.1 Chicken and egg problem; spread of the credit card

No consumer would go to a mall with no shops nor would any shop want to install into a mall that no shopper visits. The chicken and egg problem is quite unique for the two-sided markets. It arises due to the characteristic of the demand curves caused by the indirect network externalities on both sides of the platform. To attract buyers, the platform had to already have sellers on board and vice versa. (Caillaud & Jullien, 2003, 310.). As it has been discussed in previous chapters, the users on one side benefit from the users on the other side of the platform. If the only value, a platform produces, is based on cross-network externalities, it can be difficult to launch a new platform to compete with the existing ones or even launch a new one when there are no other platforms competing in the market. The premise for this problem to arise, also requires that the platform cannot replace the seller side of the market for a time period and act as a one-sided market but has to use an existing seller base. An example of an industry where the problem can be relieved is the software industry with operation systems as platforms, where many of the basic programs are produced by the platform.

The credit card industry is an excellent example that faces the chicken and egg problem. If there was only one person who has a credit card there would not be much benefit for a shop to accept it as they would need a machine to read it and pay a transaction fee to the card issuer for the highly unlikely purchase made by the only customer using the card. Since no shop accepts the card, there will not be many people willing to get one either. This situation would be an example of the chicken and egg problem that a new platform might face when launching a service.

However, a platform has its means to alleviate this problem. As mentioned in the introduction chapter Visa managed to establish itself as the first credit card option for the middle class. Their predecessor, Bank of America accomplished this by sending unsolicited credit cards to ordinary US residents. They started by sending unsolicited 60000 credit cards to the residents of Fresno county in California in 1956. Soon after the successful launch, they sent 2 million cards to residents across the California state. This way they managed to get a high number of users on one side of the platform and could then establish a network of sellers who would accept the card and be willing to pay the transaction fees to Bank of America. By the end of the decade Bank of America had over 20000 merchants that would accept their card. (Nocera, 1994, 23).

Now, 60 years later we might be witnessing another competition between payment platforms as paying with mobile phone is becoming more and more popular. Many major banks are launching their own payment system meanwhile, tech companies like Apple and Google are also coming to the market with Apple Pay and Google Wallet. While I haven't heard of anyone receiving an unsolicited payment app, the advertising of the payment apps has become visible in Finland. It will be interesting to see, who can solve the chicken and egg problem and capture the new payment market.

There are other methods to solve the chicken and egg problem as well. Many internet platforms are offering signing bonuses for registering users. For instance, both the largest Finnish restaurant food delivery firms Wolt and Foodora are known to give free coupons for the first-time users to attract them. Many platforms tend to pander the buyers with offers instead of the sellers. It is even the case that the buyers can get a negative price from the platform. This is due to the price elasticity of the buyer's side compared to the seller's side which has been discussed in the previous chapters three and four.

Apart from subsidizing one side of the platform, the two-sided markets rely heavily on advertising. I will bring some examples of both of these strategies in the next subchapter.

5.2 Travel agents as search engine aggregators; evidence of buyer subsidies and market capture

Even the brick and mortar travel agents have had some of the two-sided market aspects when being intermediaries between buyers and sellers in the market. However, a lot of their work used to be selling the service and a big part of their job has been bringing assurance for the buyer side to make sure they get scammed. Thus, their value as an intermediary comes from reducing the asymmetric information between the trading parties. Trade assurance can be, of course, a service provided by the two-sided market but these intermediaries are mostly linked to the information asymmetry problems that are not a subject in this article. The old travel agencies also have large marginal cost of serving clients meaning that there exists a clear limit that how many customers they could serve at a time making it hard to quickly capture a large share of the market. This makes brick and mortar agents inflexible in many ways compared to the online travel agents, for instance they would always have to adjust first the personnel if they would try to change the price.

With the online travel agents, the situation is different though. Online travel agents and search engine aggregators are websites that let buyers to perform a search for a flight or a hotel to a destination they want to visit with some criteria of the buyer's choice. The buyer will then get many quotations from the platform for flights or hotels with their search criteria. If they find what they were looking for they can buy a flight or a hotel via the platform. The online travel agents' search results are drawn from an airline booking systems like Sabre or Worldspan that are used by the airlines and show results for the consumer (Bilotkach & Rupp 2014, 344). This innovation changes the travel agency's role completely. After initially setting the matchmaking platform, they can serve new buyers with almost zero marginal cost. They can also quote vastly higher number of sellers than without the technology. This means that there is a large number of cross-network effects that cannot be internalized between the traders but by the platform. The more there are buyers, the more important it is for a specific airline or hotel chain to be found in the quotations when a byer performs a search. To present an example of the importance of the platforms in the airline industry, the American Airlines revenue declined by 50 million on the first quarter of 2011 or 1.6% of its revenue due to not being listed in two of the three major online travel agents in US (Bilotkach, Rupp, & Pai, 2013, 2).

Due to their nature of the two-sided market, online travel agents have interested the research before. In one of the first empirical researches on the two-sided markets, Bilotkach & Rupp (2014) found in their research an indication towards buyer subsidies in the online travel agent platforms. The whole travel booking industry is very complex with price discrimination towards buyers and negotiations between the airline company and the intermediary platform. For an intermediary platform to improve its negotiation position, it needs a large user base of buyers. The best strategy to achieve this is to make sure the buyers find the cheapest price in their webpage. In the end, the value these agents offer for the consumer is to save their time in the search for the cheapest and most suitable tickets in the market.

Online travel agents have taken this very seriously and some applied this strategy already in 2004. Orbitz offered a $ 50 voucher to any customer who would find lower priced ticket for identical flight. This price guarantee was quickly adopted by Orbitz competitors. In 2006 Expedia and Travelocity adopted a similar policy even promising refund on top of the voucher if a customer found a cheaper ticket than theirs. In 2008, Orbitz went even further making the price guarantee automatic so that the customers themselves did not have to check if the price was the cheapest. They promised to pay any difference if a customer payed higher price for using Orbitz even after the trip had occurred and that they would track this reliving the customer from this duty. At the same time, Orbitz dropped their consumer prices. One of the competitors, Travelocity also reduced their prices which could have been a reaction to Orbitz policy. (Bilotkach & Rupp 2014, 349 – 350.).

The nature of the contracts between the travel agents and the airlines used to be that one agent gets the cheapest quotations directly from the airline. The fact that the agents are having price guarantee policies and that they try to match their competitors' prices can be then considered a buyer subsidy. In the study of Bilotkach & Rupp, two of the three companies implemented this policy. This means that one player's strategy might have caused others to react as well. Additionally, all the airlines also removed their booking fees during the studied period which also supports the idea of a buyer subsidy.

Did the strategy work for Orbitz? That is hard to say, they increased their sales during the period of the study but currently all the three brands are in fact owned by Expedia Inc. that has become one of the two leading online travel booking companies with multiple aggregator websites. (Expedia Inc. annual report, 2016,1)

The competition between the online travel agents has been heating up lately. There has been a lot of acquisitions in the last 15 years leading into a situation where a few players own most of the brands. Two biggest players are The Priceline Group which owns for example booking.com and Momondo and is by far the biggest player outside of US and Expedia Inc. that owns for instance Trivago and Hotels.com being the biggest platform in US. There are, of course, smaller especially regional companies. In Finland, Super saver is still a large platform while facing hard competition. The two biggest companies, The Priceline Group and Expedia, as well as multiple smaller ones have been advertising very aggressively even in Finland. The top three adword budgets in February 2017 belonged to Trivago, ebookers.fi and booking.com while also Momondo and hotels.com made it to the list of top 40. In addition, there were some brick and mortar agencies like Tjäreborg on the list as well. (Genero, "Suurimmat AdWords-mainostajat helmikuussa 2017", 22.3.2017).

Interestingly, the two big players are not trying to focus on one platform each but actively promote multiple ones. These platforms are actively advertised on television as well. Personally, I have multiple times seen three different platforms running an ad during the same commercial break. Company data suggest this as well, for example Trivago has spent over 80% of its revenue to advertising in three consecutive years from 2014 to 2016. The actual numbers spent in advertising in those years are 271 million, 432 million and 623 million euros. (Trivago Annual Report 2016, 56). It is quite remarkable that advertising represents over 80% of the company's cost structure and shows that the company can serve new clients virtually at no cost and all the money goes into getting new users and maintaining old ones. Then, of course, it is very important to capture as much market as possible using not only advertising but tactics like buyer subsidies. The goal would be to get in to a position where the buyers have deep loyalty towards the platform so that they would be less subsided leaving more profit. This could be considered as the single-homing index discussed in earlier chapters, a term brought by Rochet & Tirole. The market seems to have some qualities from Caillaud & Julliens article, as well. Many companies do not turn profits early on as they need to use large amount of the money to maintain and grow their market share or they could become non-used as buyers would adopt pessimistic beliefs towards them.

The online travel agents have also significantly changed the travel industry, not only by bringing competition towards brick and mortar agents but also changing the whole pricing system. In the hotel industry, where the online travel agents have become very popular among consumers, the buyers are heavily subsidized by the platforms. In North America consumers who would make their reservation through a booking platform would receive 44 % discount compared to the regular price of the room (Cossa & Tapatta 2013, 3). Interestingly Cossa & Tapatta found that those discounts are not only hotels unsold inventory but also normal priced rooms. They suggested that the hotels may use online travel agents to price discriminate customers. It is likely that those who book through the hotel’s own web page are less price sensitive and more brand loyal than those using an online travel agent.

5.3 The frictionless trade; disrupting traditional industries

Two-sided markets have disrupted many industries for different reasons. Not only have they become matching platforms and intermediaries for already existing sellers like online travel agents or online market places, but they have also started offering new services competing with traditional non-platform industries in the same markets.

There are some other instances where the market is disrupted by more competition on the seller side when a two-sided market emerges. Sometimes a two-sided market can bring competition by circumventing regulations. The controversial peer riding services Uber and Lyft would be this kind of two-sided markets. The taxi services have traditionally been quite regulated industries even in the United States. The cities have often limited the number of taxis allowing to operate within its area. For instance, in New York it has been possible to invest in a Taxi medallion (license to operate one’s own taxi). However, Uber drivers often operate without owning a taxi license (Ridesharing, Uber driver requirements: Do you qualify to drive? 3.4.2018) and as a result, the value of a Taxi medallion has dropped in US after these taxi type services have brought additional competition to this regulated market. In Europe, there has been a huge backslash against Uber from law makers and Taxi services with the accusations of circumventing the local laws. These accusations are not completely unfounded. Uber has been acting as an intermediate in connecting its drivers and the clients. This gives them an unfair advantage compared to taxi firms as they can ignore many mandatory regulations towards workers’ protection. Therefore, it is harder to say if the actual platform has any market disrupting advantage or is their success a result of circumventing the current regulation.

There are also clear instances where platforms disrupt the market for other reasons than circumventing current regulations. They might just have a superior technology and perhaps a better reachability of customers with extremely low marginal cost. One of these disruptors would be Craiglist with their classified ads. Craiglist an eMarket focused on consumer to consumer sales of product and services. Craiglist allows users to post ads and browse them online, entering into a market previously highly dominated by newspapers and especially local ones. Its Finnish equivalent would be tori.fi.

Between 2000 and 2007 Craiglists entry to the ad market lead to over 20% drop in the classified ad rates imposed by the newspapers. It also generally raised subscription prices to the newspapers. It is estimated to have saved over 5 billion USD for the classified ad buyers from 2000 to 2007. (Seamans & Zhu 2014, 490). In their study, Seamans & Zhu also found that those newspapers most dependent on classified ad income were by far most hurt by the Craiglist’s entry into the market.

When comparing Craiglist to local newspapers, it is not hard to see the advantages that Craiglist has. First, it allows users to perform advanced searches it is already more efficient matchmaker than the papers. It also has unlimited space for the ads and the ads are cheaper to produce. Craiglist started as a nonprofit company which might have influenced its success on attracting the sellers which it managed to do convincingly. Perhaps the only advantage a newspaper would have is the constant influx of the buyer side in form of readership. However, Craiglist has managed to establish itself as US wide brand that has a large user base from the buyer side.

One market disruptor is Airbnb which allows regular people to rent their homes as a hotel type service via the Airbnb platform. Airbnb also allows people to sell experiences for instance tourist guidance or cooking classes through their platform. This is a separate service but it often has a complementary nature.

Airbnb has some competitive advances compared to hotels. It can react with great flexibility towards changes in demand. Since it does not have to own any property and can have minimal staff, both the fixed cost and the marginal cost of serving a client are very low which result in some great advantages. The case of slow demand in some area does not cause Airbnb any sort of loss in unused property like it would do for a hotel. On the other hand, it can respond to an increase in demand with little friction. When the demand increases in a certain area, for instance due to a yearly festival, the prices rise quickly and more people are willing to rent their homes via the platform. There is some empiric data backing up this claim. In an empirical study (Zervas et al. 2016) found that Airbnb specifically reduces hotels' average prices during times of a peak demand.

This optimal response to changes in the demand is very typical for the two-sided markets. In a way they create optimal market conditions between buyers and sellers that can resemble perfect competition or at least come closer to it than a market that operates normally.

Airbnb has been able to exploit their advantages very well. In 9 years Airbnb has been able to grow in to multinational company with over 2,6-billion-dollar revenue (Bort, "Airbnb made $93 million in profit on $2.6 billion in revenue, but an internal showdown with the CFO has put an IPO on pause", Nordic Business Insider). Indeed, the quick success of Airbnb has already had a notable effect in the hotel industry. One Credit Suisse analyst showed that hotel prices started going down in 2015. The room prices were as much as 18% down in January 2015 from the previous year (Philips, "New York City hotel rooms are getting cheaper thanks to Airbnb", Quartz, 9.2.2015).

Similar impacts have been noted elsewhere. Texas concluded that the weakest hotels' revenues were impacted by 8-10% in Austin as the result of Airbnb coming into the market. (Zervas et al. 2016, 688). Their study found a clear impact by Airbnb coming into the market as the hotel prices in 2014 and 2015 levelled or went down in all price categories from previous years in Austin, where Airbnb is strong, while kept going up Dallas, where there are very little Airbnb homes. They found that the prices went down especially during the high demand season compared to the years when Airbnb was not yet in the market.

This is an indication that Airbnb's frictionless response to changes in demand, affect hotels' possibilities to raise prices during a high demand. Hotels that are mostly catering leisure travelers took the biggest hit while those who mostly serve business travelers were less impacted by Airbnb's competition (Zervas et al. 2016, 697). The hotels responded to new competition by lowering prices (Zervas et al. 2016, 704). Interestingly this means that not only the consumers who chose Airbnb benefitted from competition but also those who kept using hotel services meaning that in this case, consumers as whole are the winners of this two-sided market.

All the platforms discussed in this subchapter, seem to have at least attributes that apply for both the models, the one by Rochet & Tirole of competing platforms and the one by Caillaud & Jullien without exclusivity except Airbnb which does not seem to have a relevant platform competitor. The price structure is favoring mostly buyers, again, with exception of Airbnb where they have interestingly two different prices depending on the nature of the trade.

Generally, Airbnb has a transaction fee 3 % for host and a between 0-20 % transaction fee for the guest. However, in their service for providing experiences, the seller pays the whole 20 % and the buyer is charged no fee. (Airbnb, What are Airbnb Service Fees? 23.4.2018). Of course, this could be a coincidence but it could also be that the elasticities of demand towards Airbnb platform differ depending on the type of the service. If the experience provider sells their service as professional, and are depend on the generated income, they could have lower elasticity of demand than the home renters who are likely to have another source of income. On the other hand, this could also be caused by the buyer side. The experience is a complementary service and the buyers might have higher elasticity of demand towards the service than for finding a place to rent. Either of these hypotheses would cause a shift in the price structure by changing the relation between the elasticities of demand familiar from the third chapter: $\frac{P_m}{P_i} = \frac{\varepsilon_m}{\varepsilon_i}$.

5.4 Reverse auctions platforms; international trade and labor outsourcing

There are multiple different types of two-sided markets that work different ways. However, since they are becoming more and more relevant it is good to analyze if there are indications on who benefits most of the rise of the platform economy. It is also interesting to see if anyone loses when a new platform emerges into an industry.

In most of the cases, consumers (or the buyer side) should be better off with a platform since platforms, especially the matching ones, tend to increase competition that saves their time of doing research of the market prices on their own. In addition, they often tend to get subsidized as a strategy by the platform to capture more market thus, improving the consumer’s welfare even more. Moreover, the market situation before the platforms might be regulated and the platform can perhaps break the regulation.

There is one type of benefit for the buyer side that has not been discussed in this article. International outsourcing and direct international B2B sales have become a normal form of business that helps buyer companies to find more options and possibly cut the middle man, for instance, an importer. Special cases are those where, not only can the buyer compare large number of sellers, but also publish a project and ask for offers from the seller. These matching platforms are essentially creating a situation of a reverse auction. This applies, for instance to platforms that connect suppliers to customers like Alibaba and platforms that help in outsourcing like upwork.com. They often function as the reversed first price sealed auctions where the buyer creates a project and the sellers react to it with sealed offers. After having received the offers, they can negotiate with the sellers before making the decision. The buyers can still even opt out of the deal if they choose. (Upwork, How it works?,)

This system puts the buyer in a favorable situation. The reverse auction yields similar profit to the auctioneer as a normal first price sealed bid auction where the benefit for the auctioneer is $\frac{n-1}{n+1}$, n being the number of bids. If the platform is popular among the sellers, the number of bids should be high. Additionally, the auctioneer can set a max cost which then eliminates the possibility for the sellers to use symmetric equilibrium strategies. In most platforms, the sellers do not know accurately the amount of the bidders for the reverse auction. This makes the bidder's task to use any strategies even harder.

With this reverse auction system, the buyer side can get adequate bids for their project even with a presence of high information asymmetry for instance in a case of buying products directly from a manufacturer or hiring a freelancer from abroad. The buyer will benefit from the transparency of and the fact that the bidders often fiercely compete to win the auction. Also, they are not limited geographically in a same way as often in normal trade without the platform. (Manoochehri & Lindsy 2008, 125).

These possibilities of using a platform can bring huge benefit for the buyer. Buying directly from the supplier for instance through Alibaba cuts off the importer and can lower the costs significantly. When considering the case of hiring a freelancer the cost level can be lower as the buyer can look to get service from countries with a lower wage level in general. Additionally, if the buyer does not have a good knowledge of the price level of the project, the auction mechanism helps them to get close to truthful quotations from sellers which might not be the case had they to negotiate independently. The savings for a company can be huge. After Rio Grande Regional Hospital started using a bidding process to contract individual nurses, their wage costs dropped over 64 % (Zack, 2006, 14).

5.5 Who loses in the platform economy

So, who loses in the platform economy if anyone? In most cases, the sellers should also get benefits in a form of more demand for their product or service. Even if they are the ones who end up paying the buyer a subsidy, this should leave them at least profitable as otherwise they would not participate in the platform. However, there can be cases where the sellers participate but it is not hundred percent clear if they are happy to do so. One example would be the shops that accept the credit cards. Shops end up paying for the convenience of the shoppers not having to carry money but it is unclear, what is the benefit of the credit cards for the shops themselves. On the other hand, they cannot really stay out and not accept as the customers would just carry their cards elsewhere. Sometimes shops try to drive customers away from using credit cards with tactics like giving cash discount or have minimum payment for credit card purchases. (Emch & Thompson 2006, 49). This is an indication that they are not necessarily happy with the widespread use of the cards. The big law suits towards the platforms are an indication that merchants would rather not allow these cards to be used, as well.

Another group that might lose when a two-sided market emerges are clearly those who benefit from the uncompetitive market conditions that are present without the two-sided market. These conditions can be a result of regulations such as in the taxi services. In that case a debate might arise if the regulations are needed. The barriers can also be something more natural. The information asymmetry between the trade parties and the lack of common legal ground can cause the buyers to prefer local sellers or importers as middleman in international trade. When a two-sided market emerges, the importers and local sellers might be worse off. For importers they face a completely new type of competition that can be more efficient. In the case of local sellers, the situation is similar erasing a tariff or trade barrier in international theories. The local production must move to another industry if they are not competitive enough. However, for the seller that has a comparative advantage, the market size increases with a platform. Producers in China for instance enjoy much larger markets through the Alibaba platform. With freelancers, again it depends on where they live. If they are from a country with a high capital/labor ratio compared to the rest of the world, they become worse off. The aggregate offer for a labor increases through the platform more than any possible projects to participate and thus the local wage level decreases. On the other hand, the workers in countries with low K/L ration will be better off with more opportunities. (Lucas, 1990).

Sometimes, the market just could be inefficient allowing the sellers to enjoy the monopoly power and good negotiation positions. In the end, in many cases the whole value created by the platform lies in lowering the search cost for the buyers. Yannis Bako argued already in 1998 that many industries from electronic appliance sellers to travel agents will see their monopolistic power to go down as the price transparency goes up.

Even if currently the consumer is benefitting from the platforms, it is important for the antitrust agencies to beware of the growing platforms. While currently the monopolies might not be harmful for the economy, with this new topic it is impossible to say with certainty if this remains in the future.

6 CONCLUSIONS

This article aimed to bring some clarity into the literature of two-sided markets which is currently rich but quite vague without any clear definitions and terminology. The article identified some definitions on what a two-sided market is, what are some of the main theories of competition related to and how do they differ. The chapter two, identified an acceptable definition of the phenomenon having three key properties to separate from the traditional one-sided markets and one unique to this article to divide the two-sided markets into two different types depending on some key properties. Chapters three and four went through the main theories of the two-sided market competition and their implications as well as. In those chapters, the article also tried to identify what possible empirical examples would be relevant with to which theory. The chapter five went deeper into connecting the theories with empirical examples by providing some real-world instances of different two-sided markets. The chapter shed some light on different questions related their competition with the examples.

Based on this article and previous literature, it is obvious that the two-sided markets have different properties than the normal firms and compete in a different fashion. Many of these properties are attributed to the cross-network benefits that heavily influence the two-sided markets. The platforms might use a variety of tactics in growth and compete very aggressively. They also, face some unique problems when growing that they need to solve.

However, when successfully launched, the two-sided market platforms can be very profitable as often they can operate with extremely high volume while maintaining low costs compared to normal firms. Indeed, with the examples, this article presented how in numerous instances traditional firms can suffer when a two-sided market starts to compete with them.

The examples also shed light on who are the winners and the losers of the platform economy. This article argues with supporting results from previous studies that the consumers are almost exclusively benefitting from the two-sided markets. Often the core concept of a two-sided market is to bring transparency into the market benefitting the consumers. Moreover, due to the nature of the pricing structures, the consumers often end up being subsidized by the platform. Besides, the firms that get trampled by the competition introduced by a platform, the sellers sometimes can end up on the losing side, as well. It seems that there are instances where a platform can be so influential that sellers are forced to participate in it, even while being the ones who end up paying the consumer's subsidy. This has resulted in antitrust lawsuits as some of the platforms are believed to exploit their monopolistic power. Of course, it is not a clear cut that all the sellers lose. They can get more demand and some of them can be so popular among the customers that they can negotiate a favorable deal with the platform.

The previous literature on the subject has managed to identify the two-sided markets as a subject for academic research. It has also managed to create some widely accepted theories on the competition of two-sided markets. These theories have sparked more detailed continuations on top them as well as some empirical experiments on the subject. The empirical studies have managed to support some claims of the theories, for instance, the peculiar price structure.

However, as the subject is relatively young, there is room for more studies definitively for empirical ones but probably also for new theoretic ones. Empirical ones will become easier to conduct as there are number of new platforms emerging thanks to internet while some already established have not yet produced enough data to study but will do it within a decade. One interesting area to study would be the equilibrium points of the chicken and egg problem. When do users start to naturally gravitate towards a platform? With the Visa card they had to give millions of cards for their users for free of charge. With many internet platforms rising, it becomes easier to study these cases and find the tipping points. Perhaps studying the geographic of the spread of some services can give us an empirical indication of the equilibriums. Other area with a need to conducts studies is the antitrust perspective as the platforms are becoming bigger and bigger players in the global markets making it important to know what the consequences are if they have a monopoly situation. All in all, with the raise of internet-based commerce, the two-sided markets make an interesting and topical field of study with peculiar dynamics and huge implications to the global economy.

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