Three Essays in Industrial Organization

Competition Policy and Regulation

Inaugural-Dissertation
zur Erlangung des Grades
Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität München

2009

vorgelegt von

Joachim Klein

Referentin:	Prof. Dr. Monika Schnitzer
Korreferent:	Prof. Dr. Andreas Haufler
Promotionsabschlussberatung:	22. Juli 2009

To my parents Rosemarie and Wilfried,
my sisters Ulrike, Marion and Bianca,
my brother Michael,

for 30 years of love, patience and support.

Acknowledgements

First and foremost, I would like to thank my supervisor Monika Schnitzer. She gave me continuous support, encouragement and guidance. Without her patience, her sharing of experience and knowledge as well as rigorous academic thinking, writing this dissertation would have been impossible. I am indebted to Andreas Haufler who gave me precious feedback and kindly agreed to become my second supervisor. I am also grateful to Sven Rady and Ray Rees for offering their support and time and agreeing to join my thesis committee. Special thanks go to my co-authors of the first chapter, Richard Schmidtke, and the second chapter, Hans Zenger. I learned some of the most valuable lessons, intellectually as well as personally, from working together with them.

Part of this dissertation was written during my stay as a visiting fellow at the European Commission, Chief Economist Team, Directorate-General for Competition in Brussels, Belgium. I would like to thank all members of the team for welcoming and hosting me. I enjoyed the inspiring environment at the intersection of economic research and its application to real world cases in the field of international competition policy and regulation. Moreover, I benefited a lot from the insightful suggestions I received on my work. Special thanks go to Daniela Bremer, Damian Neven, Miguel de la Mano, Mario Mariniello, Oliver Stehmann and Vincent Verouden. I thank the Kurt-Fordan Stiftung for financing this stay.

Over the years, colleagues, conference and seminar participants have influenced my work through their comments and suggestions. Christian Bauer, Jan Philipp Bender, Matthias Fahn, Tobias Klein, Maria Lehner, Tu-lam Pham, Markus Reisinger, Patrick Rey, Linda Rousova, Sebastian Scholz, Florian Schütt, Anno Stolper and Catherine Roux deserve special mention. I would also like to thank participants of the 2008 EALE Annual Conference in Haifa, Israel; the 2008 EARIE Annual Conference in Toulouse, France; the Warsaw International Economic Meeting 2008 in Warsaw, Poland, the 2007 BGPE Research Workshop in Würzburg, Germany; and the 2007 Summer School "Antitrust for Networks" in Alba di Canazei, Italy, for helpful comments and suggestions.

The stimulating environment at the Munich Graduate School of Economics has been an important factor for my research. Therefore I would like to thank all professors and doctoral students with whom I have been in contact there. My office comrades Silvia Appelt, Johannes Maier, Felix Reinshagen and Jan Schikora helped me to get some distraction from research and teaching. I am going to miss those days a lot. During the past years, I also benefited from the administrative assistance of Ingeborg Buchmayr, Silke Englmaier, Gabriella Szantone-Sturm and Ines Pelger who have always been ready to offer their help when needed. Financial support from the Deutsche Forschungsgemeinschaft through GRK 801 is gratefully acknowledged.

I would also like to thank people who have paved my way to writing a doctoral thesis through their incitement and support during my studies in Mannheim, Germany, and in Toulouse, France. An incomplete list includes Claude Crampes, Helmuth Cremer, Guido Friebel, Martin Hellwig, Andreas Irmen, Marc Ivaldi, Bruno Jullien, Oliver Kirchkamp, Heiko Karle, Johannes Koenen, Jeanine Miklós-Thal, Benny Moldovanu, Michel Moreaux, Martin Peitz, Francois Salanie, Aude Schloesing, Giancarlo Spagnolo, Konrad Stahl, Bertrand Villeneuve and Alexander Wagner.

Finally, I would like to thank my family and all my friends who supported me during my academic journey. In particular, I am grateful to Anna von Behr, Anny Degani, Tobias Köhne, Rainer Lanz, Sven Laube, Annika Nübold, Eyal Petersiel, Anna Petry and Torsten Thurmann.

Joachim Klein

Munich, September 2009

Contents

Preface

"To widen the market and to narrow the competition is always the interest of the dealers [...] The proposal of any new law or regulation of commerce which comes from this order, ought always to be listened to with great precaution, and ought never to be adopted, till after having been long and carefully examined, not only with the most scrupulous, but with the most suspicious attention. It comes from an order of men, whose interest is never exactly the same with that of the public, who have generally an interest to deceive and even to oppress the public, and who accordingly have, upon many occasions, both deceived and oppressed it." (Adam Smith, 1776)

This quote shows that economists have been worried about the potentially diverging interests of firms and society for centuries. While Adam Smith stresses the point that producers and dealers have a strong interest in gaining market power and limiting competition, economists nowadays are also well aware that governmental intervention can sometimes overshoot the mark. As Jean Tirole (1988) puts it: "Imperfectly competitive markets [...] are unlikely to maximize social welfare. This does not necessarily mean that government intervention can improve on the private outcome given its structure of information, nor does this observation indicate when and how the government should intervene."

Since the nineteen-seventies the application of game theoretic models to the analysis of individual industries and markets has helped to give answers to the problem of determining the right measure of intervention in private markets. In the constantly evolving real business world new conflicts between policy makers and firms arise that should be addressed and analyzed by economists.

In this thesis the strategic interplay between government policy and firms is analyzed using tools from cooperative and non-cooperative game theory. Chapter 1 is joint work with Richard Schmidtke. We consider the problem of governments to set appropriate transfer pricing regulations for business relocations by multinational enterprises.

Chapter 2 is joint work with Hans Zenger. We examine under which circumstances incumbent firms can predate competitors through exclusive dealing contracts with buyers. In Chapter 3, I propose a model of advertising on internet websites. The websites have the ability to screen users and address them with targeted information. We analyze whether a ban of this practice is desirable from a social point of view.

In the remainder of this preface, we briefly summarize the main contributions of the three following chapters of the thesis. All chapters are self-contained and can be read separately.

In recent years, globalization has caused an increasing volume of international trade to remain outside the scope of market forces. Today, more than half of global cross-border trade takes place within multinational enterprises. This affects the profits which occur in each country and therefore also corporate tax payments. Any kind of cross-border transaction may allow multinational firms to engage in income shifting from high-tax to low-tax countries and therefore to benefit from differences in local tax rates. National governments react by installing transfer pricing regulations to avoid an erosion of their tax base. In Chapter 1, we characterize the optimal choice of transfer pricing regulations with a special emphasis on the treatment of business relocations. Taking corporate tax rates as exogenously given, we ask which transfer pricing regulation countries should agree on in order to maximize their common welfare.

Our study is motivated by two observations: First, although transfer pricing has emerged as the most important topic for multinational firms to optimize their worldwide tax burden, so that national governments have enforced strict regulations in response, the economic literature does not yet consider any welfare implications of transfer pricing regulations. In particular, the interactions of transfer pricing regulations with the organizational forms firms choose or the investment decisions firms take has not been analyzed yet. Second, detailed transfer pricing regulations are by now also starting to cover business relocations in addition to cross-border transactions of goods, services and intellectual property rights. The shift in potential future profits through the relocation of businesses has emerged as one of the most important topics.

We develop a three-stage game that models the relationship between transfer pricing regulations and welfare. In the first stage governments cooperatively determine the transfer pricing regulation. In the second stage firms choose the organizational form, i.e., whether to relocate a business or not and whether to trade via external markets or to carry out trade via internal markets as a multinational firm. In the last stage prices and profits are realized and taxes are paid by the firms.

In our analysis, we focus on two potential distortions that are attributable to inappropriate transfer pricing regulations. First, transfer pricing regulations may influence a firm's business relocation decision. Thus, inappropriate regulations can either prevent welfare-increasing relocations or encourage relocations that are merely driven by tax saving incentives, but do not realize production efficiency gains. Second, transfer pricing regulations can have an impact on the type of a business relocation, i.e., whether it is carried out between unrelated parties or related parties. As an example, it is possible that multinational firms have efficiency gains compared to unrelated firms that are not realized when firms prefer to trade as unrelated firms.

Surprisingly, we find that a simple transfer pricing regulation dictating that "related parties have to use the market price of unrelated parties as the intercompany transfer price as long as no party is worse off" implements the first best solution. The reason is that the incentives for unrelated parties to relocate business are not distorted by taxes. Relocation will only occur in cases where to do so is welfare-enhancing and where unrelated parties split up additional tax savings according to their bargaining power. Intuitively, unrelated parties will only agree on a relocation if neither party is worse off. This implies that the transferor has to receive a compensation that is at least as high as the income capitalized if the party does not sell. This threshold value ensures that only efficiency-increasing relocations are realized.

This result implies that one does not have to account for efficiency differences of a MNE compared to unrelated parties. Our finding contributes to the ongoing discussion that is centered around the question of whether and how to take into account efficiency gains in transfer pricing. Efficiency gains of a multinational firm are not reflected in the empirically observable market prices and one would have to adjust the market price for transfer pricing purposes. We show that they need not be incorporated if one is concerned about welfare.

In Chapter 2 we turn to practices of predatory pricing and predatory exclusive dealing. Predatory pricing means that a firm sets prices at a level that implies short term losses in order to force a rival out of the industry and then get higher profits in the long-run. Predatory exclusive dealing means that incumbents offer buyers exclusive dealing contracts at terms that also imply the sacrifice of short term profits and an increase in profits in the long-run after a rival has been driven out of the market.

There are two motivations for our study. First, most recent antitrust procedures against exclusive dealing have been concerned with predatory exclusion of active rivals. Strong incumbent companies are accused of accepting lower profits in one period to exclude an incumbent competitor (in this context called prey) and then recoup those losses in future periods. Indeed, U.S. antitrust enforcement currently seems to consider only this type of exclusive dealing as anticompetitive, while typically not intervening against exclusive dealing which raises short-term profits. Second, predatory exclusive dealing has so far not been analyzed formally in the economic literature. In this chapter, we try to fill this gap by investigating the ability of firms to use exclusive dealing in order to predate.

We develop a two-period price competition model where two (efficient) incumbent firms compete against each other. One firm is dominant and has a deep pocket, i.e., the firm has unlimited financial resources, while the other firm has a small pocket (i.e., it is dependant on investors). In each period, firms first simultaneously announce whether they insist on exclusivity or not. Then both firms set prices and consumers make their orders. Two scenarios are possible in the second period. Either both firms are still active in the market and the first stage game is repeated, or the small firm has left the market. The latter case can occur when its profits turned out to be so low in the first period that it did not obtain continued financing by its investors. If the small firm has left the market, the large firm receives monopoly profits in the second period.

By allowing for exclusivity clauses in a model of predation, we show that exclusive dealing may arise in equilibrium even in circumstances where it can not be profitable in a one period setting. This is an interesting result, because the literature has so far concentrated on firms' possibilities to increase short term profits through exclusive dealing agreements. We show that exclusive dealing is often a cheaper way of predating than predatory pricing. In our model this is the case if the prey's access to capital is not too limited, so ordinary price predation is expensive. It also turns out that the more market power the predator has with respect to the prey, the more likely it is that exclusive dealing is preferable for the predator compared to predatory pricing.

These results reflect the main advantages and disadvantages of the two instruments. The big disadvantage of predatory pricing is that it forces the predator to decrease prices not only for marginal units (those that it intends to capture from the prey to force the latter's profits down), but also for intramarginal units. Predation is a costly exercise: the predator wants to enhance the reach, but this implies to decrease prices.

Exclusive dealing is less harmful in that respect. However, exclusive dealing is not without cost relative to predatory pricing. The big disadvantage of exclusive dealing is its scope. Exclusivity forces consumers to give up the entire consumer surplus that they would enjoy from sourcing some units from the prey. This makes it costly to convince consumers to accept an exclusivity clause.

The previous literature on exclusive dealing has concluded that the exclusion of existing competitors (as opposed to abstract potential entrants) can only have anti-competitive effects under particular conditions, for instance, if there are contracting externalities from related markets. Our model, in contrast, reveals that the scope for anticompetitive exclusive dealing is much larger. While exclusive dealing may often not be profitable in a static context, it does provide a cheap and effective instrument to predate in a dynamic setting.

The last chapter of this thesis discusses whether internet websites should be allowed to analyze user information in order to target advertising. In traditional media like newspapers and televisions, the content of advertisements is inevitably the same for all consumers. However, recent technological advances enable internet-based media to identify users and send them advertisements with different content. This practice is called targeted advertising. Targeted advertising on internet websites raises new and interesting economic questions. When firms are able to learn the identity and characteristics of users they are able to send individual users selective information on products. While this could be potentially beneficial to users if they get less undesired advertisements, targeted advertising may also facilitate the practice of price discrimination.

The issue of market power arises here, because internet websites become information gatekeepers with regard to the information they have about their users. Websites can charge higher prices for their advertising space by passing these pieces of information on to advertisers. One interesting question that is raised here is whether the ability to identify users increases or lowers the amount of advertisements sent to a user. On the one hand, advertisers can abstain from sending ads to users who would never buy their products, but on the other hand they could increase the amount of ads for products that consumers like. With this study we contribute to the ongoing public debate among website providers, users and privacy advocates on the desirability of a governmental ban on such business models.

We develop a three-stage model to analyze the strategic interaction between the website, users and advertising firms. Advertising is purely informative in our model, i.e., people learn about the existence and characteristics of products. In the first period, the website provider has to choose between financing the website with traditional non-targeted or with targeted advertising. Given the chosen mode, the website then sets a price per ad. In the second stage, users decide to enter the website or not. In our model users differ in their valuation of the services that the site provides, while they all have the same aversion towards watching advertisements. Moreover, users differ in their preferences for consumer products. Finally, firms selling consumer products have to decide on the amount of advertisement they demand and the price that they promote in their ads.

Our study leads to some new and surprising results. While targeted advertising always benefits firms, consumers are not better off in this mode. Under targeted advertising, the amount of advertisement can indeed be lower compared to conventional non-targeted advertising. However, this potentially positive effect for consumers is overcompensated by the reduction in consumer rent that is caused by firms' practice of price discrimination. We extend our model to examine the effect of targeted advertising when firms have to send the same content to all users they address. Interestingly, in this case consumers can also benefit from targeted advertising because they do not loose rent from buying products compared to the non-targeted advertising mode.

From our analysis we derive some interesting policy implications. On the one hand, it is undoubtedly positive that targeting lowers the wastage of redundant advertisement and thus increases efficiency. On the other hand, the ability to target certain user groups with special rebates decreases consumer utility. To conclude from this that targeted advertising should per se be prohibited seems to go too far. However, a ban on price discrimination could make sure that targeted advertising increases the welfare for all agents involved.

Chapter 1

Transfer Pricing Regulations and Business Relocations *

1.1 Introduction

Globalization causes an increasing volume of international trade to remain outside the scope of market forces. UNCTAD (2003), for example, reports that 60% of international trade takes place within multinational enterprises (hereafter MNEs). Such cross-border transactions may allow MNEs to engage in income shifting from high-tax to low-tax jurisdictions and therefore to benefit from differences in local tax rates.

National governments react by installing transfer pricing regulations to avoid an erosion of their tax base. Most industrialized countries base their national legislation on their interpretation of the OECD Transfer Pricing Guidelines (OECD, 2001).[1] Presently, tax authorities in over 44 countries have implemented explicit and detailed regulations. At the same time, they have increased their administrative resources to monitor compliance. The internationally accepted standard of most countries is the arm's length principle laid out in Paragraph 1 of Article 9 of the OECD Model Tax Convention (OECD, 2008a).[2] This paragraph basically states that related parties have

*This chapter is joint work with Richard Schmidtke.

[1] The OECD transfer pricing guidelines were first issued in 1979 and have since become internationally followed. The OECD recommends using the "arm's length" principle when treating related enterprises within a multinational group and affirm traditional transaction methods as the preferred way of implementing this principle. An extensive update was published in 1995, and revisions and additional material are published periodically.

[2] The OECD publishes and continually updates a model tax convention that serves as a template

to use intercompany transfer prices that would be agreed upon between two unrelated parties under similar conditions. Therefore, for tax reporting, market prices have to be applied to intercompany transactions.

In this chapter, we determine the optimal choice of transfer pricing regulations for two countries in a cooperative setting. Taking corporate tax rates as exogenously given, we ask on which transfer pricing regulation countries should agree in order to maximize their common welfare. In this context, we put special emphasis on the treatment of business relocations. Our work is motivated by two observations:

First, although transfer pricing has emerged as the most important topic for MNEs to optimize their world-wide tax burden and national governments have enforced strict regulations, the economic literature does not yet consider any welfare implications of transfer pricing regulations. In most papers dealing with this topic, transfer pricing is considered one of the inputs for modeling tax competition between competing jurisdictions. However, to the best of our knowledge, no paper has analyzed the interactions of transfer pricing regulations with the organizational forms firms choose or the investment decisions firms take.[3]

Second, detailed transfer pricing regulations are also now starting to cover business relocations in addition to cross-border transactions of goods, services and IP. The transfer of business functions and therefore the shift in potential future profits have emerged as one of the most important topics. An OECD working group has been discussing the issue of business relocations since 2005 and has just recently published a public discussion draft on this issue[4]. The German government has fuelled the debate on this issue; as part of its recent corporate tax reform, it articulated an interpretation of arm's length that has been heavily criticized by practitioners, both domestically and internationally.[5]

There exists a recent real world example of the importance of business relocations

---

for bilateral negotiations regarding tax coordination and cooperation. This model is accompanied by a set of commentaries that reflect an OECD-level interpretation of the content of the model convention provisions.

[3] One exception is Peralta et. al (2003). In their model, multinationals can choose the production location, but the applied concept of the transfer pricing rules is very simple. Here, governments can build up a reputation for monitoring the rules strictly or loosely. Lower enforcement makes a country more attractive for MNEs, as firms know that they can lower their corporate tax since profit shifting is possible.

[4] See OECD (2008b).

[5] See Kroppen et al. (2007).

for economies and of the impact of taxes on the incentives for relocation decisions. Nokia, which seemed to have a profitable factory in Bochum (Germany), decided to relocate its production to Jucu in Romania. Reasons publicly offered were lower labor costs and the differences in corporate taxes. Romania has a flat tax of 16% in contrast to Germany, where the average corporate tax rate is about 30%. The Nokia example raises the interesting question of whether this relocation would have happened without such a difference in local tax rates. If the relocation decision was heavily influenced by tax aspects, the relocation might actually decrease global welfare due to additional shut down costs in Germany and build up costs in Romania.

In order to determine the optimal transfer pricing regulation for business relocations, we develop a simple three-stage game that models the relationship between welfare and transfer pricing. In the first stage governments cooperatively settle on the transfer pricing regulation. In the second stage firms choose the organizational form of their activities, i.e., how to set up the supply chain and whether to trade via external markets or to carry out trade via internal markets as a multinational firm. In the last stage prices and profits are realized and taxes are paid by the firms.

In our model, we focus on two potential distortions that are attributable to inappropriate transfer pricing regulations. First, transfer pricing regulations may influence a firm's business relocation decision. Thus, setting the "wrong" transfer pricing regulations can either prevent relocations that are welfare-increasing or encourage relocations that are merely driven by tax saving incentives and do not realize production efficiency gains. Second, transfer pricing regulations can have an impact on the type of a business relocation, e.g., whether it is carried out between unrelated parties or related parties. If the transaction takes place between related parties, i.e., in the form of a MNE, the related parties may have an opportunity to shift income and thus avoid taxes. Hence, transfer pricing regulations could lead firms to choose an organizational form that maximizes their after-tax profits but decreases welfare.

Interestingly, we find that the simple transfer pricing regulation dictating that "related parties have to use the market price of unrelated parties as the intercompany transfer price as long as no party is worse off" implements the first best solution. This is somehow surprising because this simple rule does not account for any efficiency gains of a MNE compared to unrelated parties. One would expect that in order to give the firms the right incentives, one would have to condition the optimal regulation on the efficiency gains realized. However, we find that the market price of unrelated parties already maximizes welfare.

Our finding has interesting implications because there is an ongoing discussion of whether and how to take into account efficiency gains in transfer pricing. Efficiency gains of a MNE are not reflected in the empirically observable market prices and one would have to adjust the market price for transfer pricing purposes. We show that one can avoid such cumbersome analyses without negatively impacting welfare. Moreover, our finding rationalizes the application of the arm's length principle from a welfare point of view.

Furthermore, we find that, as expected, related and unrelated firms are able to benefit from differences in tax rates. However, counter-intuitively, the incentives for unrelated parties to relocate business are not distorted by taxes. Relocation will only occur in cases where to do so is welfare-enhancing and where unrelated parties split up additional tax savings according to their bargaining power. Intuitively, unrelated parties will only agree on a relocation if neither party is worse off. This implies that the transferor has to receive a compensation that is at least as high as the income capitalized if the party does not sell. This threshold value ensures that only efficiency-increasing relocations are realized.

We then compare our results to the German interpretation of the arm's length principle in the case of business relocations. According to the German government, loosely speaking, the transfer price should be the average of the after-tax profits realized at home and abroad if the taxpayer does not show that an alternative price is more reasonable. The idea behind the average may be that unrelated parties would split equally the additional profit. However, we show that the German proposal fails to take into account that the split of profits after tax cannot be used to directly determine the price paid before taxes. In this chapter we derive the right transfer price given the assumptions applied by the German government. Furthermore, we point out that the average may be ad hoc and does not correspond to a welfare-maximizing transfer price.

Related Literature

The literature on transfer pricing can be divided into two fields. One field focuses on transfer prices as providers of incentives for managers who have independent decision power. Examples of this literature are Amershi and Cheng (1990), Holmstrom and Tirole (1991), and Anctil and Dutta (1999). The second field examines the implications of transfer pricing and tax regulations on intercompany transactions across different countries that compete with each other. Examples are Kind et al. (2002, 2005), Haufler and Schjelderup (2000), Peralta et al. (2003), and Amerighi (2006). While the incentive literature is applicable to all multidivisional firms, the tax literature applies only to firms that engage in cross-border transactions across different tax jurisdictions. Given that firms are usually allowed to have two sets of books, one for internal bookkeeping and one for tax accounting requirements, we assume that these problems should be treated separately. In the following, we therefore refer only to papers from the second field.

Since we are concerned with the effect of transfer pricing regulations when MNEs operate across different jurisdictions, this chapter belongs to the second group. However, in contrast to the existing literature, we do not consider a tax competition model but rather look at governments that coordinate their transfer pricing regulation. We acknowledge that tax competition takes place but the question regarding the level on which this competition occurs arises. What we observe is that countries are able to agree on double tax treaties based on the model tax convention of the OECD. The basic idea behind these agreements is to avoid double taxation, i.e., profits should be taxed only once. We assume that it is fair to say that tax competition is more about tax rates and less about transfer pricing regulations. Differences in transfer pricing regulations will result in double taxation. Generally double taxation has to be resolved through costly arbitration procedures as stipulated in the double tax treaties.

Furthermore, we observe that countries were able to coordinate on a common standard, namely the arm's length principle. However, the interpretation of what arm's length means may differ from country to country. Our work is intended to provide guidelines for the application of the arm's length principle by analyzing the welfare maximizing transfer pricing regulations.

There exists some previous literature on optimal transfer pricing regulations starting with Horst (1977) who analyzes the output decision of a MNE that produces in one country and sells both domestically and abroad. It is shown that the transfer price that is selected as the internal price for the transaction to the selling division abroad does not influence the quantity decision. The transfer price just cancels out and therefore, in this setting, does not influence the allocation[6]. The intuition behind this result is

[6] At the end of the appendix, we discuss in a short extension that in our setting the transfer price does influence a MNE's quantity decision regarding what percentage of a business to relocate.

that the firm would not be maximizing profits if it did not set marginal revenue equal to marginal cost in each market under imperfect competition. The transfer price is then simply an internal transaction that occurs after sales and production have taken place. Eden (1982) reveals the same result in a more general setting with different cost structures.

There are two more recently published papers in which the choice of transfer pricing rules is also explicitly modeled. Mansori and Weichenrieder (2001) consider two governments in jurisdictions with (exogenously fixed) different tax rates. They show that competition for tax revenue from a MNE leads to the choice of different transfer prices and thus double taxation as a non-cooperative equilibrium. The results are excessive taxation and depressed international trade. In a cooperative setting, both governments are better off by choosing a common transfer price when side payments are possible. The reason for this is that the double-marginalization problem is solved and trade and profits increase. In the absence of side payments, cooperation is not always possible, as a common transfer price can leave one party worse off. Scharf and Raimondos-Moller (2002) analyze a similar setup with a more general model and arrive at the same result. In contrast to the literature, we concentrate on deriving optimal transfer price regulation in a cooperative setting, where governments look for the welfare maximizing rules.

The chapter proceeds as follows. In the next section, we set up the model. We solve for the optimal transfer pricing regulation in section 1.3. In section 1.4, we compare our findings to the new German transfer pricing rules. In section 1.5, we discuss alternative outside options for the transferring and the receiving parties. Section 1.6 concludes.

1.2 The Model

We consider a simple model with two countries denoted by $i \in \{h, l\}$. The two countries have different tax rates, $\tau_h \in [0,1]$ and $\tau_l \in [0,1]$, which we assume as given. This is in line with both Mansori and Weichenrieder (2001) and Raimondos-Moller and Scharf (2002). Country h is the high-tax country, country l is the low-tax country, $\tau_h > \tau_l$. A firm is considered multinational if it is located in countries h and l. We assume that taxes have to be paid locally by each entity, hence the effective taxation of related firms is source-based. This is in line with most of the literature, see e.g. Keen (1993). If a firm is solely located in one country, the firm has to pay the local tax rate on its full profits realized.

We assume that the firm located in country h has developed an improved version of its old product. Its old product, produced in country h, becomes redundant. The firm decides on how to set up its supply chain, choosing either to keep the full production in country h or to relocate part of the production to country l. For simplicity we consider the production location decision as a zero-one decision for the firm. In the following, this will be denoted by the variable r. If $r = 1$, the considered part of the production is relocated to country l, and if $r = 0$, the full production remains in country h.

The product can be sold in the world market for a given competitive price p which is not influenced by the firm's production decisions. We assume that a capacity constraint allows the firm to sell a fixed quantity, which is normalized to one. Hence, the pre-tax revenue is equal to p. By assuming a capacity constraint, we abstract from any quantity effects. The reason is that for our analysis, we only need to have the possibility that firms can face different profits from producing at home or abroad. The absolute value of the two profits is not important for our quantitative results.

To keep the model simple, we only consider the part of the production that can be relocated and normalize the rest, i.e., the part that will always be carried out in country h, to zero. This is without loss of generality. We assume that for the part of the production being considered total costs of c_i are incurred. c_i depends on the location choice of the firm. We allow c_h to be higher, equal to, or lower than c_l. Total costs include variable costs for producing, any fixed costs for either converting the old plant or setting up a new plant as well as transportation costs.

If the firm decides to produce in country l, it has to choose whether to form a multinational that owns a foreign subsidiary or to remain unrelated and to outsource production to an unrelated party in country l. We introduce a binary variable m, which takes the value $m = 1$ for the first case and $m = 0$ for the latter. We assume that a MNE's transaction costs for producing in country l are different compared to the case of two unrelated parties.[7] As Williamson discusses, the determinants of transaction costs are frequency, specificity, uncertainty, limited rationality, and opportunistic behavior. Hence, to be as general as possible, we assume that the transaction costs incurred by a MNE can be higher or lower than the transaction costs of unrelated parties.

[7] For a foundation, see Williamson (1975).

We normalize the transaction costs of two unrelated parties to zero and denote by $d_i, i = l, h$ the additional transactions costs incurred by a MNE in country i, where d_i can be higher, lower or equal to zero. Thus, we put no restriction on the additional transaction costs, which means that it can be efficient to set up a MNE ($d_l + d_h < 0$) or it can be harmful to efficiency ($d_l + d_h > 0$). Moreover, the effect can be different for both subsidiaries in each country (e.g. $d_l < 0, d_h > 0$).[8]

Governments make a decision regarding transfer price regulation. The transfer pricing regulation demands that the multinational complies with the transfer pricing rule which we denote by P^{TP}. In our case the transfer price P^{TP} is payable from the firm in country l to the firm in country h in the case of a production relocation as a MNE. We assume perfect and complete information regarding the variables p, c_i, r, m. To make the regulation problem interesting we assume that the government cannot condition P^{TP} on d_i, since otherwise the optimal regulation would be trivial. We consider this assumption as realistic because it is quite impossible for an outsider to perform a reasonable estimate of the differences in efficiency of internal transactions compared to transactions carried out via the external market. Therefore, in our setting, the transfer price P^{TP} is a function of p, c_i, r, m so:

$$P^{TP} = P^{TP}(p, c_{i,}, r, m)$$

If production relocation occurs between unrelated parties, the firms negotiate a market price P^M that is payable from the firm in country l to the firm in country h in order to compensate for the foregone profit.

We apply the Nash-Bargaining Solution as a micro-foundation of the market price and make no specific assumption regarding the bargaining power, i.e. we allow for a range of possible market prices P^M.

Given the assumptions mentioned before, firms' profit functions can be stated as follows:

$$\pi_h = (1 - \tau_h)\left[(1 - r)(p - c_h) + r(m(P^{TP} - d_h) + (1 - m)P^M)\right]$$

[8]Note that we consider net present values. So transaction costs refer not only to the actual relocation of the business, but also to the future relationship between the two firms. It could be the case, for example, that the product is a good that the enterprise in country h requires as an input for future production. Given the nature of the particular product it can be better or worse for the future receiver of the input to be integrated with the supplier or not. Consequently, our d_i can be interpreted both as a factor in a one-time transaction or in a long-term relationship.

which is the net (after-tax) profit in country h and

$$\pi_l = (1 - \tau_l)\left[r((p - c_l) + m(-P^{TP} - d_l) - (1 - m)P^M)\right]$$

which is the net (after-tax) profit in country l.

The governments' objective is to maximize global welfare. Given that the final product market is perfectly competitive, consumer surplus is not affected by any decision in our model and we can restrict attention to the production side. This is in line with the setup of Raimondos-Moller and Scharf (2002).

One might ask what would happen if we allowed consumers to benefit from the relocation decision of a MNE. If the final product market were not perfectly competitive, lower production costs would also lead to a lower price for the final good. The impact on the consumer price would depend on the particular features of the final good market, e.g., the demand elasticity and the number of firms serving this market. There would be a direct relation between the higher profits firms get from a business relocation and the benefits consumers get through lower prices. This means that if firms realized an efficiency gain, consumers would also benefit. If no efficiencies were realized, consumers would not enjoy a higher surplus, too. Since the absolute values of these welfare gains are not relevant for our quantitative results, we think it is an appropriate simplification to focus only on producer surplus.

Global welfare in our model is defined as the sum of the firms' profits plus taxes paid. This equals the sum of the firms' pre-tax profits:

$$W = (1 - r)(p - c_h) + r(p - c_l) - rm\,(d_l + d_h)$$

Obviously, the transfer pricing regulation P^{TP} does not directly influence the welfare function, as P^{TP} does not appear in the function above. Shifting income from country l to country h via P^{TP} is left pocket/ right pocket and yields no direct welfare effect. However, as we will show in the following, P^{TP} changes the firms' profit-maximizing behavior and therefore has an indirect impact on welfare.

We assume that the timing of the game is as follows: first, governments implement a transfer price regulation P^{TP}. Second, firms observe P^{TP} and decide whether to relocate production and if they relocate production, whether to relocate within a MNE or between unrelated parties. In the last stage, prices and profits are realized, and taxes are paid.

1.3 Equilibrium

We solve the model by backward induction and first look at the last stage where three different outcomes are possible.

1.3.1 Third Stage

If the firm has decided to transfer business within a MNE ($r = 1, m = 1$), then a cross-border transaction by a multinational enterprise occurs. The transfer price applied has to comply with the regulation P^{TP} set by the government. In this case the following profits are realized:

$$\pi_h = (1 - \tau_h) \left(P^{TP} - d_h\right)$$

in country h, and

$$\pi_l = (1 - \tau_l) \left[p - (c_l + d_l) - P^{TP}\right]$$

in country l.

The firm located in h can also transfer the business to an unrelated receiving party ($m = 0, r = 1$). In this case, the compensation payment P^M is determined through negotiations between both firms. The following profits are realized:

$$\pi_h = (1 - \tau_h) P^M$$

in country h, and

$$\pi_l = (1 - \tau_l) \left[p - c_l - P^M\right]$$

in country l.

Third, no production relocation occurs ($m = 0, r = 0$), and the following profits are realized:

$$\pi_h = (1 - \tau_h)(p - c_h)$$

in country h, and

$$\pi_l = 0$$

in country l.

1.3.2 Second Stage

In the second stage, the decision is made, given P^{TP}, whether to relocate the production, and if yes, whether or not to relocate as a MNE. We first analyze the relocation decision given the firms stay unrelated. The firm located in h has to decide whether to relocate its business to the firm located in l in return for a compensation payment P^M, determined through Nash-bargaining, or to realize the associated profits of the business at home.

Usually, applying the Nash bargaining solution can be performed in two steps. In the first step, firms choose the alternative that maximizes the sum of profits, and in the second stage, they split the profits according to the Nash bargaining solution. In classical Nash bargaining games, the optimum chosen always has to be the alternative that maximizes the sum of profits. Otherwise, it is possible to realize a Pareto improvement by choosing an alternative that increases the sum of profits. The additional profit can be distributed in a way in which no party is worse off, since side payments do not change the sum of profits. Therefore, maximizing the sum of profits and splitting the sum are separable problems.

Quite contrary to the classical Nash bargaining game, the relocation decision is non-separable from the compensation decision in our model considered. This is due to the fact that the compensation price P^M has an impact on the sum of profits after taxes. Firms care about profits after taxes but P^M is paid before taxes. Therefore, if the local taxes rates are different, as assumed, then P^M determines the sum of after-tax profits. Thus, the relocation decision and compensation payment are interdependent problems. Interestingly, this destroys the possibility of unrelated parties profiting from any differential in local tax rates, ceteris paribus. A tax saving effect appears only for the additional pretax profits realized through the business relocation.

Proposition 1.1 *Unrelated parties relocate the production if and only if* $c_l < c_h$. *If* $c_l < c_h$, *they agree on a transfer price* P^M *as a compensation for the business relocation* *according to the following formula:*

$$P^M = \frac{\alpha(1-\tau_l)(p-c_l)+(1-\alpha)(1-\tau_h)(p-c_h)}{1-(1-\alpha)\tau_h-\alpha\tau_l}$$

where $\alpha \in [0,1]$ *denotes the bargaining power between both parties.*[9]

We see that, due to the necessary condition $c_l < c_h$, unrelated firms will only relocate their business if it is welfare-enhancing. Intuitively, in the case of unrelated parties, each party is maximizing its own profit and not the sum of both profits. The firm in country h will only relocate its business if it receives a compensation payment that is at least as high as the profit it gains from performing the production on its own. This sets a lower limit on the price P^M. The firm in country l can only afford such a compensating payment if it realizes a profit from the production that is higher than what the firm in country h would have realized. This means that firm l has to be more efficient. Therefore, trading between the two unrelated parties ensures that only efficient relocation decisions are performed. Interestingly, this implies that the relocation decision of unrelated parties is not distorted by any differences in corporate tax rates. Even if the tax rate of the receiving firm were zero, the delivering party would still have to pay taxes on P^M, which acts as a device to ensure that only welfare-increasing relocations are performed.

Next, we consider when it does pay off for firm h to relocate as a MNE which has two consequences: First, the transfer pricing regulation P^{TP} has to be applied and second, the difference of the transactions costs d_i have to be considered. The following proposition summarizes the decisions taken by the firms.

Proposition 1.2 *Assume that producing in country l is more efficient than in country h, $c_h > c_l$, then production is relocated and if*

$$P^{TP} < \frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)} + P^M$$

the firms choose a MNE as the organizational form. If

$$P^{TP} > \frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)} + P^M$$

[9] All proofs of this chapter are contained in the appendix.

the firms chose to relocate as unrelated parties. If

$$P^{TP} = \frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)} + P^M$$

firms are indifferent.

Assume that producing in country l is less efficient than in country $c_h < c_l$, then if

$$P^{TP} < \frac{(1-\tau_h)(p - c_h + d_h) - (1-\tau_l)(p - c_l - d_l)}{(\tau_l - \tau_h)}$$

the firms choose a MNE as organizational form and relocate. If

$$P^{TP} > \frac{(1-\tau_h)(p - c_h + d_h) - (1-\tau_l)(p - c_l - d_l)}{(\tau_l - \tau_h)}$$

the firms stay unrelated and no relocation takes place. If

$$P^{TP} = \frac{(1-\tau_h)(p - c_h + d_h) - (1-\tau_l)(p - c_l - d_l)}{(\tau_l - \tau_h)}$$

they are indifferent between choosing a MNE as organizational form/ relocation and staying unrelated/ no relocation.

We find that if $c_h > c_l$, then relocation will occur for sure. If this relocation is not conducted through a MNE, then unrelated parties will agree upon a relocation, since both parties benefit from the enhanced efficiency. The decision to relocate as a MNE depends on the magnitude between the tax effect and the impact on the transactions costs weighted by the applicable tax rates. If $c_h < c_l$, then unrelated parties will not relocate the production, independent of any tax differences. However, it might pay off to relocate as a MNE if the tax savings are high enough compared to the transaction costs and the difference between c_h and c_l.

1.3.3 First Stage

Governments choose $P^{TP} = P^{TP}(p, c_i, r, m)$ to maximize the following welfare function

$$W = (1-r)(p - c_h) + r(p - c_l) - rm\,(d_l + d_h)$$

We find that there exists a simple transfer pricing rule which guarantees that neither of the potential distortions occurs despite the fact that governments cannot condition on d_i.

Proposition 1.3 *When governments cannot condition on d_i, there is a unique transfer pricing rule that implements first best in our setting:*

$$P^{TP} = \max\{p - c_h; P^M\}$$

Intuitively, the optimal transfer pricing regulation has to ensure that:

(1) a MNE relocates if and only if it is welfare-enhancing ($c_h > c_l + d_l + d_h$). This is implemented by the first part of the condition, namely that P^{TP} has to be at minimum $p - c_h$. The condition ensures that profits realized in country h are as high as those realized without a relocation. As in the case of unrelated parties, then only welfare enhancing relocations are carried out.

(2) the relocation is carried out as MNE if and only if it is welfare enhancing compared to a relocation between unrelated parties($d_l + d_h < 0$). This is implemented by the second part of the condition namely, P^M. It ensures that if $d_l + d_h < 0$, then P^{TP} is not too high and that if $d_l + d_h > 0$, then P^{TP} is not too low so that the right incentives for creating a MNE are given to the firms.

Interestingly, the proposition shows that the simple rule to "use the market price of unrelated parties as the transfer price between related parties as long as no party is worse off" implements the first best solution. Hence, no accounting for any efficiency gains has to be performed in order to maximize welfare.

This insight has quite interesting implications for the practical work in transfer pricing. In practice, tax authorities may ask for accounting of efficiency gains, using the argument that unrelated firms would also take into account efficiency gains. Basically, this comes down to the question of whether the arm's length principle suggests that related parties have to use the same prices as do unrelated parties or whether it is saying that related parties have to use the price that the latter agree upon, as would occur in a relationship between such parties (thereby explicitly taking into account transaction cost differences). In the latter case the difference is that each party maximizes its pay-off given the sum of payoffs generated from the relationship.

However, this would mean that one cannot use prices observed empirically, as such prices are between unrelated parties and the price used by related parties may differ. Consequently, if aspects related to efficiency are involved, one would always have to do a kind of hypothetical arm's length test to account for differences in efficiency, and no empirical verification would be possible. We conclude that to avoid hypothetical arm's length tests has its merits, since the test always leaves room for tedious discussions rather than furnishing verifiable facts as empirical methods do.

As we have shown, it is possible to use empirically observable prices without sacrificing efficiency. Furthermore, the first term in brackets of proposition 3 tells us what to do if it is not possible to determine an empirically observable price, since a relocation leads to efficiency gains only for related parties. In this case one can prevent distorting relocations by setting the transfer price equal to the transferring party's expected profit in the absence of a relocation.

1.4 Discussion of the German Transfer Pricing Regulations

In the following section, we discuss the new German transfer pricing regulations, Sec. 1 Foreign Tax Code, in the light of the findings above.

The German transfer pricing regulations set a hierarchy of transfer pricing rules: the transfer price has to be determined primarily by the comparable uncontrolled price method, the resale price method or the cost-plus method, i.e., by empirical methods. The aim is to derive a transfer price that would have been agreed upon between unrelated parties under similar circumstances. If comparable or limited comparable arm's length values cannot be determined empirically, the taxpayer has to perform a hypothetical arm's length test. In this case, the taxpayer has to determine the minimum price of the supplier and the maximum price of the recipient (range of potential agreement). The prices have to be based on the internal financing planning data of both sides. The minimum and maximum price will be determined using the expected after-tax profit. Then the price in the range with the utmost probability shall be used; if no other price is substantiated, the average shall be used.

Applying the empirical methods yields a transfer price that equals the market price between unrelated parties, $P^{TP} = P^M$. As shown above, this gives firms the right incentives to relocate business while ensuring that the transaction is only performed within a MNE if it is welfare enhancing, so $d_l + d_h < 0$. We therefore conclude that in this sense the new German law has no negative impact on welfare.

However, we find that the hypothetical arm's length test as outlined by the German government can lead to distortions. In particular, as described in the decree law of the German government, the tax payer has to follow a certain model of how to derive the intercompany transfer price. In the respective decree law, it is described in detail that the transfer price should be the average of the supplier's and the recipient's after-tax profits. Translated into our model this would yield the following transfer price:[10]

$$P^{TP} = \frac{(1-\tau_l)(p - c_l - d_l) + (1-\tau_h)(p - c_h - d_h)}{2}.$$

Obviously, this price is ad hoc because it is not clear why unrelated parties should agree on a price such as the market price. First, the actual outcome depends on the parties' bargaining power and outside options where the German government simply assumes that taking an average should be generally applied. Only in cases where the taxpayer can show that a different outcome is more reasonable, the taxpayer is allowed to deviate from the average rule. However, it is not clear on what basis the taxpayer should carry out such a proof.

Second, even if the bargaining power were equal and no outside options existed, the German government derives the wrong transfer price because they split up the profits after taxes without considering the fact that the transfer price has an impact on the profit after taxes.

To illustrate this point assume that the bargaining power is divided equally among both parties, so $\alpha = \frac{1}{2}$. In such a situation, the true bargaining price between unrelated

[10] From the law text, it is not quite clear whether this rule is meant in the way we present it here or whether the transfer price finally has to be divided by one minus the corporate tax rate of country h. Both interpretations do not lead to a pricing rule that corresponds to a true bargaining price and therefore can lead to distortions.

parties would be (see Proposition 1)

$$P^M = \frac{\frac{1}{2}(1-\tau_l)(p-c_l) + \frac{1}{2}(1-\tau_h)(p-c_h)}{1-\frac{1}{2}\tau_h - \frac{1}{2}\tau_l}$$

From this we conclude that if no empirical market price is available and consequently that a hypothetical arm's length test has to be performed, one should not rely on a simple ad-hoc rule, but should instead try to come as close as possible to the arm's-length price. This involves taking into account the bargaining power and outside options of the transferring and the receiving party. Moreover, proposition 3 shows that if a relocation would not be carried out between independent companies but only due to the lower transactions costs in form of a MNE, it suffices to take the expected profit of the transferring party as the transfer price to avoid inefficient relocations.

As far as we understand the recent draft published by the OECD, the OECD favors a case-by-case analysis of business relocations with special regard to the outside options of the parties involved. This would be more in line with our insights.

1.5 Conclusion

In this chapter, we examined the interaction of transfer pricing regulations and welfare, identifying two types of inefficiencies that may arise: first, firms may choose a firm structure for a relocation, which is not efficient. Regulations that favor MNEs compared to unrelated firms may lead to the formation of a MNE for tax reasons even though it would be welfare-enhancing to carry out the transaction between unrelated parties due to the differences in transaction costs. Too-tight transfer pricing regulations can prevent the formation of MNEs, although this kind of firm structure would be favorable with regard to transaction costs. Second, firms may not undertake a relocation because under given transfer pricing regulations, it may not pay off even though such transactions would be welfare-enhancing. Again, the opposite is also possible here. Regulations that are too loose can lead to transactions driven by tax saving incentives rather than by real efficiency gains.

We have shown that the simple and implementable rule that "related parties have to use the market price of unrelated parties as the intercompany transfer price as long as no party is worse off" implements the first-best solution. Surprisingly, this shows that one does not have to account for the difference in efficiency between MNEs and unrelated parties.

Furthermore, we analyzed the new German transfer pricing regulation by applying our framework. Our analysis confirms that prices that are empirically observable implement first best and that no adjustment for differences in efficiency is necessary. We conclude that in this sense the new German regulations are welfare-maximizing. However, if no empirical price is available, the German regulations require the hypothetical arm's length test. Our work shows that the average that has to be used as the transfer price if the taxpayer cannot motivate an alternative price may induce the firm to take a welfare-decreasing action. We therefore conclude that such simple rules should not be used as a regulation mechanism. In particular, the consideration of the correct outside options makes the application of a general formula very complicated and thus prone to welfare-decreasing errors.

The policy implication drawn is that one cannot avoid extensive fact-gathering on a case-by-case basis to find a reasonable arm's-length price. Given incomplete and asymmetric information in reality, we acknowledge that this not an easy task. Therefore, another study taking into account asymmetric or incomplete information would be an interesting extension of our framework and leaves room for future work.

Chapter 2

Predatory Exclusive Dealing *

2.1 Introduction

The Chicago School's critique of antitrust action against exclusive dealing is based on the argument that (under the assumptions of those models) exclusive dealing is not profitable for firms in the absence of efficiencies like the protection of prior investments (see, for instance, Bork, 1978). From this it has concluded that exclusive dealing must be beneficial for welfare because it is only profitable for firms if there is an efficiency rationale.[11]

The subsequent literature has shown, however, that exclusive dealing may be anticompetitive if the implicit assumptions of the Chicago School are relaxed. Much of this literature has focused on the exclusion of potential entrants. Exclusive dealing is often profitable in this case because potential entrants are assumed not to be in the position of making counteroffers at the time the exclusive contract is accepted (they are not in the market yet). Under certain circumstances incumbents may therefore exploit contracting externalities to prevent entry (see Aghion and Bolton, 1987, Rasmussen et al., 1991, Innes and Sexton, 1994, Segal and Whinston, 2000b, Fumagalli and Motta, 2006, Simpson and Wickelgren, 2007, and Abito and Wright, 2008). The identified circumstances under which exclusive dealing can anticompetitively exclude rival incumbents are more restricted (see Mathewson and Winter, 1987, O'Brien and

*This chapter is joint work with Hans Zenger. Parts of this chapter were written during the author's stay at the Chief Economist Team of DG Competition. The views expressed are those of the authors and do not necessarily reflect those of DG Competition or the European Commission.

[11] See Marvel, 1982, Segal and Whinston, 2000a, and De Meza and Selvaggi, 2009, for efficiency justifications of exclusive dealing.

Shaffer, 1997, and, in particular, Bernheim and Whinston, 1998).[12]

What is common in all of the above models is that product market competition takes place in a one-period game. The economic literature has therefore been concerned with the question of under which circumstances exclusive dealing may increase the static profits of a firm. Many, if not most, recent antitrust procedures against exclusive dealing, however, have been concerned with another potential motivation to engage in exclusive contracts: predatory exclusion of active rivals. Strong incumbent companies are sometimes accused of accepting lower profits in one period to exclude an incumbent competitor and recouping those losses in subsequent periods where monopoly rents can be earned.

Indeed, U.S. antitrust enforcement currently seems to consider only this second type of exclusive dealing as anticompetitive while typically not intervening against exclusive dealing of the sort discussed in the literature (which raises, rather than reduces current profits). One test that is considered in the U.S. is the profit-sacrifice or no-economic-sense test (see Salop, 2006). This test checks whether an exclusive contract was consistent with (static) profit maximization. If it is found that profits were sacrificed (and hence exclusive dealing made no economic sense from a static perspective), exclusive dealing is prohibited because it must have been predatory. If no profits were sacrificed, exclusive dealing is allowed, in line with the Chicago School argument.

To our knowledge, predatory exclusive dealing has so far not been analyzed formally in the economic literature. This study tries to fill this gap by investigating the ability of firms to use exclusive dealing in order to predate. Our model of predation loosely follows Bolton and Scharfstein (1990), who first formalized the long-purse story of predation, according to which agency problems in financial contracting may allow predatory pricing to exclude rivals.[13] By allowing for exclusivity clauses in a model of predation, we show that exclusive dealing may arise in equilibrium even in circumstances where it can not be profitable for a one-period profit maximization strategy.

[12] Spector (2007) provides a synthesis of the different strands of the literature.

[13] In some sense, our paper takes the opposite perspective of Bolton and Scharfstein (1990). While their paper is detailed in its modeling of the financial market, it is crude in the way it treats the product market. In particular, the price formation on the product market is not derived endogenously from a model of competition. Our paper, on the other hand, is detailed in the modeling of the product market while being crude in the treatment of the financial market. In particular, the financing constraints from the financial market are not derived endogenously from a model of asymmetric information, but are assumed to be exogenous.

Predatory exclusive dealing may not only be a possible strategy for dominant incumbents to exclude rivals; indeed, it is often a cheaper way of predating than predatory pricing. As shown below, this is the case if the prey's access to capital is not too limited, making ordinary price predation expensive. It also turns out that the more market power the predator has with respect to the prey, the more likely it is that exclusive dealing is preferable for the predator compared to predatory pricing.

Besides predatory pricing, other strategies of exclusion in a dynamic setup have been considered in the literature, under which firms trade off lower current profits for larger future profits. Carlton and Waldman (2002) describe how bundling can be used in a predatory way in evolving network industries. Ordover and Shaffer (2007) show that rebate schemes can be used to exclude rival incumbents.

This chapter is organized as follows. Section 2.2 sets up the model. Section 2.3 characterizes the equilibria of our two-period game. We solve the game by backward induction. First, we analyze the second period subgames and then we turn to the first period. Section 2.4 extends the model to a situation where firms can offer non-linear pricing schemes and Section 2.5 concludes.

2.2 The Model

The model combines the intuitions of Bolton and Scharfstein (1990) and Bernheim and Whinston (1998). Bolton and Scharfstein analyze a dynamic game of price competition in which exit may occur, but do not allow for exclusive dealing clauses. Bernheim and Whinston (1998), on the other hand, allow for exclusivity provisions, but consider only a static pricing game.

In our model, there are two upstream firms 1 and 2, each with fixed costs F and marginal cost c, who compete in two periods $\tau = 1, 2$. In each period, firms first simultaneously announce whether they insist on exclusivity or not, as in Mathewson and Winter (1987). Then they simultaneously set prices p_1 and p_2.[14]

[14] In order to allow for the possibility of exclusion, we assume that firms can not offer long term contracts but set prices in each period, as is common in models of predation. Note that firms' pricing strategies are restricted to linear schemes in this section. In Section 4, we extend the analysis to non-linear pricing (two-part tariffs).

The products are purchased by a large number of identical downstream buyers who have preferences over the two goods according to the standard Hotelling model. Each purchaser wants to buy a fixed number of units in each period, which is normalized to 1. Each (marginal) unit $x \in [0,1]$ gives purchasers utility $u_1 - tx$ if bought from firm 1 and utility $u_2 - t(1-x)$ if bought from firm 2, where t as usual denotes the degree of product differentiation between goods 1 and 2. As u_1 and u_2 may differ, we allow for vertical product differentiation in addition to the horizontal differentiation already inherent in the Hotelling model. Without loss of generality, let $u_1 \geq u_2$ and denote $\Delta u := u_1 - u_2 \geq 0$ as the *degree of dominance* of firm 1.[15,16] As usual in the Hotelling model, we will assume that u_1 and u_2 are large and that both firms have the capacity to serve the whole market. As a result, there will be full market coverage in equilibrium. Moreover, let $\Delta u < t$, which implies that it is socially efficient that at least some units of firm 2 are sold (if it is active).

The timing of the dynamic game is as follows. The game starts when both firms have sunk their fixed costs in period 1. The firms then play the stage game described above, consumers make their orders and first period profits are realized. If the firms expect non-negative profits in period 2 and have sufficient funds to finance their ongoing operation, they remain in the market, and the stage game is repeated in the second period. If one firm exits the market after period 1 (a possibility that will be specified further below), this firm will not have to incur fixed costs for period 2, and the other firm will be able to charge monopoly prices. Second period profits are discounted by some common discount factor δ, which we normalize to one. Where appropriate, we interpret the results to account for the possibility of lower discount factors.[17]

In line with Bolton and Scharfstein (1990), let one firm be the predator with sufficient access to capital and the other firm be the prey, which is financially constrained. Due to the assumption that $u_1 \geq u_2$, firm 1 is the stronger firm in terms of market share in a standard one-period Hotelling game. It therefore makes sense to let firm 1 (the "dominant" firm) be the predator and firm 2 the prey. We will assume that firm 2 does not obtain continued financing by its investors if its profit π_2 falls below

[15] The legal definition of dominance has typically been interpreted by economists as being equivalent to a high degree of market power or a low elasticity of demand. In our model Δu is indeed positively related to firm 1's profits and negatively related to its elasticity of demand.

[16] It would also be possible to introduce differentiated marginal cost parameters. However, this affects possible equilibria in the same way as differentiated utility parameters. In order to save on notation, we therefore omit this type of differentiation. The results can be easily reinterpreted to account for cost differentials.

[17] Doing so also allows reinterpreting the results for an infinitely repeated game, with $\delta > 1$ representing the fact that there is a stream of future profits deriving from periods $2, ..., \infty$.

some threshold $\bar{\pi}_2$ in the first period stage game. For instance, this constraint could represent Bolton and Scharfstein's (1990) argument that the weaker firm's financiers face a problem of asymmetric information. If first period profits turn out to be low, this may either reflect the fact that firm 2 is falling prey to a predator, or that firm 2 is less efficient than firm 1 and therefore can not survive in the marketplace. As investors can not distinguish the origin of the losses, they decide to withdraw their funding if profits are below $\bar{\pi}_2$.

Firm 2 can always guarantee a profit of $-F$ by not producing anything in period 1. A possibility for predation can therefore only arise if $\bar{\pi}_2 \geq -F$, which we will assume to be the case. In the other direction, it seems reasonable that the firm will not be shut down if it makes profits. We therefore have $\bar{\pi}_2 \in [-F, 0]$, which we parameterize with

$$\bar{\pi}_2 = -\alpha F, \tag{2.1}$$

where the parameter $\alpha \in [0, 1]$ represents the leniency of firm 2's banks. A value of $\alpha = 0$ means the banks are quite tough. Even if firm 2 breaks even, banks will shut it down. A value of $\alpha = 1$ on the other hand, means the banks are very soft. Only if firm 2 makes no sales at all it will be shut down; more moderate losses will be tolerated.

We are now ready to solve the game by backward induction starting in period 2. We show that exclusion can also occur in a one-stage game, as analyzed in the previous literature.

2.3 Equilibrium

2.3.1 Second Period

There are two possible subgames that start in period 2. Either both firms are still active or firm 2 has been cut off from its funding after period 1 due to insufficient profits. If only firm 1 is active, it is easy to see that it charges the monopoly price $p_1^M = u_1 - t$, leading to demand $x^M = 1$, profit $\pi_1^M = u_1 - t - c - F$ and purchasers' rent $U^M = \frac{1}{2}t$. Whether the firm announces exclusivity or not is irrelevant: there is no competition anyway.

Next consider the case where both firms are still active in period 2. If nobody has announced an exclusivity requirement, firms play the standard Hotelling game, which we denote as *regular pricing* for later reference. Given p_1 and p_2, each buyer purchases

$$x = \frac{1}{2} + \frac{p_2 - p_1 + \Delta u}{2t} \tag{2.2}$$

units of good 1 and $1 - x$ units of good 2. The best response functions of firms 1 and 2 are therefore

$$p_1(p_2) = \frac{1}{2}(c + t + p_2 + \Delta u) \text{ and } p_2(p_1) = \frac{1}{2}(c + t + p_1 - \Delta u). \tag{2.3}$$

This leads to a Nash equilibrium with

$$p_1^* = c + t + \frac{\Delta u}{3} \text{ and } p_2^* = c + t - \frac{\Delta u}{3},$$

so that

$$x^* = \frac{1}{2} + \frac{\Delta u}{6t},$$
$$\pi_1^* = \frac{1}{2t}\left(t + \frac{\Delta u}{3}\right)^2 - F,$$
$$\pi_2^* = \frac{1}{2t}\left(t - \frac{\Delta u}{3}\right)^2 - F,$$

and the purchasers' rent is

$$U^* = \frac{1}{2}(u_1 + u_2) - c - \frac{5}{4}t + \frac{(\Delta u)^2}{36t}.$$

For later reference, note that firm 2's one-period profits are non-negative if and only if

$$F \leq \frac{1}{2t}\left(t - \frac{\Delta u}{3}\right)^2. \tag{2.4}$$

If one of the firms has announced an exclusivity requirement, downstream purchasers have to decide whether to exclusively buy from firm 1 or from firm 2. Sourcing from firm 1 generates a higher utility for purchasers if and only if

$$p_1 \leq p_2 + \Delta u.$$

The only undominated Nash equilibrium in this subgame involves consumers choosing the dominant firm ($x^{ED} = 1$) and firms choosing prices

$$p_1^{ED} = c + \Delta u \text{ and } p_2^{ED} = c.$$

The proof for this equilibrium is analogous to the standard Bertrand game with differentiated cost, where Δu corresponds to the cost differential. There is cut-throat competition, except for the cost advantage (here: utility advantage) of one of the firms. Therefore, it is costly to bribe purchasers into exclusivity.[18] The resulting equilibrium profits are $\pi_1^{ED} = \Delta u - F$ and $\pi_2^{ED} = -F$, and the purchasers' rent is $U^{ED} = u_2 - c - \frac{1}{2}t$.

As $\pi_2^{ED} < \pi_2^*$ for all parameter values, it is a dominant strategy for firm 2 not to require exclusivity. Since firm 1 is the stronger competitor, firm 2 can only lose any fight for exclusivity. For firm 1, however, exclusive dealing may or may not be profitable. Comparing π_1^{ED} and π_1^*, one finds that exclusive dealing is not profitable for firm 1 if and only if

$$\Delta u \leq 3\left(2 - \sqrt{3}\right)t. \tag{2.5}$$

Since $3\left(2 - \sqrt{3}\right)t \in (0, t)$, this is a reiteration of Mathewson and Winter's (1987) result that exclusive dealing may occur in static games. In our model, exclusion in a one-period subgame arises if horizontal product differentiation is small (t is small) but vertical product differentiation is large (Δu is large).[19] For our purposes, this is just a reference point for later comparison. We will therefore now turn to the analysis of the first period to characterize the scope of predatory exclusive dealing.

2.3.2 First Period

The previous section has shown that there are two circumstances under which exit of firm 2 can occur even if firm 1 strictly maximizes one-period profits without sacrificing current rents to induce exit of firm 2. First, if condition (2.5) does not hold, firm 1 would opt for exclusivity even if firm 2 were to stay in the market. As a consequence, firm 2's profits fall below $-\alpha F$, and it must close down. Second, if condition (2.4) does

[18] As in the Bertrand game with differentiated cost, there exist additional Nash equilibria, which, however, involve the play of weakly dominated strategies by firm 2. Here, and in what follows, we will focus on undominated equilibria.

[19] A cost advantage of firm 1 vis-à-vis firm 2 has an effect equivalent to vertical product differentiation.

not hold, the competition under regular pricing is so intense that firm 2 can not cover its fixed costs of operation. In that case, firm 2 will voluntarily exit after period 1. Staying put would only inflict additional losses in period 2.

These two outcomes can be described as *predation by effect* because the implied strategies by firm 1 do not have the *object* of cutting firm 2 off from its funding. This is only the unintended *effect* of a strategy that maximizes one-period profits.[20] The analysis of the overall game for these two cases is trivial. In period 1, both firms play the strategy that is optimal in a static game; firm 2 exits and firm 1 earns monopoly rents in period 2. Hence, we will now turn to the more interesting situation where conditions (2.4) and (2.5) hold, in which case exclusion is not profitable absent the intent to remove a competitor from the market. If exclusion occurs in this setting, then it is *predation by object*; that is, the willful sacrifice of current profits to earn future monopoly rents.[21]

If future monopoly profits are sufficiently high, some form of predation might be desirable for firm 1. In order to decrease firm 2's profits below the cutoff threshold $-\alpha F$, firm 1 may either propose an exclusive contract (*predatory exclusive dealing*) or decrease its retail price below the level that is optimal from the viewpoint of static profit maximization (*predatory pricing*). The exclusive dealing strategy was outlined in the previous section. We therefore turn to predatory pricing now.

Given p_1, firm 2's optimal response $p_2(p_1)$ is given by (2.3). Plugging this into firm 2's profit function yields

$$\pi_2(p_1) = \frac{(p_1 - c + t - \Delta u)^2}{8t} - F.$$

Setting this expression equal to $-\alpha F$ and rearranging gives the largest p_1 consistent with exclusion of firm 2, which is

$$p_1^P = c - t + \Delta u + \sqrt{8t(1-\alpha)F}.$$

[20] Notice that exclusive dealing may nevertheless cause damage to consumers. Even if consumers benefit in period 1 because firm 1 has to bribe them into exclusivity by offering favorable conditions, they will incur substantial future losses by facing a monopolist in period 2.

[21] In practice, the goal of predation may not always be the virtual exit of the competitor. The predator may alternatively try to marginalize the prey by pushing it into a niche segment of the market or by making sure that the prey does not obtain the financial resources to compete in the high-quality product spectrum.

As a result, the optimal price of firm 2 is given by

$$p_2^P = c + \sqrt{2t(1-\alpha)F}.$$

This leads to

$$x^P = 1 - \sqrt{\frac{(1-\alpha)F}{2t}},$$

$$\pi_1^P = \left(1 - \sqrt{\frac{(1-\alpha)F}{2t}}\right)\left(\Delta u - t + \sqrt{8t(1-\alpha)F}\right) - F,$$

$$\pi_2^P = -\alpha F,$$

and

$$U^P = \frac{1}{2}t.$$

To determine the first period outcome, firm 1 compares the three possible strategies at its disposal: predatory pricing (leading to profits of $\pi_1^P + \pi_1^M$), predatory exclusive dealing (leading to profits of $\pi_1^{ED} + \pi_1^M$) and regular pricing (leading to profits of $2\pi_1^*$). The following proposition shows that all three outcomes are possible equilibria depending on the parameter values.[22] So indeed it may be optimal for firm 1 to use an exclusive dealing contract to predate. However, it may also be the case that predatory pricing is a more profitable strategy for firm 1 or that neither of the two predatory strategies is profitable.

Proposition 2.1 *Suppose that firms 1 and 2 compete in a dynamic pricing game. Then predatory exclusion may occur in period 1 if monopoly profits in period 2 are sufficiently large. Depending on the parameters, exclusion either takes the form of predatory exclusive dealing or of predatory pricing. Exclusive dealing may occur even in a situation where exclusivity provisions can not increase one-period profits.*

Given that both predatory pricing and predatory exclusive dealing can arise in equilibrium, the question is under which circumstances one or the other is preferable for firm 1. Proposition 2 provides a first answer.

Proposition 2.2 *Suppose that future monopoly profits are sufficiently large for some form of predatory exclusion to arise in period 1. Then, predatory exclusive dealing is*

[22] All proofs of this chapter are contained in the appendix.

more likely to occur if the financing constraint of the prey is soft (α is large), while predatory pricing is more likely to occur if the financing constraint of the prey is strict (α is small).

This result reflects the main advantages and disadvantages of the two instruments. The big disadvantage of predatory pricing is that it forces firm 1 to decrease prices not only for marginal units (those that it intends to capture from firm 2 to force the latter's profits down), but also for intramarginal units. Predation is a costly exercise: the predator wants to enhance his reach, but this forces him to decrease prices. Exclusive dealing is less harmful in that respect. While it captures sales that would otherwise go to firm 2, it is easier to obtain profits on intramarginal units: At the equilibrium price under exclusive dealing, purchasers would prefer to source both from firm 1 and firm 2. However, the exclusivity clause prohibits that. Because no purchaser can obtain any units from firm 2, the choice is to purchase either all sales from firm 1 or none. Since consumers do not want to forgo firm 1 consumption (especially if Δu is large), firm 1 can save some of the rents on intramarginal units.

However, exclusive dealing is not without cost relative to predatory pricing. The big disadvantage of exclusive dealing is its scope. Exclusivity forces consumers to give up *all* of the consumer surplus that they would enjoy from sourcing some units from firm 2. This makes it costly to convince consumers to accept an exclusivity clause, especially if firm 1's advantage Δu over firm 2 is only moderate. Predatory pricing does not suffer from this disadvantage. In fact, it can be tailored to the degree of market exclusion that is necessary to induce exit of the prey. Indeed, if a small reduction of prices is sufficient to push firm 2 into losses because the financing constraints of firm 2 are tight, then bribing consumers into exclusivity would be far too expensive. Hence, predatory pricing is more attractive if banks are tough, while exclusive dealing is more attractive if banks are soft.

The following proposition relates the foregoing discussion to the degree of dominance of the predator.

Proposition 2.3 *Suppose that future monopoly profits are sufficiently large for some form of predatory exclusion to arise in period 1. Then, predatory exclusive dealing is more likely to occur if the degree of dominance Δu of the large firm is large, while predatory pricing is more likely to occur if the the degree of dominance Δu of the large firm is small.*

Note that Proposition 3 is in line with the legal provision observed in many jurisdictions that exclusive dealing can only be an offense if practiced by a dominant undertaking. For instance, Article 82 of the Treaty of the European Union, which deals with exclusive contracts in European antitrust law, requires dominance as a precondition for an investigation. In light of the previous discussion, the intuition behind Proposition 3 is clear. If the predator is more dominant, then it would gain a large market share even if it did not predate. Bribing purchasers into accepting exclusion is less costly because the buyers do not regret losing access to firm 2's products as much as would otherwise be the case. The cost of predatory pricing, on the other hand, is relatively large in this scenario. Recall that its disadvantage is that prices are also reduced for intramarginal units. Since a dominant firm has many of those, it is more reluctant to use this instrument.

Finally, we will relate the question of when predatory exclusive dealing occurs to a measure of firm 1's optimal predatory price. Proposition 4 shows that a sharp distinction can be drawn to indicate under which circumstances exclusivity is profitable.

Proposition 2.4 *Suppose that future monopoly profits are sufficiently large for some form of predation to arise in period 1. Then, predatory exclusive dealing will always be chosen if predatory pricing would involve below-cost predation* ($p_1^P \leq c$)*.*

Proposition 4 shows that firm 1 always prefers predatory exclusive dealing if predatory pricing is so costly that firm 1 has to lower its price below marginal costs to predate ($p_1^P \leq c$).[23] This is an interesting observation given the ongoing debate concerning whether or not above-cost predation should be prosecuted by antitrust law enforcement.[24]

The prospect of predatory exclusion substantially alters the policy implications of exclusive dealing. For instance, Krattenmaker and Salop (1986) argue, based on models of exclusion in a static setting, that exclusionary practices should be prohibited only if they allow firms to raise prices. Matthewson and Winter (1987) support this standard and argue that the famous prohibition decision in *Standard Fashion* does

[23] With differentiated cost, below-cost predation can theoretically arise in our model. However, only if the predator is *less* cost efficient than the prey is this the case. If the predator has lower marginal costs than the prey, then below-cost predation can also be ruled out for differentiated cost parameters.

[24] For a discussion of above-cost predation see Edlin (2002) and Elhauge (2003), who disagree on the merits of such interventions.

not pass the test because exclusivity led to significant (short-term) price decreases for purchasers who accepted exclusivity. However, as the following proposition shows, predatory exclusive dealing *always* leads to price decreases as firm 1 has to convince consumers to give up sourcing from firm 2. The proposed antitrust standard would therefore imply per se legality of predatory exclusion, a recommendation that one may question.

Proposition 2.5 *If predatory exclusive dealing arises, then it leads to a price decrease relative to regular pricing in the first period, ($p_1^{ED} < p_1^*$), but to price increases thereafter, ($p_1^M > p_1^*$).*

We will finish this section with a short word on the welfare effects of predatory exclusive dealing. Maybe not surprisingly, these are ambiguous. Indeed, predatory exclusive dealing causes a distortion in product variety (there is no consumption of firm 2's products). It is important to note, however, that regular pricing also leads to distorted product variety, even though there is no full exclusion: While under exclusive dealing purchasers obtain too many of firm 1's products (1 instead of $\frac{1}{2} + \frac{\Delta u}{2t}$), they obtain *too few* under regular pricing ($\frac{1}{2}+\frac{\Delta u}{6t}$ instead of $\frac{1}{2}+\frac{\Delta u}{2t}$) as firm 1 exerts its market power by restricting quantity. Moreover, predation saves on future fixed costs (along the lines of Mankiw and Whinston's [1986] argument of excessive entry). Regarding consumer surplus, there is an additional trade-off. While predatory exclusive dealing leads to lower prices in period 1, it leads to higher prices in period 2. Overall, the welfare conclusions are also ambiguous here.

2.4 Non-Linear Pricing

We will now analyze an extension of our basic model that allows for non-linear pricing as in O'Brien and Shaffer (1997). Consider a game that is equivalent to our previous set-up except that firms can now set two-part tariffs. Therefore, each firm i chooses prices (L_i, p_i), where L_i denotes a lump-sum charge and p_i denotes a per-unit charge.

As before, we will first identify equilibria in the period 2 subgames. Suppose exclusivity has not been announced by any firm. If buyers purchase from both firms,

$$x = \frac{1}{2} + \frac{p_2 - p_1 + \Delta u}{2t}$$

as before. But now there are two incentive constraints that ensure that it is optimal to purchase from both firm 1 and firm 2. The utility of purchasing from both must be larger than purchasing from either firm alone. Comparing the respective consumer surpluses for firm 1 ($U(1,2) \geq U(2)$) yields

$$L_1 \leq \frac{1}{t}\left(\frac{p_2 - p_1 + \Delta u + t}{2}\right)^2. \tag{2.6}$$

Similarly, we have

$$L_2 \leq \frac{1}{t}\left(\frac{p_1 - p_2 - \Delta u + t}{2}\right)^2 \tag{2.7}$$

for firm 2. Both constraints must bind in equilibrium (otherwise, a firm could increase its profits by raising the fixed fee).

Therefore, firm 1 chooses p_1 to maximize

$$\pi_1 = \left(\frac{1}{2} + \frac{p_2 - p_1 + \Delta u}{2t}\right)(p_1 - c) + \frac{1}{t}\left(\frac{p_2 - p_1 + \Delta u + t}{2}\right)^2 - F$$

where L_1 has been substituted from (2.6). This gives $p_1^* = c$. Likewise, $p_2^* = c$. Hence,

$$x^* = \frac{1}{2} + \frac{\Delta u}{2t},$$

$$L_1^* = \frac{1}{t}\left(\frac{t + \Delta u}{2}\right)^2 \text{ and } L_2^* = \frac{1}{t}\left(\frac{t - \Delta u}{2}\right)^2$$

which leads to

$$\pi_1^* = \frac{1}{t}\left(\frac{t + \Delta u}{2}\right)^2 - F$$

and

$$\pi_2^* = \frac{1}{t}\left(\frac{t - \Delta u}{2}\right)^2 - F.$$

Note that $\pi_2^* \geq 0$ if and only if

$$\Delta u \leq t - 2\sqrt{tF} \tag{2.8}$$

which we will again assume to hold. Otherwise exit of firm 2 would automatically occur after period 1.

Next we will investigate the subgame where one of the firms has announced an exclusivity requirement. In this case, buyers will purchase the measure one units from either firm 1 or firm 2. As the volume is fixed, the structure of the payment (fixed or variable) is irrelevant; only the total level matters. Hence, without loss of generality, we can set $p_1^{ED} = p_2^{ED} = c$.

Buyers will purchase from firm 1 if and only if

$$L_1 \leq L_2 + \Delta u.$$

With the previous Bertrand argument, this leads to equilibrium fees of

$$L_1^{ED} = \Delta u \text{ and } L_2^{ED} = 0.$$

Firm 2 will always be excluded in this subgame, i.e. $x^{ED} = 1$. Therefore,

$$\pi_1^{ED} = \Delta u - F$$

and

$$\pi_2^{ED} = -F.$$

It is easy to see that $\pi_2^{ED} \leq \pi_2^*$. Therefore, firm 2 will never announce exclusivity in period 1. Exclusive dealing will be more profitable for firm 1 ($\pi_1^{ED} > \pi_1^*$) if and only if

$$(\Delta u - t)^2 < 0,$$

which can not be the case. Hence, exclusive dealing will never be used, and regular pricing is the relevant subgame in the subgame perfect Nash equilibrium of the overall game. This result contrasts with the result of Section 3: If firms can employ two-part tariffs *exclusion can never be profitable in a one-period game.* This is in line with O'Brien and Shaffer (1997) and Bernheim and Whinston (1998), who show that Mathewson and Winter's (1987) result is reversed if non-linear pricing schemes are taken into account. Essentially, these results restore the logic of Bork (1978) that firms can not increase their profits through exclusivity provisions.

But while exclusive dealing is not profitable in a static environment, it may still be the case that it is a useful instrument to predate on competitors. This would rationalize the view held by some observers that exclusive dealing should only be questioned by competition authorities if it can be shown to be predatory.

Assume period 2 profits are sufficiently large for some form of predatory exclusion to be optimal. Exclusive dealing is one possible strategy to predate. The equilibrium of this subgame was described above. Next consider price predation. As $p_2 = c$ is optimal for firm 2 irrespective of firm 1's choice of price schedule, its optimal fixed fee depending on p_1 can be inferred from (7) as

$$L_2 = \frac{1}{t}\left(\frac{p_1 - c - \Delta u + t}{2}\right)^2.$$

This yields profits of

$$\pi_2 = \frac{1}{t}\left(\frac{p_1 - c - \Delta u + t}{2}\right)^2 - F.$$

In order to predate, these profits have to be pushed down to $-\alpha F$. This occurs if

$$p_1^P = c + \Delta u - t + 2\sqrt{t(1-\alpha)F}. \tag{2.9}$$

Therefore

$$L_1^P = t - 2\sqrt{t(1-\alpha)F} + (1-\alpha)F,$$

$$x^P = 1 - \sqrt{\frac{(1-\alpha)F}{t}},$$

and

$$\pi_1^P = \Delta u - F + \sqrt{\frac{(1-\alpha)F}{t}}(t - \Delta u) - (1-\alpha)F.$$

Comparing π_1^{ED} and π_1^P then yields the following proposition.

Proposition 2.6 *Suppose that firms 1 and 2 compete in a dynamic pricing game with two-part tariffs. Then, neither of the two firms will impose an exclusivity requirement on purchasers.*

In other words, there is a one-to-one relationship between the environment that allows exclusion to be profitable in a one-period setup and the environment that allows exclusion to be profitable in a dynamic setting. In the logic of Bernheim and Whinston (1998), exclusive dealing can only be profitable in the absence of efficiency motives if there are contracting externalities. As shown in Sections 3 and 4, one such imperfection is the case where firms are restricted in setting non-linear tariffs.[25] While Proposition

[25] The argument readily extends to the case where firms can use two-part tariffs, but can only increase fixed fees up to some limit $\bar{L}$. It is easy to show that predatory exclusive dealing is profitable for firm 1 provided that $\bar{L}$ is not too large.

5 (and the previous results by O'Brien and Shaffer, 1997, and Bernheim and Whinston, 1998) calls for caution in marking exclusivity provisions as anticompetitive, there are at least two important reasons why the situation depicted in the previous sections, where predatory exclusive dealing could arise, might be more relevant in practice.

First, the assumption of two-part tariffs with full knowledge of the demand curves of individual purchasers is clearly extreme. Perfect price discrimination of the sort assumed in this section, which allows full extraction on residual demand curves, is typically not observed in the real world. However, once marginal cost pricing on incremental units can not be maintained (say, because firms do not know purchasers' individual demands with certainty), we again enter a world with contracting externalities. As Spector (2007) notes, nonlinear pricing together with asymmetric information resembles linear pricing. We are therefore back in the scenario of Proposition 1; that is, predatory exclusive dealing may occur.

Second, even if firms possess the large informational requirements leading to Proposition 5, they may still prefer exclusive dealing over predatory pricing because it is less easily detectable as a predatory strategy. This is shown in the following proposition.

Proposition 2.7 *Suppose that firms 1 and 2 compete in a dynamic pricing game with two-part tariffs. Then predatory pricing always involves below-cost predation ($p_1^P < c$), while predatory exclusive dealing can always be carried out with above-cost predation ($p_1^{ED} \geq c$).*

As a result, competition authorities may be able to infer predatory pricing from cost observations if firms use non-linear pricing schemes. Predatory exclusive dealing, on the other hand, can always be carried out with incremental prices above cost. Thus, it is likely to be more difficult for a competition authority to actually prove that the predator has sacrificed profits by offering exclusive contracts.

In summary, we believe that the result of Proposition 5 should be seen as pointing to the necessary conditions for predatory exclusive dealing to arise, rather than ruling it out as a matter of principle. In the limiting case of full information and perfect non-linear pricing, predatory exclusive dealing will not arise. However, in a less than perfect world, the intuition of the main body of this study again provides the relevant framework of analysis.

2.5 Conclusion

This chapter has introduced exclusivity clauses into a model of predation along the lines of Bolton and Scharfstein (1990). As a result, two distinct forms of predatory exclusion arose in equilibrium, which are also observed in practice: predatory pricing and predatory exclusive dealing. Exclusive dealing can be a profitable strategy to exclude rivals with financing constraints, even in circumstances where exclusive contracts can never be profitable from the perspective of static profits. The more market power a predator has on the product market, the more likely it is that predatory exclusive dealing is a profit-maximizing strategy.

The previous literature on exclusive dealing has concluded that the exclusion of existing competitors (as opposed to abstract potential entrants) can only have anti-competitive effects under particular conditions - for instance, if there are contracting externalities from related markets (see Bernheim and Whinston, 1998, and Whinston, 2006). This study, in contrast, has argued that the scope for anticompetitive exclusive dealing is much larger. While exclusive dealing may often not be profitable in a static context, it does provide a cheap and effective instrument of predation.

Our model (and the related work by Mathewson and Winter, 1987, O'Brien and Shaffer, 1997, and Bernheim and Whinston, 1998) has assumed that downstream purchasers are either final consumers or local monopolists, who do not compete with each other. It would be interesting to extend the present analysis to downstream competition. Fumagalli and Motta (2006) and Simpson and Wickelgren (2007) have shown that the effect of downstream competition on the potential for exclusion is ambiguous for the case of potential entrants. Extending this work to the exclusion of competing incumbents seems to be a promising direction for future research.

Chapter 3

Targeted Advertising on Internet Websites

3.1 Introduction

Recent technological advances enable internet websites to identify users[27] and send different individuals advertisements with different content. This practice is called targeted advertising. Targeted advertising on internet websites raises new and interesting questions for economist. When firms are able to learn the identity and characteristics of users they are able to send individual users selective information on products. While this could be potentially beneficial to users if they get less undesired advertisements, targeted advertising may also facilitate the practice of price discrimination. With this study we contribute to the ongoing public debate among website providers, users and privacy advocates on the desirability of a governmental ban on such new business models.

Our analysis is motivated by the following observations: Among websites that currently attract the highest number of users and amount of internet traffic are the so-called "social networks". Social networks allow users to interact with each other online and thus produce most of the content provided on the website themselves. In 2008, more than 10% of online time was spent on websites such as Myspace, Facebook,[28] StudiVZ, LinkedIn, Xing, etc.[29] However, in contrast to already high and increasing

[27]In the following, we use the terms *consumer* and *user* synonymously.

[28]In 2008, *myspace.com* ranked third and *facebook.com* sixth among websites with the highest market shares in the U.S., according to the web analyst Hitwise.

[29]For users that log into the internet through mobile devices the share was even above 40% in 2008.

numbers of users and amount of time spent on these sites, the share of the global online advertisement budget remains below 1%.

In order to make those websites more attractive for advertisers and thus to generate more profits, many sites are storing their users' personal characteristics and usage history of the site. The idea behind this practice is that companies hope to be able to use this information to send tailored, personalized advertisements to users. In 2007, Facebook started a cooperative with 60 companies to develop targeted advertising (Facebook Social Ads).[30] MySpace recently started a similar program (Hyper Targeting). Whether these programs will lead to higher revenues from advertising is hardly predictable today, but the fact that the software producer Microsoft announced that it purchased a 1.6% share of Facebook for $246 million on October 24, 2007, shows that the market believes in the future revenue potential of these online communities.

In the U.S. and in the EU this brought up a vigorous discussion about consumer privacy protection.[31] Some privacy advocates even demand the prohibition of such targeting practices. In some cases, users simply refrained from continuing to log on to these websites after they learned about new information gathering policies. For instance, when the German market leader for social networks, StudiVZ, forced users to accept new General Terms and Conditions in January 2008, which explicitly allowed the website to store and exploit information about users for advertising purposes, many users deleted their profiles. In February 2009, Facebook had to revert to its old policy on user information under fire from tens of thousands of protesting users. The new Terms of Use had enabled the website to store personal information on users even after they have closed their account.

The website providers argue that targeted advertising is good for consumers because consumers get fewer ads that do not interest them. In contrast, consumers and privacy advocates argue that the storage and use of information can be exploited to the user's disadvantage. Aside from the illegal use of personal information, targeted advertisements with targeted price offers seem to be the main real issue of concern. As Varian (1996) pointed out in his seminal paper on the economics of privacy: "When firms learn about consumers' preferences, they can also offer them products that better meet their needs and thereby lower their search costs. However, the disclosure of

[30] The first link that appears after entering the term "targeted advertising" on the internet search engine *google.com* leads to Facebook Social Ads.

[31] In 2007, the European Commission set up the Article 29 Working Party headed by the Federal Commissioner on Data Protection. One of the central issues to be investigated by the group is targeted advertising.

information on consumer preferences involves a trade-off between a reduction of search costs and extraction of consumer surplus."

The simple fact that the internet enables consumers to easily compare prices does not necessarily mean that prices have to be lower than before. Moreover, prices for perfectly homogeneous products that can be bought online often differ significantly. Baye and Morgan (2001) present a theoretical model concerning websites through which consumers can compare prices, e.g., *shopper.com,* and show that price dispersion can be an equilibrium strategy for firms that advertise prices for homogenous products.

Another important question is whether price discrimination is a problem at all. In the case of online advertisements consumers can always avoid high priced offers and look for cheaper alternatives. However, there are many real world examples where firms actually tried to extract extra rents from consumers. The most prominent example in the literature is the case of *amazon.com*. In 2000, *amazon.com* conducted experiments with targeted pricing strategies: DVD movies were sold to consumers at different prices (up to a 40% difference for the same product) based on their purchasing history. Some consumers react to these strategies by actively taking efforts to avoid online traces, e.g., through payment via services like *privatebuy.com* which makes purchases anonymous.

In this chapter, we develop a three-stage model to analyze the strategic interaction between a website provider, users and advertising firms.[32] Advertising is purely informative in our model, i.e., people learn about the characteristics and prices of products. In the first period, the website provider has to choose between financing the website with traditional non-targeted or with targeted advertising. Given the chosen mode, the website then sets a price per ad. In the second stage, users decide to enter the website or not.[33] In our model users differ in their valuations for the services that the site provides while they have the same aversion towards watching advertisements. Moreover, users differ in their preferences for consumer products. Finally, firms selling consumer products have to decide on the amount of advertisement they demand and the price that they promote in their ads.

While it turns out that targeted advertising always benefits firms, consumers are not better off in this mode. Under targeted advertising, the amount of advertisement

[32] For the sake of brevity, the term "website" will be used henceforth.

[33] We do not analyze the consequences of the illegal abuse of information. Besides, consumers in our setting are not naive. They agree to the use of their personal information when they register on the website.

can indeed be lower compared to conventional non-targeted advertising. Moreover, users indeed do not receive any ads for products anymore that they would never want to buy. However, this potentially positive effect for consumers is overcompensated by the reduction in consumer rent that is caused by firms' practice of price discrimination. We extend our model to examine the effect of targeted advertising when firms have to send the same content to all users they address. Interestingly, in this case consumers can also benefit from targeted advertising because they do not loose rent from buying products compared to the non-targeted advertising mode.

From our analysis we can derive some policy recommendations. On the one hand, it is undoubtedly positive that targeting lowers wastage of redundant advertisement and thus increases efficiency. On the other hand, the ability to address certain user groups with special contents decreases consumer utility. To conclude from this that targeted advertising should per se be prohibited seems to go too far. However, a ban on price discrimination could make sure that targeted advertising increases the welfare for all agents involved.

Related Literature

This chapter is mainly related to two strands of the literature, namely the literature on the economics of privacy and the literature on two-sided (media) markets.

Several papers from the small, but growing literature on two-sided markets have considered the special competitive effects in markets where advertisers exert a negative externality on consumers who dislike watching advertisements.[34] In these models, firms are willing to pay for advertisements because they are informative and thus leads to more sales (e.g., see Anderson and Coate (2005), Armstrong (2006b), Crampes et al. (2005)).[35] Consumers perceive advertisements merely as annoying distractions with no further benefit for them. However, advertising can increase social welfare, because it leads to increased sales and thus to higher profits. Because most of these studies are motivated by traditional media like television and newspapers, they do not account for

[34] The basic literature on two-sided markets describes the interaction between two groups that are mediated by a platform. See, e.g., Caillaud and Jullien (2003) , Nocke et al. (2007), Rochet and Tirole (2003).

[35] "Informative" means that people learn about products or characteristics through advertisements, but whithout changing preferences (ads are not persuasive). In the literature, many other effects of advertisements on consumers are considered, most recently in the field of behavorial economics. For an overview on the economics of advertising, see Bagwell (2007).

new technological developments in the context of internet-based media websites that allow to identify users and address certain groups of users with different contents.

We contribute to the existing literature by allowing consumers to potentially benefit from successful deals. While in our model users also dislike watching advertisement, they can receive some additional benefit from finding an offer for products which they like. Thus, we can endogenously derive user participation on the website which depends on the utility that users expect to receive from entering the website.

The paper closest to our model is probably Gantman and Spiegel (2004). They consider a single programmer who has to decide whether to distribute new software for a fee as shareware or to distribute it for free in a bundle with advertisements. Adware allows advertisers to send targeted information to specific consumers and thus may improve their purchasing decisions. In their model, a ban on (targeted) advertising always reduces welfare as it prevents users from receiving information about consumer products in addition to the utility from using the website.

However, our analysis differs from this study in several ways. First, Gantman and Spiegel do not discuss the effects of targeted advertising compared to non-targeted advertising. In their setup, a more effective way of targeting simply means that the probability that users notice advertisements increases. Second, they take the price for consumer products as exogenously given. In contrast to their analysis, we explicitly model the potential benefits of targeting, i.e., users do not have to consume advertisements for products that they would never buy, but also the potential disadvantages of targeted advertising for consumers that can be caused through price discrimination. Moreover, we endogenously derive the prices for consumer products. Maybe not surprisingly, our results suggest a more careful handling of targeted advertising.

Most of the recent literature on the economics of privacy and price discrimination is concerned with dynamic pricing techniques. This includes the strategic interaction between consumers trying to hide information about their preferences and firms trying to learn more about user preferences (e.g., see Taylor (2004), (2008), Acquisiti and Varian (2005)).[36] In our model, users who decide to enter the website cannot hide their characteristics, because we assume that some exposure of information about oneself is

[36] For an overview on recent developments in the economcis of price discrimination see Armstrong (2006a).

necessary to enjoy the usage of the website.[37] However, users can decide to refrain from entering the site at all.

The literature on dynamic pricing strategies focuses on the assumption that there is no role for informative advertising because the market is fully covered.[38] Esteves (2009) analyzes a setup where firms can recognize customers with different purchase histories and send them targeted advertisements with different prices. She shows that price discrimination is generally bad for consumer surplus and welfare, though good for firms, which is in line with our findings.

The rest of the chapter is organized as follows: Section 3.2 describes the model. In Section 3.3, we solve for the equilibrium when there is a single website provider who has to decide whether to use targeted advertisements or traditional non-targeted advertisements to finance the website. Section 3.4 examines the welfare effects of the website provider's choice and also discusses the policy implications of the model. Section 3.5 concludes.

3.2 The Model

In our model, there are three types of agents: an internet website, a continuum of potential users, and three firms, A, B and C, that each sell a different consumer product.[39] The website provides free registration and free use of its services to potential users. The website is financed by online advertisements, for which it charges advertising firms a fee. Before people register, the website has to decide whether it commits to not use the information that users disclose during the registration process and information that users provide while using services provided by the website. If the website does not commit itself, it passes collected information to advertisers, who are then able to target certain consumers.

[37] Of course, it is possible in real world situations to feed a website with fake individual information, but then it is also more difficult to contact friends, business partners, or potential employers, i.e., to enjoy the services provided by the website.

[38] Fudenberg and Villa-Boas (2006) provide a comprehensive survey on behaviour based price discrimination.

[39] We need to consider three consumer products to show that, without targeting, there will always be some misguided advertisements that create efficiency losses. This effect would not necessarily occur with only two goods.

3.2.1 Timing of the Model

Our setup consists of three stages. In the first stage, the website chooses whether to use traditional non-targeted or targeted advertisements. Under the first option, the website sets a per-unit advertising fee that firms must pay in order to display banner ads on the website. All ads are sent to all users, so each user gets the same content and number of advertisements. Under the second option, the website exploits the information that users provide about themselves in order to group users according to their preferences regarding the consumer products. Thus, advertisers again pay a per-unit fee, but now they know exactly which group of consumers will get their advertisement.[40] In the second stage, each consumer decides whether to join the website or not. In the third stage, firms choose how many ad banners to display given the advertising mode and the advertising fee. Finally, consumers observe ads and buy products, and all payoffs are realized. This timing of our model is in line with Gantman and Spiegel (2004).

3.2.2 Consumers

There is a continuum of potential users of the website with a total mass of one. Users are interested in enjoying the services a website provides. However, people do not like to be disturbed by advertisements while using the site. In the literature on media markets it is assumed that advertisements are purely informative, but the surplus generated goes entirely to the advertisers who fully extract any consumer surplus. Therefore, advertising can increase overall welfare, but consumers never benefit. In our model, we include the possibility that consumers and advertisers share the rent of a successful deal and therefore both benefit from advertising.

Let k_A ($k_A \in [0, 1]$) be the number of ads that firm A pays for (e.g., the number of times that firm A's ad banners are displayed or the percentage of the screen which is covered by ads while using the site). We assume that the probability of noticing an ad from firm A does not depend on the number of ads demanded by the other two firms, B and C. Moreover, we assume that the probability that a user notices

[40] We are aware that screening technologies developed by platforms are still in their infancy and currently are not able to perfectly group users, so there will always be some probability that ads miss their targets. However, in order to keep the model simple, we assume that in the targeting mode, users can be identfied without any probability of error. Moreover, it is expected that with technological progress, screening will become more precise.

an advertisement for a product is a concave function that increases in the amount of advertising, $f(k_A) = \sqrt{k_A}$. Thus, for $k_A = 0$, the probability of observing firm A's advertisements is zero, while for $k_A = 1$, the probability of noticing at least one of firm A's ads is one.

Users have a different willingness to pay for the three advertised goods. We assume that if a user observes the advertisement of a product, she buys one unit of it given that the promoted price does not exceed her willingness to pay. Budget considerations, preferences, and outside search options are all included in these exogenous values.[41] In our model, each user belongs to one of three symmetric groups of users that we categorize according to their preferences regarding consumer products. We denote the willingness to pay of a user from group A to pay for the consumer product of firm A by θ_A^A.[42] Moreover, we denote the willingness to pay of a user from group A for the product of firm B by θ_B^A. Finally, θ_C^A denotes the willingness to pay of a group A user for product C. We assume that $\theta_A^A > \theta_C^A$ and $\theta_B^A = 0$. This means that a consumer of group A has a higher willingness to pay for her preferred product, A, compared to product C and a willingness to pay of zero for the third product, B. To keep the analysis simple, we consider a completely symmetric setup. So, we have that $v^h = \theta_A^A = \theta_B^B = \theta_C^C$ and $v^l = \theta_A^B = \theta_B^C = \theta_C^A$ as well as $\theta_B^A = \theta_C^B = \theta_B^C = 0$. Moreover, we assume that exactly one-third of the population belongs to group A users, one third to group B users and one-third to group C users.

We assume that the utility from using the website is different for each potential user. In our model, the parameter that denotes utility, q, is uniformly distributed in the population with support $[0, Q]$. To keep the analysis simple, we set $Q = 1$ w.l.o.g. While advertising provides users with potentially useful information about consumer products, it also annoys users, because it distracts attention from using the site. We assume that the resulting disutility is directly related to the volume of overall advertisement given by $\beta(k_A + k_B + k_C)$. The variable β measures how sensitive users are concerning the advertisement intensity. The expected utility of a user in group A from joining the website is[43]

$$U^A(q) = q - \beta(k_A + k_B + k_C) + \sqrt{k_A}\left(v^h - p_A^A\right) + \sqrt{k_C}\left(v^l - p_C^A\right).$$

[41] This is consistent with the literature on informative advertising, see e.g. Esteves (2009).

[42] In the following, the subscript refers to the type of firm, while the superscript refers to the consumer group.

[43] Because the setup is completely symmetric, the same holds for the users of groups B and C.

The first term is the positive utility that a consumer enjoys from using the services of the website. The second term is the disutility from being disturbed by an advertisement. The third and fourth terms represent the potential added surplus that a user gets when she observes advertisement for a good with a price that does not exceed her willingness to pay. We assume that users have rational expectations about the prices that firms will announce as well as rational expectations about the amount of advertising that they have to encounter while using the site.

3.2.3 Firms

The website offers firms the opportunity to display ad banners on its site. We assume that firms can reach the users who enter the site only via advertising on this website. Thus, in case they do not advertise, they do not sell anything (at least not to these consumers). Moreover, we normalize production costs to zero w.l.o.g. Therefore, trade is always beneficial. Advertisers have to decide on two things. First, they have to choose the amount of advertising they want to display given the unit price r that the website sets. Second, they have to decide which price to set for their product given that a fraction α of all potential users enters the website. Their decision depends on the advertising mode of the website. Advertisers do not compete directly for consumers because they are monopolists for their consumer product. This is consistent with the literature on media markets (see Anderson and Coate, 2005).

Firms' expected profits depend on the advertising mode of the website. Let us first look at the case of targeted advertising (in the following, we will denote this with the superscript t for *targeting*). If the website has committed itself to sharing information on consumers, advertisers know exactly to which type of consumer they send their ads. The expected profit for the advertiser depends on the prices promoted to each group of consumers and the number of advertisements sent to each group. As long as firms are allowed to choose different price offers for different consumers, this leads to an expected profit for firm A of:

$$\pi_A^t = \left(\sqrt{k^{t,A}}p^A - r^t k^{t,A}\right)\frac{\alpha}{3} + \left(\sqrt{k^{t,B}}p^B - r^t k^{t,B}\right)\frac{\alpha}{3}.$$

The first term is the expected profit from users of group A and the second term is the expected profit from users of group B. Because users of group C do not have a positive willingness to pay for product A, they are of no value for firm A. The probability that a user of group A notices an ad, $\sqrt{k^{t,A}}$, times the advertised price, p^A, is the expected revenue, while $r^t k^{t,A}$ denotes the cost of advertising for firm A. This includes the number of demanded ads times the per-unit price for ads. The second term is the expected profit from ads sent to group B users.

Now consider the case with standard non-targeted advertising (in the following, denoted by the superscript s for *standard*). Because the advertiser does not know whether somebody who observes an ad is of type A, B or C, advertisement cannot be targeted, but only sent to all users. In this case, the expected profit of firm A depends on the price it promotes and the advertising intensity. If the price is so high that only users from group A buy (in the following denoted by superscript h), the expected profit is:

$$\pi_A^{s,h} = \sqrt{k^{s,h}} p^{s,h} \frac{\alpha}{3} - r^s k^{s,h} \alpha,$$

where $p^{s,h} > v^l$ is such that only users of group A buy the product when they notice an ad. If the price for good A is below or equal to the willingness of a consumer from group B to pay (in the following denoted by superscript l), advertising can lead to potential purchases from two-thirds of the population. Therefore, the expected profit is

$$\pi_A^{s,l} = \sqrt{k^{s,l}} p^{s,l} \frac{2\alpha}{3} - r^s k^{s,l} \alpha.$$

Because group C users have no interest in product A, there will always be some ads that are completely wasted in the non-targeting mode.

3.2.4 Website Provider

We assume that the development cost for the website is already sunk at the moment when the operator launches the site. Moreover, we assume that the website does not incur any costs from additional users. Thus, the only cost that can occur from the website's point of view is potentially fewer users when the advertisement intensity increases.

The website provider's problem is to decide in which mode to organize advertisement and to set a price for ad banners. Therefore, the website first determines the optimal per-unit advertising fee given the expected profit from the targeting and the non-targeting modes. Then, the website decides to which mode to commit itself to. Under the targeting mode, the website's expected profit is

$$\Pi^t\left(r^t\right) = 3r^t\left(k^{t,A}\left(r^t\right)\frac{\alpha\left(k^{t,A}\left(r^t\right),k^{t,B}\left(r^t\right)\right)}{3} + k^{t,B}\left(r^t\right)\frac{\alpha\left(k^{t,A}\left(r^t\right),k^{t,B}\left(r^t\right)\right)}{3}\right).$$

We have three different firms to which the website sells ads. Each firm sends ads to the group that favors its product and to the group that likes its product less but still has a positive willingness to pay. The share of potential users that actually join the site is a function of the advertising intensity and therefore also depends on the advertising fee that the website sets.

Now let us consider the case where the website commits to not exploit information about consumers to target them. The expected profit is

$$\Pi^s\left(r^s\right) = 3r^s\left(k\left(r^s\right)\right)\alpha\left(3k\left(r^s\right)\right).$$

Here, advertisements cannot be directed to a particular group of consumers; rather, all advertisements from all three firms reach all consumers.

3.3 Equilibrium

In this section, we solve for the subgame perfect equilibrium of our three-stage model. We start with the last stage of the game and then solve by backward induction.

3.3.1 Third Stage

When firms have the opportunity to decide on the amount and content of advertising, they can find themselves either in the targeting or in the non-targeting mode. At this stage users have already decided whether to enter the website. Therefore, firms take the consumer decision as given. Consequently, they demand the number of banner ads that maximizes their expected profits facing the per-unit fee for ad banners that the website set in the first period. Firms first determine the profit maximizing amount of ads for every price that they could possibly set for their consumer product and then they choose the profit maximizing price.

Targeting

Let us first consider the case where the website has chosen the targeting mode in the first stage of the game. Advertisers receive explicit information about the preferences of users and can therefore identify the users of all three different groups. Thus, firm A is able to target the users who have the highest willingness to pay for its consumer product. If it is profitable, firm A can also send some advertisements to the users of group B who like its product less. Obviously, sending ads to the third group of users, C, is never profitable because they have a willingness to pay of zero for consumer product A. Firm A faces the following maximization problem:

$$\max_{k^{t,A},k^{t,B}} \pi^t = \left(\sqrt{k^{t,A}}\left(p^{t,A}\right) - r^t k^{t,A}\right)\frac{1}{3}\alpha + \left(\sqrt{k^{t,B}}\left(p^{t,B}\right) - r^t k^{t,B}\right)\frac{1}{3}\alpha.$$

One-third of the users who actually joined the website in stage 2 belong to group A, and one third belong to group B. The following Lemma characterizes firms' optimal decisions.[44]

Lemma 3.1 *In the targeting mode, firm A promotes the price $p^{t,A} = v^h$ to all users of group A for its consumer product, and A price of $\left(p^{t,B} = v^l\right)$ to all users of group B. Firm A's demand for advertisements sent to users of group A given a per-unit price of r^t is*

$$k^{t,A}\left(r^t\right) = \frac{\left(v^h\right)^2}{4\left(r^t\right)^2}.$$

Firm A's demand for advertisements sent to users of group B is:

$$k^{t,B}\left(r^t\right) = \frac{\left(v^l\right)^2}{4\left(r^t\right)^2}.$$

The consumer price decision is trivial. When firm A knows for sure that only users of group A receive its ads, it can not be profitable to advertise any other price than the one that corresponds to the users' full willingness to pay for the consumer product. The same holds for ads sent to users of group B. The quantity decision depends on the price per unit that the website sets in stage 1, r^t. The optimal number of advertisements increases with the maximum price that the advertiser can charge for its consumer product and decreases with the price of the ads. Due to the fact that the

[44] All proofs of this chapter are contained in the appendix.

probability function is concave in the number of ads, it is always optimal for firm A to demand at least a small number of ads to be send to the users of group B.

Non-Targeting

Let us now turn to the standard non-targeting mode of advertising. Here, firms do not receive specific information about the type of users whom they face. They only know how people who joined the website are distributed within the population. Therefore, firms have to decide whether they wish to promote a low price for their consumer product and thereby potentially reach a larger number of users who observe their ads or whether to promote a high price and thus reach only users who have a high willingness to pay for their consumer good. In the latter case, ads that are received by people with a willingness to pay lower than the price of the good are just wasted. Under the standard advertising mode where firms offer their products for a high price to users, firms face the following maximization problem:

$$\max_{k^{s,h}} \pi^{s,h} = \sqrt{k^{s,h}} \left(p^{s,h}\right) \frac{\alpha}{3} - r^{s,h} k^{s,h} \alpha.$$

Firms have to pay to send ads to all users, but only a third of the users will in fact buy when they notice the ad. Under the standard advertising mode where firms offer a potential bargain to some users, the expected profit is:

$$\max_{k^{s,l}} \pi^{s,l} = \sqrt{k^{s,l}} \left(p^{s,l}\right) \frac{2\alpha}{3} - r^{s,l} k^{s,l} \alpha.$$

Here, all ads that are observed by a user of group A or group B lead to a purchase. For a given advertisement price r, and a given number of users α, we can now determine when one price dominates the other. A firm's optimal consumer price decision and the optimal demand given r^s are summarized in the following Lemma.

Lemma 3.2 *For a given advertisement price per-unit, r^s, firm A demands*

$$k^{s,h}\left(r^s\right) = \frac{\left(v^h\right)^2}{36\left(r^s\right)^2}$$

units of advertisement in case it decides to advertise the high price $p^h = v^h$ and

$$k^{s,l}\left(r^s\right) = \frac{\left(v^l\right)^2}{9\left(r^s\right)^2}$$

if it decides to advertise the low price, $\left(p^l = v^l\right)$*. In the non-targeting mode firm a chooses to advertise the high price when* $v^h > \sqrt{2}v^l$ *and the low price otherwise.*

Now that we have determined a firm's behavior under each mode and given a fee for placing advertisements on the website, we turn to the behavior of potential users.

3.3.2 Second Stage

At this stage of the game, the website has already committed to a mode. Potential users observe the mode of advertising of the website and form expectations about the behavior of firms. Thus, each consumer calculates her expected profit from joining the website and decides whether to join or not. Therefore, we have to distinguish three cases: Non-targeting when consumers expect to get some extra positive utility from a good bargain from buying a consumer good; non-targeting, when consumers do not expect to get a good deal for any consumer good; and finally, targeting, when consumers also do not expect any extra utility from buying goods.

Targeting

Let us look again at the first mode, targeting. Since users anticipate that firms will extract their full willingness to pay, they do not expect to get any additional benefit from joining the site except for the utility that they derive from the using the website itself. Expected utility for a type A user is, therefore

$$U^t\left(q, p_A^{t,A} = v^h, p_B^{t,A} = v^l\right) = q - \beta\left(k_A^{t,A} + k_B^{t,A}\right).$$

Consumers will join the website if and only if they expect to receive a positive utility from joining. Therefore, we can determine the marginal consumer who just gets expected utility of zero and is therefore indifferent about joining the website or not. Since $U^t(q)$ is increasing in q, we get a unique value of q, denoted by $\widehat{q}$, below which the user will not join the website. From this we can derive the number of users who join the website under each mode. For targeting, the threshold is

$$\widehat{q}^t\left(p_A^{t,A} = v^h, p_B^{t,A} = v^l\right) = \beta\left(k_A^{t,A} + k_B^{t,A}\right).$$

Since q is uniformly distributed on the interval $[0,1]$, the fraction of users who decide to enter the website, α, equals

$$\alpha^t\left(p_A^{t,A}=v^h,p_B^{t,A}=v^l\right)=\left\{1-\widehat{q}^t\right\}=\left\{1-\beta\left(k_A^{t,A}+k_B^{t,A}\right)\right\}.$$

Non-targeting

Let us now turn to the mode of standard advertising without targeting. Given that consumers expect firms to promote only high prices, they do not expect to get any additional benefit. The difference from the targeting mode is that consumers may expect to see a different amount of attention-disrupting ads. Thus, the expected utility of a type A user is:

$$U^{s,h}\left(q,p_A^{s,A}=v^h,p_B^{s,A}=v^h\right)=q-\beta\left(k_A^{s,h}+k_B^{s,h}+k_C^{s,h}\right).$$

The marginal consumer has the following critical q

$$\widehat{q}^{s,h}\left(p_A^{s,A}=v^h,p_B^{s,A}=v^h\right)=\beta\left(k_A^{s,h}+k_B^{s,h}+k_C^{s,h}\right).$$

From this follows the share of potential users who actually join the website

$$\alpha^{s,h}\left(p_A^{s,A}=v^h,p_B^{s,A}=v^h\right)=\left\{1-\beta\left(k_A^{s,h}+k_B^{s,h}+k_C^{s,h}\right)\right\}.$$

Finally, when consumers expect to receive offers that are below their willingness to pay, they expect to get some extra rent. This leads to the following utility for a user of type A

$$U^{s,l}\left(q,p_A^{s,A}=v^l,p_B^{s,A}=v^l\right)=q-\beta\left(k_A^{s,l}+k_B^{s,l}+k_C^{s,l}\right)+v\left(k_A^{s,l}\right)\left(v^h-v^l\right).$$

Here, the threshold value for q is

$$\widehat{q}^{s,l}\left(p_A^{s,A}=v^l,p_B^{s,A}=v^l\right)=\beta\left(k_A^{s,l}+k_B^{s,l}+k_C^{s,l}\right)-v\left(k_A^{s,l}\right)\left(v^h-v^l\right).$$

Thus, the share of potential users who actually join the website is

$$\alpha^{s,l}\left(p_A^{s,A}=v^l,p_B^{s,A}=v^l\right)=1-\beta\left(k_A^{s,l}+k_B^{s,l}+k_C^{s,l}\right)+v\left(k_A^{s,l}\right)\left(v^h-v^l\right).$$

The fraction of website users, $\alpha^{s,l}$, is increasing with the potential benefits from joining the website $\left(v\left(k_A^{s,l}\right)\left(v^h-v^l\right)\right)$ and decreasing with the intensity of advertising that each user faces, $\beta\sum k$.

3.3.3 First Stage

In the first stage of the game, the website needs to choose its advertising mode, either targeting or standard non-targeting. To determine the optimal choice, we have to compare the expected profits under each alternative. Thus, we need to calculate the profit-maximizing per-unit fees for advertisement r for each possible mode. For the non-targeting mode, the website has to form expectations about which kind of offers the firms will finally advertise. An increase in r has several effects that the website has to consider. First, the higher r is, the lower the firm's demand for advertisement. Second, less advertising makes the website more attractive for users, but it also reduces the probability that users observe ads and buy consumer products. To start, we consider the situation where the website decides to choose the targeting mode.

Targeting

Under targeting, the website is able to sell advertisements to firms targeted at a certain group of consumers. Because we have three symmetric groups of consumers, the expected profit is:

$$\max_{r^t}\Pi^t\left(r^t\right)=\left\{1-\beta\left(k^{t,h}\left(r^t\right)+k^{t,l}\left(r^t\right)\right)\right\}\left(k^{t,h}\left(r^t\right)+k^{t,l}\left(r^t\right)\right)r^t$$

under the targeting mode. The first order conditions yield the optimal per unit price for ads. We can then solve for the equilibrium of this subgame that is described in Lemma 3.3.

Lemma 3.3 *The targeting equilibrium is characterized by*

$$r^t = \sqrt{\frac{3\beta\left((v^h)^2 + (v^l)^2\right)}{4}},$$

$$k^{t,h} = \frac{\left(v^h\right)^2}{3\beta\left((v^h)^2 + (v^l)^2\right)}, k^{t,l} = \frac{\left(v^l\right)^2}{3\beta\left((v^h)^2 + (v^l)^2\right)},$$

$$\alpha = \frac{2}{3}.$$

This leads to a profit of

$$\Pi^t = \frac{1}{3}\sqrt{\frac{\left((v^h)^2 + (v^l)^2\right)}{3\beta}}$$

for the website,

$$\pi^t = \frac{\sqrt{(v^h)^2 + (v^l)^2}}{2\sqrt{3\beta}}$$

for the firms, and a surplus of

$$CS = \frac{2}{9}$$

for consumers.

Non-Targeting

Under non-targeting, the website can only sell ads to all users. Because the website knows that consumers behave differently according to the expected product prices, the website has to take firms' advertising decision into account when setting the optimal fee. Let $\Pi^{s,h}$ denote the website's profit when it expects that firms will promote high prices, and $\Pi^{s,l}$ when it expects that firms will promote low prices. When expecting high prices, the website faces the following maximization problem:

$$\max_{r^{s,h}} \Pi^{s,h}\left(r^{s,h}\right) = 3\left\{1 - \beta 3k^{s,h}\left(r^{s,h}\right)\right\} k^{s,h}\left(r^{s,h}\right) r^{s,h}$$

and the following maximization problem when it expects low prices:

$$\max_{r^{s,l}} \Pi^{s,l}\left(r^{s,l}\right) = 3\left\{1 - \beta 3k^{s,l}\left(r^{s,l}\right) + v\left(k^{s,l}\right)\left(v^h - v^l\right)\right\} k^{s,l} r^{s,l}.$$

To make sure that we have an interior solution to our model, we make the following assumption:

Assumption 1: $\beta \geqslant \sqrt{3}\left(v^h - v^l\right)$.

Assumption 1 implies that the disutility from watching advertisements is not too low compared to the potential benefit from finding a cheap consumer product. Without this assumption, it would be possible that all consumers want to enter the website regardless of the amount of advertising that they have to consume.

Again, we can derive the optimal fees from the profit functions. Lemma 3.4 describes the subgame when a high price for consumer products is expected:

Lemma 3.4 *Given that the website expects firms to promote high prices, the equilibrium is characterized by*

$$\begin{aligned} r^{s,h} &= \frac{v^h\sqrt{\beta}}{2}, \\ k^{s,h} &= \frac{1}{9\beta}, \\ \alpha^{s,h} &= \frac{2}{3}. \end{aligned}$$

This leads to a profit of

$$\Pi^{s,h} = \frac{v^h}{9\sqrt{\beta}}$$

for the website, and

$$\pi^{s,h} = \frac{v^h}{27\sqrt{\beta}}$$

for the firms, and a surplus of

$$CS = \frac{2}{9}$$

for consumers.

Lemma 3.5 describes the subgame when a low price is expected. In the following, let g denote the difference between the willingness to pay for the most and the less preferred good: $g = v^h - v^l$.

Lemma 3.5 *Given that the website expects firms to promote low prices, the equilibrium is characterized by:*

$$\begin{aligned} r^{s,l} &= v^l \frac{\sqrt{9\beta + g^2} - g}{3}, \\ k^{s,l} &= \frac{1}{\left(\sqrt{9\beta + g^2} - g\right)^2}, \\ \alpha^{s,l} &= 1 - \frac{\beta}{\left(\sqrt{3\beta + (g)^2} - g\right)^2} + \frac{g}{\left(\sqrt{3\beta + g^2} - g\right)}. \end{aligned}$$

This leads to a profit of

$$\Pi^{s,l} = \left(1 - \frac{3\beta}{\left(\sqrt{9\beta + (g)^2} - g\right)^2} + \frac{1}{\left(\sqrt{9\beta + (g)^2} - g\right)} g\right) \frac{v^l}{\sqrt{9\beta + (g)^2} - g}$$

for the website, and

$$\pi^{s,l} = \left(1 - \frac{3\beta}{\left(\sqrt{9\beta + (g)^2} - g\right)^2} + \frac{1}{\left(\sqrt{9\beta + (g)^2} - g\right)} g\right) \frac{v^l}{3\sqrt{9\beta + g^2} - g}$$

for the firms, and a surplus of

$$CS = \frac{\left(1 - \frac{3\beta}{\left(\sqrt{9\beta + (g)^2} - g\right)^2} + \frac{g}{\left(\sqrt{9\beta + \left(v^h - v^l\right)^2} - g\right)}\right)^2}{2}$$

for consumers.

One can see that the optimal per-unit fee for ads increases with the difference between v^h and v^l.

Mode Choice

We are now able to solve the first stage of the game. The website has to decide which mode to select. This involves a comparison of the expected payoffs from each subgame.

The website's profit consists of three components: first, the per-unit price per ad; second the number of ads per user; and third, the number of users. From Lemma 3.1 and 3.2, firms' demand for ads for a given per-unit price is always higher under the targeting mode for two reasons: for one, the probability that an ad reaches its target is higher. For another, ads that are noticed by a firm's special clientele lead to higher profits per purchase. In contrast, consumers are more tolerant of advertising when they expect to receive some benefit from buying a product in case that they notice an ad and buy a product. The higher the expected additional benefit $v^h - v^l$ compared to the disutility from watching distracting advertisements (measured through β), the more tolerant they are regarding the number of ads.

It turns out that the number of users under non-targeting with low prices is always higher than the number of users under targeting. The same applies to the number of ads that the website can sell. However, the price per ad is always higher under targeting. Thus, the question is when the latter effect dominates.

We know from Lemma 3.2 that $v^h \leq \sqrt{2}v^l$ implies that firms promote a low price for their consumer product under the non-targeting mode. Advertisers take this decision regardless of what the website prefers. Consequently, the website has to compare $\Pi^{s,l}$ and Π^t. The following proposition describes the website's decision when firms are expected to advertise low prices.

Proposition 3.1 *If preferences for the consumer product are relatively homogenous* $\left(v^h \leq \sqrt{2}v^l\right)$*, two cases can be distinguished. i) If the disutility from advertisement captured through* β *is low compared to the difference in the willingness to pay for different products,* $v^h - v^l$*, there exist parameters such that the website prefers the non-targeting mode. If the disutility* β *from consuming advertisement is relatively high compared to* $v^h - v^l$*, the website will choose the targeting mode.*

When β is high in comparison with $v^h - v^l$, the targeting mode is more preferable. Intuitively, the potential benefit from advertising is relatively low for consumers. Therefore, from the website's point of view it is more important that firms are willing to pay more for ads under targeting. In contrast, when β is high compared to $v^h - v^l$, the additional effect of an expected bargain from buying a consumer product is considerably large. Consequently, as the share of users under non-targeting approaches 1, at some point, profits under non-targeting fall below the profits under non-targeting.

However, we know from Lemma 3.2 that when $v^h - v^l$ increases ceteris paribus firms will advertise the high price when the threshold $v^h = \sqrt{2}v^l$ is passed. The following proposition describes the website's decision in that case.

Proposition 3.2 *When user preferences for the consumer products are relatively heterogenous $\left(v^h > \sqrt{2}v^l\right)$, the website will always opt for the targeting mode.*

Here, the website compares $\Pi^{s,h}$ and Π^t. In both modes, consumers are not able to get additional benefits from advertising. All rents from successful purchases go to the firms. However, firms demand more ads for the same per-unit fee under targeting, because they do not have to waste ads on users who do not buy their product, even when noticing an ad. In addition to serving the group of users who like their product the most, firms can also send ads with rebates to the group of users with the lower willingness to pay for their product. Therefore, targeting always leads to higher profits. This means that non-targeting with high prices will never be observed in equilibrium, because this subgame is strictly dominated by targeting.

Our assumptions lead to clear-cut results. They mainly depend on two assumptions in our model. First, we assume that the ability to identify consumer groups means that firms can perfectly determine the willingness to pay for users. Second, we assume that consumers buy exactly one unit of a consumer product when they notice advertisement for it. Relaxing these assumptions could lead to the result that consumers always get some rent from a successful purchase, also in the targeted advertising mode. In this case, the results from proposition 3.1 and 3.2 would be less concise. At the end of the next section we discuss the effects when consumers can receive some rent under the targeting mode.

3.4 Welfare and Policy Discussion

3.4.1 Welfare Analysis

In the previous section, we determined in which cases the website decides to choose targeting over non-targeting. In the next section, we discuss the welfare consequences of this decision. The following proposition describes the welfare consequences given that non-targeting with high prices never occurs:

Proposition 3.3 *When user preferences for the consumer product are relatively heterogeneous* $\left(v^h > \sqrt{2}v^l\right)$*, consumer surplus is the same under targeting and non-targeting, but profits are higher under targeting. Thus, targeting leads to higher welfare.*

From Proposition 3.2, the website and advertisers obtain higher expected profits from targeted advertising. From Lemma 3.4 and Lemma 3.5, consumer surplus is exactly the same under non-targeting with high prices and targeting (therefore, welfare is higher in the targeting mode). The reason is that consumer rent is fully skimmed under both modes. Thus, the website sets the price for advertising such that users face exactly the same total amount of advertising under both targeting and non-targeting. The only difference is that the package of advertisement which is send to a consumer of group A does not contain any ads for product C under targeting. Since consumers never enjoy advertisement in our setup, but are equally annoyed by any ad which distracts them from using the website, targeting does not provide any benefits for them.

This result may come as a surprise at first glance. Intuitively, one would expect that better targeting leads to less advertising because the monopolist can trade off the number of users against the number of ads. However, this result does not arise in our model.

The reason is that without any additional benefits through buying cheap products, the number of users joining the website is linearly decreasing in the total amount of advertisement. The number of users constitutes the first part of the website's profit. The second component is the number of ads sold to the advertisers. Therefore, one element of the website's profit is linearly increasing in k and one part that is linearly decreasing in k. The last component of the profit function is the per unit fee per ads. The relationship between r and k is determined through the advertising technology, i.e., the probability function. Thus, the optimal amount of k sent to consumers depends on β and the slope of the probability function. Although the total amount of ads does not change, consumers get more ads from the firms whose products they actually buy in the targeting mode. Consequently, the efficiency gains from targeted advertising compared to non-targeted advertising are merely shared by the website and advertising firms.

Our results may not be robust to some generalizations. First, we assumed that the setup is completely symmetric. If this were not the case, different consumer groups would, we conjecture, face a different amount of advertising under each mode. As a result, the number of users from different consumer groups joining the website could vary under each mode. Second, we consider only a per-unit fee for advertisement. While this is a realistic baseline assumption, other forms of contracts between a website and advertisers could bring about further results. For example, alternative to a per-unit fee, some websites charge a fee for successful clicks.

The comparison between the non-targeting mode with low prices and the targeting mode is summarized in the next proposition.

Proposition 3.4 *When user preferences for the consumer product are relatively homogenous* $\left(v^h \leq \sqrt{2}v^l\right)$*, consumers always prefer the non-targeting to the targeting mode. Profits can be higher or lower under targeted advertising compared to non-targeted advertising.*

The intuition is as follows. From Lemmas 3.4 and 3.5, consumer surplus is always higher under non-targeting with low prices compared to targeting. Although the amount of advertising that users have to consume is lower under the targeting mode, this potentially positive effect is overcompensated by the loss in consumer rent from successful purchases.

So far, our analysis suggests that, while targeting seems to be good news for firms, consumers are, at best, indifferent. We do not quantify the effects, i.e.; whether the loss in consumer rent is compensated by an increase in profits. As it stands, the model suggests that a government that places more weight on consumer surplus than on producer rents should consider a ban on targeted advertising. In the following section, we will discuss a policy measure that mitigates the rather negative picture of targeting.

3.4.2 A Ban on Price Discrimination

In some countries, e.g. in Germany, sending specific users personal price offers conditional on their purchasing history or other user characteristics is prohibited. Translated to our setting this would mean that price discrimination between users from different groups is not allowed. Nevertheless, firms can still have the possibility to send targeted information to certain user groups. However, the content of advertisement has to be the same for all users.

Analogous to the non-targeting mode in the previous section, advertisers now have to decide again whether they prefer to advertise a low price and thus reach more consumers or whether to advertise a high price and thus earn more money from a successful deal. In the latter case, the results for consumers carry over from the previous setting. Since consumers do not benefit from ads per se, they are again indifferent between targeting and non-targeting. For firms, the additional constraint leads to lower profits compared to the unconstrained equilibrium. Nevertheless they still benefit from a reduction in wasted advertisement in the targeting mode. Therefore, targeting is still the preferred choice.

The more interesting case is the one where advertisers prefer to promote low prices in their ads. The following Lemma describes the subgame in such a setting.

Lemma 3.6 *If consumers' preferences for the consumer product are relatively homogenous* $\left(v^h \leq \sqrt{2}v^l\right)$, *firms prefer to advertise low prices under targeting with a ban on price discrimination. The equilibrium is characterized by*

$$\begin{aligned}
r^{t,l} &= \frac{v^l\left(\sqrt{3\beta+g^2}+g\right)}{2}, \\
k^{t,l} &= \frac{1}{\left(\sqrt{3\beta+g^2}+g\right)^2}, \\
\alpha^{t,l} &= 1-\frac{\beta}{\left(\sqrt{3\beta+g^2}-g\right)^2}+\frac{g}{\left(\sqrt{3\beta+g^2}-g\right)}.
\end{aligned}$$

The website then earns

$$\Pi^{t,l} = \left(1-\frac{\beta}{\left(\sqrt{3\beta+g^2}-g\right)^2}+\frac{g}{\left(\sqrt{3\beta+g^2}-g\right)}\right)\frac{v^l}{\sqrt{3\beta+g^2}-g},$$

the firms earn

$$\pi^{t,l} = \left(1 - \frac{\beta}{\left(\sqrt{3\beta + g^2} - g\right)^2} + \frac{g}{\left(\sqrt{3\beta + g^2} - g\right)}\right) \frac{v^l}{2\left(\sqrt{3\beta + g^2} + g\right)},$$

and consumers receive

$$CS = \frac{\left(1 - \frac{\beta}{\left(\sqrt{3\beta+g^2}-g\right)^2} + \frac{g}{\left(\sqrt{3\beta+g^2}-g\right)}\right)^2}{2}.$$

The following proposition summarizes the effects of a ban on price discrimination with regard to welfare.

Proposition 3.5 *When firms are allowed to send targeted advertisements, but are not allowed to price discriminate, consumers are never worse off under targeting compared to non-targeting. Profits for the website and advertising firms are always higher under targeting compared to non-targeting.*

Intuitively, due to the fact that consumers do not loose rents from a successful deal compared to non-targeting, they may now benefit from targeting. Ceteris paribus, the same number of advertisements lead to a higher utility for users. As a consequence, more users want to join the website. The reason is that while the disutility remains the same, the probability of noticing an ad for the preferred product increases for the same amount of advertising.[45]

Here, the website can in fact trade off the total sum of ads sent to users against the number of users. Since consumers are more tolerant towards ads, it is optimal for the website to increase the number of ads in the targeting mode compared to the non-targeting mode. Nevertheless, there will still be more users on the website under targeted advertising compared to non-targeted advertising.

Since all agents benefit from targeting, we conclude that as long as firms are not allowed to price discriminate, e.g. through sending certain consumer groups special

[45] At this point it becomes clear why we consider a setting with three consumer products. If there were only two products, there would be no difference between targeting with low prices and non-targeting with low prices.

offers and rebates, targeted advertising is positive for society. The reason is that in this case both users and advertisers benefit from an increase in the efficiency of advertising.

3.5 Conclusion

This chapter has developed a model that allows us to study an internet website providers' choice between financing the website with targeted or non-targeted advertising. Advertising in this setting is purely informative and allows to transmit relevant information on the characteristics and prices of products to consumers. Our model explicitly accounts for the strategic interaction between the website, firm that advertise and consumers. We show that targeted advertising always benefits firms, but consumers are at best indifferent between targeted and non-targeted advertising.

Consumers do not benefit from targeted advertising, because it allows firms to price discriminate and thus reduce consumer rent. This effect overcompensates the positive effect of a reduced number of distracting advertisements that users have to consume while visiting the website. In an extension of our basic model, we examine the effect of targeted advertising when firms are forced to send the same content to all users who receive their advertisements. Interestingly, in this case consumers can also benefit from targeted advertising, because they do not loose rent from buying products compared to the non-targeted advertising mode.

From our analysis we can derive some interesting policy recommendations. On the one hand, it is positive that targeting lowers wastage of redundant advertisements and thus increases efficiency. On the other hand, the ability to address different user groups with different content can decrease consumer surplus. While prohibiting targeted advertising may go to far, a ban on price discrimination could guarantee that targeted advertising increases the welfare for all agents involved.

Acquisiti and Varian (2005) consider the possibility that firms use the information they receive on consumer preferences from early purchases to offer them products that better match their tastes und thus increase consumers' utility in subsequent periods. It would be interesting to extend our analysis to a dynamic setting with repeated interaction between a website, consumers, and advertising firms in future research. Furthermore, to introduce website competition could be a natural extension, bringing new insights to our analysis.

Appendix to Chapter 1

Proof of Proposition 1.1:

First part of the proposition: Firm h is willing to transfer its business only when the compensation price is higher than the profit for producing at home:

$$(1-\tau_h)(p-c_h) < (1-\tau_h) P^M.$$

Firm l is willing to receive the business whenever:

$$(1-\tau_l)\left(p-c_l-P^M\right) > 0.$$

From this follows:

$$\begin{aligned} p-c_h &< P^M < p-c_l, \\ c_l &< c_h. \end{aligned}$$

Second part of the proposition: We assume that unrelated parties share the after-tax surplus for relocation, denoted by $S\left(P^M\right)$, according to their bargaining power, α. The firm in country h thus receives an after tax surplus equal to:

$$s_h = (p-c_h)(1-\tau_h) + \alpha S\left(P^M\right), \tag{1.1}$$

where $(p-c_h)(1-\tau_h)$ corresponds to the after-tax profit which firm h can realize as outside option. The after-tax surplus which the firm in country l receives is:

$$s_l = (1-\alpha) S\left(P^M\right). \tag{1.2}$$

The total surplus $S\left(P^M\right)$, which is subject to negotiations, is no longer a fixed value, but changes with the amount of surplus attributed to each party, because of the different tax rates. In the standard Nash-bargaining approach, the total surplus is invariant to the split of the surplus. In our setting, the surplus is exchanged via paying a compensation price. Denote by π_h the after-tax profit of the transferring firm in country h after the transfer has taken place:

$$\pi_h = P^M (1 - \tau_h). \tag{1.3}$$

Denote by π_l the expected after-tax surplus by the receiving firm:

$$\pi_l = \left(p - c_l - P^M\right)(1 - \tau_l). \tag{1.4}$$

Given the premise that the negotiated surpluses correspond to the expected after-tax profits, it follows that

$$\pi_h = s_h,$$

and

$$\pi_l = s_l.$$

Replacing π_h and π_l from (1.3) and (1.4) in the equations (1.1) and (1.2) leads to

$$(p - c_h)(1 - \tau_h) + \alpha S\left(P^M\right) = P^M (1 - \tau_h), \tag{1.5}$$

and

$$(1 - \alpha) S\left(P^M\right) = \left(p - c_l - P^M\right)(1 - \tau_l). \tag{1.6}$$

Rearranging (1.6) leads to:

$$\alpha S\left(P^M\right) = \frac{\alpha}{(1 - \alpha)}\left(p - c_l - P^M\right)(1 - \tau_l).$$

Substituting $\alpha S\left(P^M\right)$ in (1.5) leads to the following equation:

$$(p - c_h)(1 - \tau_h) + \frac{\alpha}{(1 - \alpha)}\left(p - c_l - P^M\right)(1 - \tau_l) = P^M (1 - \tau_h).$$

Solving for P^M:

$$P^M = \frac{\alpha (1 - \tau_l)(p - c_l) + (1 - \alpha)(1 - \tau_h)(p - c_h)}{1 - (1 - \alpha)\tau_h - \alpha\tau_l}.$$

Proof of Proposition 1.2:

First part of proposition: The sum of profits of MNE after relocation can be stated as follows

$$(1-\tau_h)\left(P^{TP}-d_h\right)-(1-\tau_l)(P^{TP})+(1-\tau_l)(p-c_l-d_l). \tag{1.7}$$

The sum of profits of unrelated parties after relocation can be stated as follows

$$(1-\tau_h)\left(P^{M}\right)-(1-\tau_l)(P^{M})+(1-\tau_l)(p-c_l). \tag{1.8}$$

(1.7) > (1.8) if and only if

$$(\tau_l-\tau_h)P^{TP}-(1-\tau_l)d_l-(1-\tau_h)d_h>(\tau_l-\tau_h)P^{M}.$$

Rearranging leads to

$$P^{TP}<\frac{(1-\tau_l)d_l+(1-\tau_h)d_h}{(\tau_l-\tau_h)}+P^{M}.$$

Second part of proposition: The sum of profits of MNE after relocation can be stated as follows

$$(1-\tau_h)\left(P^{TP}-d_h\right)-(1-\tau_l)(P^{TP})+(1-\tau_l)(p-c_l-d_l). \tag{1.9}$$

The sum of profits of unrelated parties given no relocation can be stated as

$$(1-\tau_h)(p-c_h). \tag{1.10}$$

(1.9) > (1.10) if and only if

$$(1-\tau_h)(p-c_h)<(1-\tau_h)\left(P^{TP}-d_h\right)-(1-\tau_l)P^{TP}+(1-\tau_l)(p-c_l-d_l).$$

Rearranging leads to

$$P^{TP}<\frac{(1-\tau_h)(p-c_h+d_h)-(1-\tau_l)(p-c_l-d_l)}{(\tau_l-\tau_h)}.$$

Proof of Proposition 1.3:

Condition 1: The relocation inside a MNE shall take place only if $c_h > c_l+d_l+d_h$.From this follows that if it is not possible to condition on d_l and d_h the transfer price has to be at least higher than the expected profit in country h

$$P^{TP}\geq p-c_h.$$

Condition 2: If $d_l + d_h \geq 0$, the relocation has to take place as MNE rather than between unrelated parties. From this follows

$$(1-\tau_h)\left(P^{TP} - d_h\right)+(1-\tau_l)(p-(c_l + d_l)-P^{TP}) \geq (1-\tau_h)P^M+(1-\tau_l)(p-c_l-P^M), \forall d < 0.$$

Rearranging leads to

$$P^{TP} \leq P^M + \frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)}. \tag{1.11}$$

If $d_l + d_h < 0$, the transaction has to take place between unrelated parties. Thus,

$$(1-\tau_h)\left(P^{TP} - d_h\right)+(1-\tau_l)(p-(c_l + d_l)-P^{TP}) < (1-\tau_h)P^M+(1-\tau_l)(p-c_l-P^M), \forall d < 0.$$

Rearranging leads to

$$P^{TP} > P^{MP} + \frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)}.$$

If governments cannot condition on $d_i, i = l, h$, it follows from (1.11) and (1.12) that $P^{TP} = P^{MP}$ is the unique intersection of the two sets of prices. Therefore, the unique pricing rule which fulfills condition 1 and 2 and thus implements first best irrespective of the realization of $d_i, i = l, h$ is

$$P^{TP} = \max\{p - c_h; P^M\}.$$

If it were possible $d_l + d_h \geq 0$, the following set of transfer prices implements first best

$$P^{TP} = P^M + y\frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)},$$

with $y \in [0, 1]$. If $d_l + d_h < 0$,the following set of transfer prices implements first best

$$P^{TP} = P^M - y\frac{(1-\tau_l)d_l + (1-\tau_h)d_h}{(\tau_l - \tau_h)},$$

with $y \in [0, 1]$. However, since our simple pricing rule is part of both sets for $y = 0$, it is not necessary to know d_l and d_h to make sure that condition 2 is fulfilled.

Extension to a monotonous decision on relocation

So far we considered the case that a company has to decide whether to relocate a business or not. Now we generalize the setting so that a firm has to decide on what percentage of a business to relocate. To keep the analysis simple we assume that the profits of firm h and firm l after the relocation are a monotonic function of the amount of relocation. We denote by z $(z \in [0,1])$ the percentage of relocation. Thus, $z = 0$ means that no relocation takes place, $z = 1$ means that one hundred percent of the business is relocated. Other values stand for intermediate shares. Let $\pi_l(z)$ denote the after-tax profit of firm l and $\pi_h(z)$ the after-tax profit of firm h. We assume that $\frac{\partial \pi_l(z)}{\partial z} > 0$ and $\frac{\partial \pi_h(z)}{\partial z} < 0$. The transfer pricing rule, P^{TP}, does not directly depend on z. But, in line with our previous analysis we assume that the transfer price is conditioned on the after tax profits that realize after a share of z is relocated $\left(P^{TP}(z) = f(\pi_l(z)(1-\tau_l), \pi_h(z)(1-\tau_h))\right)$. Thus, the MNE's maximization problem with regard to z is

$$\max_z \Pi(z) = \left(\pi_l(z) - P^{TP}(z)\right)(1-\tau_l) + \left(\pi_h(z) + P^{TP}(z)\right)(1-\tau_h).$$

Related firms maximize the joint after-tax surplus of both subsidiaries after a relocation. Depending on the properties of $\pi_l(z)$ and $\pi_h(z)$ (e.g., if functions are concave) there will either be a corner solution, i.e. no relocation at all, or full relocation, or an interior solution.

From the first order conditions follows that the transfer price influences the percentage of business to relocate

$$\frac{\partial \pi_l(z)}{\partial z}(1-\tau_l) + \frac{\partial \pi_h(z)}{\partial z}(1-\tau_h) - \frac{\partial P^{TP}(z)}{\partial z}(\tau_h - \tau_l) = 0.$$

Thus, the decision on the optimal quantity is always influenced by the transfer pricing regulation.

In the following, we will show some consequences that follow from this fact with a simple, numerical example:

Let $\pi_l(z) = 1 - z$. So, for $z = 0$, the profit in country h is 1 and for a relocation of hundred percent it is zero. Let $\pi_h(z) = \sqrt{z}$. So, for $z = 0$, the profit in country l is zero and for $z = 1$, it is 1. First, we consider the case where tax rates are the same in both countries ($\tau_h = \tau_l = \tau$). The MNE faces the following maximization problem

$$\max_z \Pi(z) = (\pi_l(z) + \pi_h(z))(1-\tau) = \left(1 - z + \sqrt{z}\right)(1-\tau).$$

From this follows the optimal percentage of relocation is $z = \frac{1}{4}$. Now we consider the case that countries have different tax rates, but no transfer price regulations. Without loss of generality, we assume that the tax rate in country l is zero and positive in country h. The maximization problem now is

$$\max_z \Pi(z) = \pi_l(z) + \pi_h(z)(1-\tau_h) = (1-z)(1-\tau_h) + \sqrt{z}.$$

This leads to a percentage of relocation of $z = \frac{1}{4(1-\tau_h)^2}$. Maybe not surprisingly, z increases in τ_h. This means that the higher the tax rate in country h compared to country l, the higher the distortion. Intuitively, since the firm maximizes after-tax profits it is optimal to relocate more than the efficient amount, because the reduction in profits before taxes is compensated by avoiding taxes in the high tax country. Finally, we consider the influence of a transfer price. The MNE now faces the following maximization problem

$$\max_z \Pi(z) = \pi_l(z) + \left(\pi_h(z) - P^{TP}(z)\right)(\tau_h) = (1-z)(1-\tau_h) - P^{TP}(z)\tau_h + \sqrt{z}.$$

The percentage of relocation now depends on $P^{TP}(z)$:

$$z = \frac{1}{4\left(1 - \tau_h + \left(\frac{\partial P^{TP}(z)}{\partial z}\right)\tau_h\right)^2}.$$

Thus, a positive transfer price can reduce the distortion. We see that only in case that $\frac{\partial P^{TP}(z)}{\partial z} = 1$, the first best allocation can be achieved.

Finally, we will show that even the market price negotiated by unrelated firms does not necessarily lead to a first best allocation. We take the market price from Proposition 1 and assume that $\alpha = \frac{1}{2}$. This means that firms share the after-tax surplus of a relocation equally. For our example, this leads to a price of

$$P^M = \frac{\frac{1}{2}(\pi_l(z)) + \frac{1}{2}(1-\tau_h)(1-\pi_h(z))}{1 - \frac{1}{2}\tau_h}.$$

The derivative of P^M with regard to z can be higher or lower than 1

$$\frac{\partial P^M}{\partial z} = \frac{\frac{1}{2}\left(\frac{1}{2\sqrt{z}}\right) + \frac{1}{2}\left(1 - \tau_h\right)(1)}{1 - \frac{1}{2}\tau_h}.$$

Therefore, even the market price does not necessarily lead to a first best allocation. Intuitively, the condition to share the after-tax profits equally implies that the transfer price is not the same for different values of z. Consequently, the decision on z is influenced. To determine the second best transfer pricing rule in such an extended setting goes beyond the scope of this chapter. The results from this extensions leave room for future research.

Appendix to Chapter 2

Proof of Proposition 2.1:

Assume that $u_1 - u_2 \leq 3\left(2-\sqrt{3}\right)t$, so that an exclusive contract is not profitable in the last period of the game. Predatory exclusion occurs if

$$\pi_1^* + \pi_1^* \leq \max\left\{\pi_1^{ED}, \pi_1^P\right\} + \pi_1^M.$$

From section 3 and 4, we know the values for all four profits which can occur in the dynamic pricing game. Thus,

$$\frac{1}{t}\left(t - \frac{\Delta u}{3}\right)^2 \leq u_1 - t - c + \max\left\{\Delta u, \left(1 - \sqrt{\frac{(1-\alpha)F}{2t}}\right)\left(\Delta u - t + \sqrt{8t(1-\alpha)F}\right)\right\}. \tag{2.10}$$

Let us first consider the case that $\pi_1^P < \pi_1^{ED}$. Therefore, if predatory exclusion occurs, it takes the form of predatory exclusive dealing. In this case, inequality (2.10) reduces to

$$t + \frac{(\Delta u)^2}{t9} - \frac{2\Delta u}{3} \leq u_1 - t - c + \Delta u. \tag{2.11}$$

We start the analysis for the case that both firms have the same market power. Thus, for $\Delta u = 0$, inequality (2.11) reduces to

$$2t - c \leq u_1. \tag{2.12}$$

As long as (2.12) is fulfilled, predatory exclusive dealing is a profitable strategy for the predator. It is straightforward to see that exclusion in a one period setting (i.e., in the last period of the game) can not occur in this case as

$$\Delta u = 0 < 3\left(2 - \sqrt{3}\right)t.$$

Now we analyze what happens if Δu increases ceteris paribus. A marginal positive change of Δu increases the profit in case of predatory exclusion by 1 and the profit from the standard pricing game without exclusion by $\frac{2\Delta u}{t9} - \frac{2}{3}$. Thus, only when $\Delta u > \frac{15}{2}t$ profits from predatory exclusive dealing increase less in Δu compared to the case of no exclusion. However, when $\Delta u > \frac{15}{2}t$, Δu is also higher than $3\left(2-\sqrt{3}\right)t$ so even if predatory exclusive dealing is no longer more profitable, exclusion will nevertheless occur as exclusion by effect in a one-period setting.

Now we consider the case when $\pi_1^P \geq \pi_1^{ED}$. Thus, if predatory exclusion occurs, it will be achieved by predatory pricing. For this to be a profit maximizing strategy for the predator, the following inequality must be satisfied:

$$t+\frac{(\Delta u)^2}{t9}-\frac{2\Delta u}{3} \leq u_1-t-c+\left(1-\sqrt{\frac{(1-\alpha)F}{2t}}\right)\left(\Delta u-t+\sqrt{8t(1-\alpha)F}\right). \quad (2.13)$$

We start again with $\Delta u = 0$, thus (2.13) reduces to

$$t \leq u_1 - t - c + \left(1-\sqrt{\frac{(1-\alpha)F}{2t}}\right)\left(-t+\sqrt{8t(1-\alpha)F}\right). \quad (2.14)$$

We can see that as long as the future monopoly profit is high enough (here represented by u_1) predatory pricing is a profitable strategy. Rearranging (2.14) leads to:

$$2t - c - \left(1-\sqrt{\frac{(1-\alpha)F}{2t}}\right)\left(-t+\sqrt{8t(1-\alpha)F}\right) \leq u_1. \quad (2.15)$$

The first term of (2.15) is the same as under predatory exclusive dealing. Therefore, for predatory pricing to be the profit maximizing strategy in case that $\Delta u = 0$, the product of the brackets has to be positive. This is the case if $-t+\sqrt{8t(1-\alpha)F} > 0$. We know that firm 2's static profit is non-negative for $\Delta u = 0$ if and only if $2F \leq t$. Since $\alpha \in (0,1)$, both conditions are fulfilled as long as $\alpha \leq \frac{3}{4}$.

Now we consider what happens when Δu increases ceteris paribus. A marginal increase in Δu increases profits from predatory pricing by $\left(1-\sqrt{\frac{(1-\alpha)F}{2t}}\right)$ compared to $\frac{2\Delta u}{t9} - \frac{2}{3}$ from the normal pricing game without predation. Thus, for small values of Δu predatory pricing becomes ceteris paribus more likely to occur when Δu increases, while at some point the increase in Δu will make predatory pricing less attractive compared to no predation at all. Again, this is not possible in the parameter space which we allow for, i.e., $\Delta u \leq 3\left(2-\sqrt{3}\right)t$.

Proof of Proposition 2.2:

In the proof of proposition 1 we compared the two-period profits from predatory pricing and predatory exclusive dealing with the profits from the pricing game without predation. Now we compare the two predation strategies with each other. Since monopoly profits in period 2 are the same after successful predation, we only need to compare the profits in period 1. Exclusive dealing is preferred by the predator, if

$$\Delta u > \left(1 - \sqrt{\frac{(1-\alpha)\,F}{2t}}\right)\left(\Delta u - t + \sqrt{8t\,(1-\alpha)\,F}\right). \tag{2.16}$$

Again, we start comparing the two profits for $\Delta u = 0$. In this case, the profit in period 1 from exclusive dealing is zero. From (2.16), the profit from predation is higher, if

$$\left(1 - \sqrt{\frac{(1-\alpha)\,F}{2t}}\right)\left(-t + \sqrt{8t\,(1-\alpha)\,F}\right) \geq 0.$$

This is the case when $1 - \frac{t}{8F} \geq \alpha$. Thus, predatory pricing is more likely to occur if the financing constraint of the prey is soft (α is large).

Let us now consider what happens when Δu increases. The first period profit from exclusive dealing increases by 1 for a marginal increase in Δu. The first period profit from predatory pricing increases by $\left(1 - \sqrt{\frac{(1-\alpha)F}{2t}}\right)$ (which is below 1 per definition) for a marginal increase in Δu. Therefore, the critical α from which on exclusive dealing is preferred to predatory pricing decreases ceteris paribus in Δu.

Proof of Proposition 2.3:

The proof of Proposition 3 follows directly from the proof of proposition 2. The first period profit from exclusive dealing increases by 1 for a marginal increase in Δu, but the profit from predatory pricing increases by less than 1. Thus, ceteris paribus exclusive dealing becomes more likely to occur than predatory pricing.

Proof of Proposition 2.4:

We know from section 4 that

$$p_1^P = c - t + \Delta u + \sqrt{8t\,(1-\alpha)\,F},$$

and from section 3 that

$$p_1^{ED} = c + \Delta u.$$

We start again with $\Delta u = 0$. Since $p_1^{ED} = c$, predatory pricing leads to fewer losses in period 1 only if $p_1^P \geq c$. Otherwise, exclusive dealing dominates. As Δu marginally increases, both prices ceteris paribus increase by 1, but $x_1^{ED} < x_1^{ED} = 1$. Therefore, with a positive Δu, the optimal price under predatory pricing has to be even significantly higher than c to dominate exclusive dealing. From this follows proposition 2.4.

Proof of Proposition 2.5:

From Proposition 4, exclusive dealing implies that $p_1^P \geq c$ and so

$$\Delta u \leq t - \sqrt{t(1-\alpha)F}. \tag{2.17}$$

$p_1^{ED} < p_1^*$ on the other hand implies that

$$\Delta u < \frac{3}{2}t. \tag{2.18}$$

As the right-hand side of (2.17) is smaller than the right-hand side of (2.18), the proposition follows.

Proof of Proposition 2.6:

Comparing π_{ED}^1 and π_P^1 and rearranging yields that exclusive dealing is more profitable if and only if

$$\Delta u > t - \sqrt{t(1-\alpha)F}. \tag{2.19}$$

The right hand side of (2.19) is larger than the right hand side of (2.8), therefore (2.19) can not hold. Hence, Predatory pricing must yield higher profits than predatory exclusive dealing.

Proof of Proposition 2.7:

From (2.9), $p_1^{ED} < c$ if and only if

$$\Delta u < t - 2\sqrt{t(1-\alpha)F}. \tag{2.20}$$

The right hand side of (2.20) is larger than the right hand side of (2.8), therefore (2.20) always holds. Moreover, as pointed out in the main text, the incremental price $p_1^{ED} = c$

is part of an equilibrium in the exclusive dealing subgame; that is, $p_1^{ED} < c$ can always be avoided.

Appendix to Chapter 3

Proof of Lemma 3.1:

Lemma 3.1 follows directly from the first order conditions

$$\frac{\partial \pi^t}{\partial k^{t,A}} = \frac{v^h}{\sqrt{k^t}} - r^t,$$

$$\frac{\partial \pi^t}{\partial k^{t,B}} = \frac{p^l}{\sqrt{k^{t,B}}} - r^t.$$

Proof of Lemma 3.2:

The first part of Lemma 3.2 follows directly from the first order conditions

$$\frac{\partial \pi^{s,h}}{\partial k^{s,h}} = \frac{v^h}{6\sqrt{k^{s,h}}} - r^s,$$

$$\frac{\partial \pi^{s,l}}{\partial k} = \frac{v^l}{3\sqrt{k^{s,h}}} - r^s.$$

The second part of Lemma 2 follows from the first part. Given that firms know their optimal demand for advertisement for each consumer price, they compare the expected profits. Promoting the high price leads to higher profits if

$$\sqrt{\frac{(v^h)^2}{36\,(r^s)^2}\frac{\alpha}{3}}v^h - r^s\frac{\left(v^h\right)^2}{36\,(r^s)^2}\alpha > \sqrt{\frac{(p^l)^2}{9\,(r^s)^2}}v^l\frac{2\alpha}{3} - r^s\frac{\left(v^l\right)^2}{9\,(r^s)^2}\alpha.$$

The left hand side is the expected profit from promoting a high price and the right hand side is the expected profit from promoting a low price. Solving for v^h leads to

$$v^h > \sqrt{2}v^l.$$

Proof of Lemma 3.3:

The website anticipates the reaction of the advertisers and thus the maximization problem reduces to

$$\max_{r^t} \Pi^t\left(r^t\right) = \left\{1 - \beta\left(\frac{\left(v^h\right)^2}{4\left(r^t\right)^2} + \frac{\left(v^l\right)^2}{4\left(r^t\right)^2}\right)\right\}\left(\frac{\left(v^h\right)^2}{4\left(r^t\right)^2} + \frac{\left(v^l\right)^2}{4\left(r^t\right)^2}\right) r^t.$$

The optimal per unit price follows from the first order conditions

$$\frac{\partial \Pi^t\left(r^t\right)}{\partial r^t} = -\frac{1}{\left(r^t\right)^2} - 3\beta\frac{\left(v^h\right)^2 + \left(v^l\right)^2}{4\left(r^t\right)^4}.$$

Proof of Lemma 3.4:

Here again, the website anticipates the reaction of advertisers. Given advertisers are expected to advertise a high price, the website faces the following maximization problem

$$\max_{r^{s,h}} \Pi^{s,h}\left(r^{s,h}\right) = 3\left\{1 - \beta 3\frac{\left(v^h\right)^2}{36\left(r^t\right)^2}\right\}\frac{\left(v^h\right)^2}{36\left(r^t\right)^2} r^t.$$

The optimal fee follows from the first order conditions

$$\frac{\partial \Pi^{s,h}\left(r^{s,h}\right)}{\partial r^{s,h}} = -\frac{1}{\left(r^t\right)^2} - 3\beta\frac{\left(v^h\right)^2}{12\left(r^t\right)^4}.$$

Proof of Lemma 3.5:

Given advertisers are expected to advertise the low price, the website's maximization problem is

$$\Pi^{s,l}\left(r^{s,l}\right) = 3\left\{1 - \beta 3\frac{\left(v^l\right)^2}{9\left(r^{s,l}\right)^2} + \frac{\left(v^l\right)}{3\left(r^{s,l}\right)}\left(v^h - v^l\right)\right\}\frac{\left(v^h\right)^2}{9\left(r^{s,l}\right)^2} r^{s,l}.$$

The optimal fee follows from the first order conditions

$$\frac{\partial \Pi^{s,l}\left(r^{s,l}\right)}{\partial r^{s,l}} = -\frac{1}{\left(r^{s,l}\right)^2} + 3\beta\frac{\left(v^l\right)^2}{3\left(r^{s,l}\right)^4} - \frac{2\left(v^l\right)}{3\left(r^{s,l}\right)^3}\left(v^h - v^l\right).$$

Proof of Proposition 3.1:

From Lemma 3.3, we know that the expected profit under targeting is

$$\Pi^t = \frac{\sqrt{\left((v^h)^2 + (v^l)^2\right)}}{\sqrt{3\beta}}.$$

From Lemma 3.4 follows the profit under the non-targeting mode for low prices

$$\Pi^{s,l} = \left(1 - \frac{3\beta}{\left(\sqrt{9\beta + g^2} - g\right)^2} + \frac{1}{\left(\sqrt{9\beta + g^2} - g\right)} g\right) \frac{v^l}{\sqrt{9\beta + g^2} - g}.$$

Now we can compare Π^t and $\Pi^{s,h}$. Π^t is higher than $\Pi^{s,h}$ when:

$$\frac{\sqrt{\left((v^h)^2 + (v^l)^2\right)}}{\sqrt{3\beta}} > \left(1 - \frac{3\beta}{\left(\sqrt{9\beta + (g)^2} - g\right)^2} + \frac{g}{\left(\sqrt{9\beta + (g)^2} - g\right)}\right) \frac{v^l}{\sqrt{9\beta + (g)^2} - g}.$$

First, for $v^h = v^l$, we can see that the left hand side is always higher than the right hand side:

$$\frac{\sqrt{2}v^l}{3\sqrt{3\beta}} > \frac{2v^l}{9\sqrt{\beta}}.$$

When v^h increases, the profit under non-targeting ceteris paribus increases more than under targeting. At some point, non-targeting leads to higher expected profits. The highest possible g follows from assumption 1. The most favorable situation for non-targeting is when α is close to 1, so: $g = v^h - v^l = \sqrt{3\beta}$. In this case, non-targeting is always preferred as once can see from comparing the profits:

$$\sqrt{\frac{\beta\left((v^h)^2 + (v^l)^2\right)}{3}} \frac{1}{3\beta} < \frac{v^l}{\sqrt{12\beta} - \sqrt{3\beta}}.$$

Rearranging leads to:

$$\left(v^h\right)^2 + \left(v^l\right)^2 < 9\left(v^l\right)^2.$$

Since we are considering a parameter space where $v^h \leq \sqrt{2}v^l$, the right hand side is always higher than the left hand side. Therefore, non-targeting is preferred.

Proof of Proposition 3.2:

From Lemma 3.3 we know that the expected profit for the website in the targeting mode is

$$\Pi^t = \frac{\sqrt{\left((v^h)^2 + (v^l)^2\right)}}{3\sqrt{3\beta}}.$$

From Lemma 3.4 follows that the expected profit under standard non-targeting with high prices is

$$\Pi^{s,h} = \frac{v^h}{9\sqrt{\beta}}.$$

It is straightforward to see that Π^t is always higher than $\Pi^{s,h}$.

Proof of Proposition 3.3:

We know that $\Pi^t > \Pi^{s,h}$ from the proof of Proposition 3.1. Moreover, we know from Lemma 3.3 and 3.4 that $\alpha^t = \alpha^{s,h} = \frac{2}{3}$. Thus, consumer surplus is also the same: $CS = \alpha^2 = \frac{2}{9}$ under both modes.

Proof of Proposition 3.4:

We know that consumer rent is the same under both modes when $v^h \leq \sqrt{2}v^l$. The question is whether targeting can ever lead to a higher consumer surplus compared to non-targeting. We know from Proposition 3 that consumer surplus is $\frac{2}{9}$ under non-targeting with high prices and under targeting. We show in the following that $\alpha^{s,l} > \frac{2}{3} = \alpha^t$ for all g:

$$\alpha^{s,l} = 1 - \frac{3\beta}{\left(\sqrt{9\beta + g^2} - g\right)^2} + \frac{g}{\left(\sqrt{9\beta + g^2} - g\right)} > \frac{2}{3}.$$

Rearranging leads to

$$9\beta > 0.$$

This inequality is always fulfilled. Due to the characteristics of our setup, there is a one-to-one relationship between the share of users and utility. Thus, a higher share of users under non-targeting means that users are better off than under non-targeting.

Proof of Lemma 3.6:

When firms are not allowed to send information with different contents, they have to decide whether to concentrate on their clientele or whether to address a larger part of users. From Lemma 3.1, we know firm's demand for advertisement given a per unit price of r^t:

$$k^{t,h} = \frac{\left(v^h\right)^2}{4r^t}, k^{t,l} = \frac{\left(v^l\right)^2}{4r^t}.$$

Given that firms know the optimal demand for advertisement for each consumer price, they compare the expected profits. Promoting the high price leads to higher profits if

$$\frac{\alpha}{3}\left(\sqrt{\frac{\left(v^h\right)^2}{4\left(r^t\right)^2}}v^h - r^t\frac{\left(v^h\right)^2}{4\left(r^t\right)^2}\right) > \frac{2}{3}\alpha\left(\sqrt{\frac{\left(v^l\right)^2}{4\left(r^t\right)^2}}v^l - r^t\frac{\left(v^l\right)^2}{4\left(r^t\right)^2}\right).$$

The left hand side is the expected profit from promoting a high price and the right hand side is the expected profit from promoting a low price. Solving for v^h leads to

$$v^h > \sqrt{2}v^l.$$

Given advertisers are expected to advertise the low price, the website's maximization problem is

$$\max_{r^{t,l}}\Pi^{t,l}\left(r^{t,l}\right) = 3\left\{1 - \beta\frac{\left(v^l\right)^2}{4\left(r^{t,l}\right)^2} + \frac{\left(v^l\right)}{2\left(r^{t,l}\right)}\left(v^h - v^l\right)\right\}\frac{\left(v^h\right)^2}{4\left(r^{t,l}\right)^2}r^{t,l}.$$

The optimal fee follows from the first order conditions

$$\frac{\partial\Pi^{t,l}\left(r^{s,l}\right)}{\partial r^{t,l}} = -\frac{1}{\left(r^{t,l}\right)^2} + \beta\frac{3\left(v^l\right)^2}{4\left(r^{t,l}\right)^4} - \frac{\left(v^l\right)}{\left(r^{t,l}\right)^3}\left(v^h - v^l\right).$$

Proof of Proposition 3.5:

No we compare the number of users under targeting with low prices and non-targeting with low prices. $\alpha^{t,l} > \alpha^{s,l}$, if

$$1 - \frac{\beta}{\left(\sqrt{3\beta + (g)^2} - g\right)^2} + \frac{g}{\left(\sqrt{3\beta + (g)^2} - g\right)} > 1 - \frac{3\beta}{\left(\sqrt{9\beta + g^2} - g\right)^2} + \frac{g}{\left(\sqrt{9\beta + g^2} - g\right)}.$$

Rearranging leads to:

$$\sqrt{9\beta + g^2} - \sqrt{9\beta + 3\left(g\right)^2} < g\left(1 - \sqrt{3}\right).$$

The left hand side is always negative and the right hand side always positive. Thus, we can see that the number of users under targeting is always higher than the number of users under non- targeting. Therefore, consumers are better off under targeting. Comparing the profits, it is straightforward to see from Lemmas 3.5 and 3.6 that $\Pi^{t,l} > \Pi^{s,l}$, and also that $\pi^{t,l} > \pi^{s,l}$.

Bibliography

ABITO, JOSE MIGUEL AND JULIAN WRIGHT (2008). "Exclusive dealing with imperfect downstream competition", *International Journal of Industrial Organization* 26, 227-246.

ACQUISITI, ALLESANDRO AND HAL R. VARIAN (2005). "Conditioning Prices on Purchase History", *Marketing Science* 24, 367-381.

AGHION, PHILIPPE AND PATRICK BOLTON (1987). "Contracts as a Barrier to Entry", *American Economic Review* 77, 388-401.

AMERIGHI, OSCAR (2006). "Transfer Pricing and Enforcement Policy in Oligopolistic Markets", *Working Papers* 567, Dipartimento Scienze Economiche, Università di Bologna.

AMERSHI, A. AND CHENG, P. (1990). "Intrafirm Resource Allocation: The economics of transfer pricing and cost allocation in accounting", *Contemporary Accounting Research* 7, 61-99.

ANCTIL, REGINA M. AND DUTTA- (1999). Transfer pricing, decision rights, and divisional versus firm-wide performance evaluation", *The Accounting Review* 74, 87-104.

ARMSTRONG, M. (2006A). "Recent Developments in the Economics of Price Discrimination", in *Advances in Economics and Econometrics: Theory and Applications*: Ninth World Congress of the Econometric Society, Blundell, R., Newey, W. and Persson, T. eds., Cambridge University, Cambridge U.K.

ARMSTRONG, M. (2006B). "Competition in Two-Sided Markets", *RAND Journal of Economics* 37, 668-691.

BAGWELL, KYLE, (2007). "The Economic Analysis of Advertising", In Armstrong, M. and Porter, R. eds., *The Handbook of Industrial Organization, Vol.3.*

BERNHEIM, B. DOUGLAS AND MICHAEL D. WHINSTON (1998). "Exclusive Dealing", *Journal of Political Economy* 106, 64-103.

BOLTON, PATRICK AND DAVID S. SCHARFSTEIN (1990). "A Theory of Predation Based on Agency Problems in Financial Contracting", *American Economic Review* 80, 93-106.

BORK, ROBERT (1978). *The Antitrust Paradox: A Policy At War With Itself*, New York: Basic Books.

CAILLAUD, BERNARD AND BRUNO JULLIEN (2003). "Chicken and Egg: Competition among Intermediation Service Providers", *RAND Journal of Economics* 34, 309-328.

CARLTON, DENNIS W. AND MICHAEL WALDMAN (2002). "The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries", *RAND Journal of Economics* 33, 194-220.

CRAMPES, CLAUDES, CAROLE HARITSCHABALET AND BRUNO JULLIEN (2009). "Advertising, Competition and Entry in Media Industries", *The Journal of Industrial Economics* 57, 7-31.

DE MEZA, DAVID AND MARIANO SELVAGGI (2009). "Exclusive Contracts Foster Relationship-Specific Investment", *RAND Journal of Economics*, forthcoming.

EDEN, LORRAINE (1978). "Vertically Integrated Multinationals: A Microeconomic Analysis", *Canadian Journal of Economics* 3, 534-546.

EDLIN, AARON (2002). "Stopping above-cost predatory pricing", *Yale Law Journal* 111, 941-991.

ELHAUGE, EINER (2003). "Why above-cost price cuts to drive out entrants are not predatory: and the implications for defining costs and market power", *Yale Law Journal* 112, 681-827.

Esteves, Rosa B. (2009). "Customer Poaching and Advertising", *The Journal of Industrial Economics* 57, 112-146.

Fudenberg, Drew and J. Miguel Villas-Boas (2006). "Behavior-Based Price Discrimination and Customer Recognition", In *Handbook on Economics and Information Systems*, Hendershott, T. ed.

Fumagalli, Chiara and Massimo Motta (2006). "Exclusive Dealing and Entry, when Buyers Compete", *American Economic Review* 96, 785-795.

Gantman, Nataly and Yossi Spiegel (2004). "Adware, Shareware, and Consumer Privacy", *NET Institute Working Paper* 04-02.

Haufler, Andreas and Guttorm Schjelderup (2000). "Tax Competition and Transfer pricing Disputes", *Oxford Economic Papers* 52, 306-325.

Holmstrom, Bengt and Jean Tirole (1990). "Transfer Pricing and Organizational Form", *Journal of Law, Economics and Organization* 7, 201-228.

Horst, Thomas (1977). "American Taxation of Multinational Firms", *American Economic Review* 67 (3), 376-389.

Innes, Robert and Richard J. Sexton (1994). "Strategic Buyers and Exclusionary Contracts", *American Economic Review* 84, 566-584.

Kind, Hans J., Helene Midelfart & Guttorm Schjelderup (2005). "Corporate Tax Systems, Multinational Enterprises, and Economic Integration", *Journal of International Economics* 65, 507-521.

Kind, Hans J., Guttorm Schjelderup and Karen-Helene Ulltveit-Moe (2004). "Why Corporate Taxes May Rise: The case of Trade Liberalization and Foreign Ownership" *CEPR Discussion Papers*, 3383.

Krattenmaker, Thomas G. and Steven Salop (1986). "Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power Over Price", *Yale Law Journal* 96, 209-293.

Kroppen, Rasch, Eigelshoven (2007). "Germany's Draft Law on Business Restructuring", *Tax Management Transfer Pricing Report* 15, 842.

Mankiw, N. Gregory and Michael D. Whinston (1986). "Free Entry and Social Inefficiency", *RAND Journal of Economics* 17, 48-58.

Mansori, and Weichenrieder (2001). "Tax Competition and Transfer Pricing Disputes", *FinanzArchiv: Public Finance Analysis* 58, 1-11.

Marvel, Howard P. (1982). "Exclusive Dealing", *Journal of Law and Economics* 25, 1-25.

Mathewson, G. Frank and Ralph A. Winter (1987). "The Competitive Effects of Vertical Agreements: Comment", *American Economic Review* 77, 1057-1062.

Nocke, Volker and Martin Peitz and Konrad Stahl (2007). "Platform Ownership", *Journal of the European Economic Association*, 5. 1130-1160.

O'Brien, Daniel P. and Greg Shaffer (1997). "Nonlinear Supply Contracts, Exclusive Dealing, and Equilibrium Market Foreclosure", *Journal of Economics & Management Strategy* 6, 755-785.

OECD (2001). "Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations", OECD Publishing.

OECD (2008a). "Model Tax Convention on Income and on Capital", http://www.oecd.org/dataoecd/14/32/41147804.pdf.

OECD (2008b). "Transfer Pricing Aspects of Business Restructurings", http://www.oecd.org!dataoecd/59/40/41346644.pdf.

Ordover, Janusz and Greg Shaffer (2007). "Exclusionary Discounts", *CCP Working Paper* 07-13.

Peralta, Susana And Xavier Wauthy and Tanguy van Ypersele (2006). "Should countries control international profit shifting?," *Journal of International Economics* 68, 24-37.

RAIMONDOS-MOLLER, PASCALIS AND KIMBERLEY SCHARF (2002). "Transfer Pricing Rules and Competing Governments", *Oxford Economic Papers* 54, 230-246.

RASMUSSEN, ERIK B., J. MARK RAMSEYER AND JOHN S. WILEY, JR. (1991). "Naked Exclusion", *American Economic Review* 81, 1137-1145.

SALOP, STEVEN C. (2006). "Exclusionary Conduct, Effect on Consumers, and the Flawed Profit-Sacrifice Standard", *Antitrust Law Journal* 73, 311-374.

SEGAL, ILYA R. AND MICHAEL D. WHINSTON (2000A). "Exclusive Contracts and the Protection of Investments", *RAND Journal of Economics* 31, 603-633.

SEGAL, ILYA R. AND MICHAEL D. WHINSTON (2000B). "Naked Exclusion: Comment", *American Economic Review* 90, 296-309.

SIMPSON, JOHN AND ABRAHAM L. WICKELGREN (2007). "Naked Exclusion, Efficient Breach, and Downstream Competition", *American Economic Review* 97, 1305-1320.

SMITH, ADAM (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*, Book I Chapter XI.

SPECTOR, DAVID (2007). "Exclusive Contracts and Demand Foreclosure", *Paris School of Economics Working Paper* 2007-07.

TAYLOR, CURTIS (2004). "Consumer Privacy and the Market for Customer information", *RAND Journal of Economics 35, 631-650.*

TAYLOR, CURTIS AND LIAD WAGMAN (2008). "Who benefits from Online Privacy?", *NET Institute Working Paper #08-26.*

TIROLE, JEAN (1988). *The Theory of Industrial Organization*, MIT Press.

TIROLE, JEAN AND JEAN-CHARLES ROCHET (2003). "Platform Competition in Two-Sided Markets", *Journal of the European Economic Association* 1, 990-1029.

UNCTAD (2003). "FDI Policies for Development: National and International Perspectives", *World Investment Report 2003.*

Varian, Hal (1996). "Economic Aspects of Personal Privacy", in *Privacy and Self-Regulation in the Information Age*, U.S. Department of Commerce.

Whinston, Michael D. (2006). *Lectures on Antitrust Economics*, Cambridge: MIT Press.

Williamson, Oliver E. (1975). *Markets and Hierarchies: Analyses and Antitrust Implications,* Free Press.

Curriculum Vitae

10/2005-ongoing	Ph.D. program in Economics Munich Graduate School of Economics Ludwig-Maximilians-University, Munich, Germany
01/2008 - 04/2008	Visiting fellow program for Ph.D. students Chief Economist Team, DG Competition, European Commission, Brussels, Belgium
04/2000 - 09/2005	Studies in Economics, Diplom-Volkswirt University of Mannheim, Germany
10/2003 - 09/2004	Studies in Economics, Master of Science University of Toulouse, France
09/1998-02/2000	Alternative Civilian Service Home for the aged Galei HaOpera, Tel Aviv, Israel
06/1998	Abitur Gymnasium Sedanstraße, Wuppertal, Germany
07/15/1979	born in Wuppertal, Germany