# Essays on the Theory of Industrial Organization: Credence Goods, Vertical Relations, and Product Bundling

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To the memory of my mother and to the memory of my father.

# Contents

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# Abstract

## English Version

This thesis analyzes various research topics in the field of the theory of industrial organization, which relate to traditional and digital industries as well as to the research scope of the CRC 901 - On-The-Fly Computing. The first chapter is the synopsis. Chapters 2 and 3 investigate the fraud incentives of experts and the search incentives of customers in credence goods markets with regulated prices and heterogeneous experts. We find that introducing expert heterogeneity has an ambiguous impact on customer search and expert fraud, where some findings are in contrast to intuition. Chapters 4 and 5 examine the bundling incentives of a downstream firm and the welfare effects of bundling in a distribution channel with a downstream leverage theory set-up. We demonstrate that bundling may not always be beneficial for a downstream firm. The ultimate findings depend on either the marginal costs or the product qualities as well as on the downstream competition mode and the distribution of market power in the channel. Under downstream quantity competition, bundling can only be profitable in a centralized channel where the downstream firms own all market power. We further observe that bundling always lowers welfare in the decentralized channel but may increase welfare in the centralized one under price competition. In chapter 6 we analyze a distribution channel with a CES production function downstream. We illustrate that seminal literature findings regarding oligopolistic competition are robust for a more general (vertical) set-up with $n$ upstream firms and a general production function. We additionally find that a vertical merger may be maximize welfare.

# Deutsche Version

Diese Dissertation analysiert verschiedene Themen im Bereich der Theorie der Industrieökonomik, die mit traditionellen und digitalen Industrien sowie mit dem Forschungsumfang des SFB 901 - On-the-Fly Computing verbunden sind. Das erste Kapitel ist die Synopse. Kapitel 2 und 3 untersuchen die Betrugsanreize von Experten und die Suchanreize von Kunden in Vertrauensgütermärkten mit regulierten Preisen und heterogenen Experten. Wir beobachten, dass die Einführung von Expertenheterogenität vielfältigen Einfluss auf die Suche und den Betrug hat, wobei manche Ergebnisse im Kontrast zur Intuition sind. Kapitel 4 und 5 bewerten die Anreize einer Downstream Firma für Produktbündelung und die Wohlfahrtseffekte von Bündelung in einem Distributionskanal. Wir zeigen, dass bündeln nicht immer vorteilhaft für eine Downstream Firma ist. Die finalen Ergebnisse hängen entweder von den Grenzkosten oder den Produktqualitäten sowie von dem Typ des Downstream Wettbewerbs und der Verteilung der Marktmacht im Distributionskanal ab. Bei Downstream Mengenwettbewerb kann Bundling nur in einem zentralisierten Kanal profitabel sein, in dem die Downstream Firmen die Marktmacht besitzen. Wir finden außerdem heraus, dass die Bündelung immer die Wohlfahrt im dezentralisierten Kanal reduziert, aber diese im zentralisierten Kanal erhöhen könnte. In Kapitel 6 analysieren wir einen Distributionskanal mit einer CES Produktionsfunktion im Downstream Markt. Wir zeigen, dass fundamentale Literaturergebnisse hinsichtlich oligopolistischen Wettbewerbs robust für einen allgemeineren (vertikalen) Aufbau mit $n$ Upstream Firmen und einer allgemeinen Produktionsfunktion sind sowie dass eine vertikale Fusion die Wohlfahrt maximieren könnte.

# Chapter 1

# Introduction

## 1.1 The Theory of Industrial Organization

### 1.1.1 Fundamentals

This thesis analyzes various research questions in the field of the theory of industrial organization (IO) via various economic models. The theory of industrial organization is the economic study of markets where firms can influence the market outcomes such as prices, quantities or profits with their strategic decisions. This means that it analyzes markets in which firms with market power operate. Such markets can have a monopolistic or an oligopolistic structure. The case of perfect competition where all firms are price takers resulting in an efficient market in terms of welfare serves as benchmark case for the research on industrial organization (see e.g. Vives, 1999; Bester, 2017).

The seminal work of Cournot (1838) is considered the foundation of the theory of IO (see e.g. Daughety, 2005; Belleflamme and Peitz, 2015). Cournot studies an oligopoly where at least two identical firms engage in quantity competition with homogeneous products. He illustrates that the firms set profit-maximizing quantities in a such a manner that a Nash (1950) equilibrium is established. The resulting market price lies above the marginal costs of the firms, leading to an inefficient market outcome. Nevertheless, the Cournot equilibrium price is below the price that would be the market price if the market was served by a monopolistic supplier.

Another fundamental contribution to the theory of IO was made by Bertrand (1883). Bertrand criticizes Cournot's model, highlighting that the firms would have strong incentives to undercut each other's prices as the products are perfect substitutes and hence one firm could gain the whole demand by lowering its price below the prices of its competitors. The firms would undercut each other until prices equal marginal costs (or unit costs) (see also e.g. Tirole, 1988; Shy, 1995). Consequently, the market equilibrium in Bertrand's model is welfare efficient. The Bertrand equilibrium is established under the assumptions of homogeneous goods, no capacity constraints, as well as symmetric and

constant marginal costs. In addition, it is the equilibrium even when there are only two firms in the market. This means that the market in the Bertrand model is efficient even when there are only two competitors. This result is generally known as the *Bertrand paradox* (Tirole, 1988).

Over time, many articles were developed that contributed to the theory of IO through testing the robustness of the seminal papers of Cournot (1838) and Bertrand (1883) by introducing variations in the assumptions and set-ups, making the theory of IO applicable to more situations in reality. They showed that the Bertrand paradox highly depends on the rather unrealistic assumptions of the Bertrand model. For instance, Edgeworth (1925)[1] demonstrates that when firms engage in price competition but have capacity constraints, we do not reach the equilibrium of the Bertrand model. Also, Levitan and Shubik (1972) find that when firms can at most produce the Cournot quantities and compete in prices, they may set the Cournot price in the equilibrium and thereby the market would be inefficient. Relatedly, Kreps and Scheinkman (1983) analyze a two-stage model where the firms decide on their capacities in the first stage and compete in prices in the second stage. They show that the firms choose the Cournot quantities as capacities in the first stage and set prices equal to the Cournot equilibrium price in the second stage. Furthermore, when firms compete in prices and the good are homogeneous but the firms have heterogeneous marginal costs, one firm has a cost advantage. This cost advantage results in equilibrium prices above marginal costs (Tirole, 1988; Bester, 2017).

Hotelling (1929) considers a duopoly model with price competition and (horizontally) differentiated products. He illustrates that as long as products are differentiated, the equilibrium prices exceed marginal costs. Spence (1976a,b) highlights that imperfect competition may lead to overprovision of substitutes and underprovision of complementary products because the competing firms do not take demand externalities into account. Singh and Vives (1984) study a duopoly with complementary or substitutable products. They find that the companies always set higher prices under quantity competition than under price competition, irrespective of the goods being substitutes or complements. This leads to the finding that when the products are substitutes (complements), the firms gain greater profits under quantity (price) competition. Häckner (2000) extends the framework of Singh and Vives (1984) to a more general framework with $n \geq 2$ firms and assumes vertical product differentiation. He observes that the results in Singh and Vives (1984) depend on the duopoly assumption as he finds, for example, that some firms in his model might charge higher prices under price competition than under quantity competition.

[1]The Bertrand-Edgeworth model itself was originally published in 1897.

### 1.1.2 Credence Goods, Vertical Relations and Product Bundling

Even though the IO literature has progressed a lot, it cannot fully capture the complexity of all markets. Besides this aspect, one must also take into account that markets change. Especially with the rise of digital markets and the data-driven economy, the market structures gain increasingly more complexity and change rapidly due to constant incremental innovations. Traditional economic models often cannot be applied to, for instance, multi-sided markets, in which firms such as Google, Facebook, Amazon, some of the largest market players in the world, operate (Evans and Schmalensee, 2016; Stucke and Grunes, 2016). Consequently, there is constantly a need for research that analyzes various traditional and newly emerged markets in order to understand the mechanisms behind such markets as well as to derive managerial and economic implications for them. This thesis therefore studies special features of digital markets but also of more traditional industries from the perspective of industrial organization and competition policy. It focuses on three main market features. We next expose these features and their most important characteristics by reviewing the respective fundamental related literature.[2]

**(i) Credence goods**. For certain goods, customers cannot even estimate *ex-post* whether they purchased the quality of a good they actually needed and/or which kind of quality they actually received. For example, when you visit a physician, it is difficult to tell whether you received the quality of the medical service you needed if you do not possess the medical knowledge of the physician. The physician is the expert in this case and knows exactly which quality the patient needs. Products with such ex-post information asymmetries are referred to as *credence goods* (Darby and Karni, 1973). Generally, credence goods are defined by information asymmetries between expert sellers and non-expert customers, where the sellers are experts concerning the right fit between the qualities of the goods and the customers' needs (see e.g. Pitchik and Schotter, 1987; Wolinsky, 1993, 1995; Emons, 2001; Pesendorfer and Wolinsky, 2003; Sülzle and Wambach, 2005; Dulleck et al., 2011; Mimra et al., 2016a). There is, however, a strand of literature that focuses on the information asymmetries regarding the characteristics or qualities of goods. More precisely, a customer cannot identify process attributes of certain goods ex-post such as whether food was produced without genetic modification or ethical issues such as whether food was produced under fair condition for employees. Such goods can therefore be classified as credence goods (Roe and Sheldon, 2007; Bonroy and Constantatos, 2008). This thesis investigates credence goods but concentrates on the standard type of credence goods with information asymmetries between experts and customers with respect to the customers' needs. Besides medical services, there are further primes examples for standard credence goods such as taxi rides in unknown locations or car repairs (see e.g.

[2]For the sake of consistency, I use "we" throughout this thesis even when "I" applies, except in the acknowledgment sections.

Wolinsky, 1993; Balafoutas et al., 2013; Fong et al., 2014).

The experts' information advantage over the customers regarding the needed qualities may induce the experts to defraud their customers by selling them a lower than needed quality (*undertreatment*), a higher than needed quality (*overtreatment*) or the needed quality but charge an inappropriate price (*overcharging*) (Dulleck and Kerschbamer, 2006). Anticipating possibly being defrauded, the information disadvantage of customers may make the customers sample several experts before purchasing a good or a service (Wolinsky, 1993). There is indeed evidence for expert fraud in credence goods markets. For instance, Schneider (2012) examines the repair and charging behavior of car garages in a field experiment. He finds that overtreatment (providing unnecessary repairs) and undertreatment (missing necessary repairs) are very common among those car garages, whereas overcharging (charging for not provided repairs) rarely happens. Moreover, in field experiments, studying the fraud incentives of taxi drivers, Balafoutas et al. (2013) and Liu et al. (2019) show that non-informed passengers are commonly overtreated by taxi drivers in Athens, Greece, and New York, USA, respectively, since they are often taken on unnecessary detours. Balafoutas et al. observe in addition that the taxi drivers in Athens tend to overcharge foreign passengers.

Dulleck and Kerschbamer (2006) theoretically analyze under which conditions fraud occurs in credence goods markets and what type of fraud occurs. They study four basic assumptions of the credence goods literature and their influence on expert fraud in a credence goods market with flexible prices. In their model, a customer can either suffer from a major problem or from a small problem. One assumption is *homogeneity*. When homogeneity applies, then all consumers have the same probability of suffering from the major problem and have the same valuation for receiving a treatment. Another assumption is *commitment*. If commitment is assumed, then a customer is committed to undergo a treatment and an expert is committed to treat the customer once a diagnosis was made. A further assumption is *verifiability*. When we assume verifiability, a customer can observe and verify which type of treatment was provided but not necessarily whether it was necessary. The fourth assumption is *liability*. If we have liability, then an expert must treat a customer sufficiently when a treatment is provided. In this case, the customer can observe and verify the outcome of a treatment but not necessarily which kind of treatment was provided. Dulleck and Kerschbamer highlight that when the assumptions of homogeneity, commitment and liability or verifiability hold, then there is no expert fraud in the market.

Prices in credence goods markets can be flexible, such as in most car repair service markets, but can also be regulated like such as in some health care markets (Sülzle and Wambach, 2005). This can have different effects on the level of expert fraud and of customer searches in credence goods markets. Wolinsky (1993) finds that in a credence goods market with flexible treatment prices, the experts do not defraud customers at

all. There emerges either an equilibrium with customer search for second opinions or one without searches when prices are flexible. When prices are fixed then the experts always cheat, but customers may not search for second opinions in the equilibrium (also compare Sülzle and Wambach, 2005). The analysis of expert fraud and customer search in credence goods markets with regulated prices is the main focus of Chapters 2 and 3.

**(ii) Vertical Relations**. While the models of Bertrand and Cournot consider that firms produce and sell all their goods by themselves, later work on IO analyzed vertical set-ups in which inputs or complete products are manufactured by independent upstream firms that sell to downstream firms which then sell to the final consumers. Spengler (1950) demonstrates that when an upstream and a downstream firm set prices above their respective marginal costs (*double marginalization*), inefficiencies in the market arise from which firms and consumers suffers. More precisely, if the upstream firm and the downstream firm merge vertically (*vertical integration*), then the vertical externalities due to double marginalization are eliminated. As a consequence, the firms gain a larger total profit than before the merger and the final market price is reduced leading to higher welfare. This inefficiency arises because the downstream firm does not take into account that a higher price-cost margin reduces the upstream profit and it is often referred to as *double marginalization problem* (see e.g. Tirole, 1988; Belleflamme and Peitz, 2015).
The model of Spengler (1950) investigates a successive monopoly but in a vertically related market, competition can occur at each tier of the vertical channel. The kind and the extent of competition at any tier can have a pivotal influence on the whole channel such as affecting the degree of the double marginalization, the firms' strategic decisions or the welfare effects. For example, Mukherjee et al. (2012) show that quantity competition between downstream firms can induce higher input prices than price competition. Furthermore, the pricing strategy of the monopolistic upstream firm in their model has a pivotal impact on whether the downstream firms prefer price or quantity competition. Additionally, Reisinger and Schnitzer (2012) illustrate that the intensity of competition at any stage of the supply chain can affect the entry decisions of firms at the respective other stage. Alipranti et al. (2014) analyze a vertically related market consisting of an upstream monopoly and a downstream duopoly with imperfect substitutes. They assume trading via two-part tariffs and find that social welfare is greater under downstream quantity competition than under downstream price competition.
As pointed out above, many players in the digital industries are multi-sided platforms that serve as matchmakers for certain groups. A further example is the platform Airbnb that matches flat owners and guests looking for an accommodation (Evans and Schmalensee, 2016). Such platform markets cannot be characterized as vertically related markets in the classical sense (Evans, 2016). Nevertheless, we have vertical market structures in the digital industry (Rennhoff and Serfes, 2009). For instance, a Subscription Video-on-Demand

streaming service such as Netflix buys (some of) its contents from producers and sells it to the streaming viewers. Hence, a streaming service operates along a linear supply chain and can thus fit the definition of Evans and Schmalensee (2016) of a traditional firm (see also Bhargava, 2012). Investigating upstream or downstream competition, interdependencies between upstream and downstream firms as well as between firms and customers in vertically related markets is a main research goal of Chapters 4 - 6.

**(iii) Bundling and Tying**. Firms often offer their product via non-linear pricing schemes. For instance, most sports teams offer a package containing the tickets for all games in one season or restaurants sell complete dinners. The strategy of selling two or more distinct products at a single price is referred to as *bundling*. One distinguishes between *mixed bundling* and *pure bundling*. When a firm practices pure bundling, it sells certain goods solely in a bundle. When the firm practices mixed bundling, it sells the bundle but it also sells the components of the bundle separately (Adams and Yellen, 1976). The term *tying* refers to the practice of making the purchase of one product conditional upon the purchase of another good (Bowman Jr, 1957; Whinston, 1990). This thesis only deals with bundling as defined above, but be aware that some literature results refer to the tying strategy and that we use the terms 'bundling' and 'tying' synonymously in the rest of the thesis.

Firms may have a motivation to bundle certain products because they may want to reduce the dispersion in reservation prices among consumers by bundling, which permits the firms to raise their prices in comparison to selling the products separately. This holds especially true in case the consumers have a high valuation for one good but a low valuation for another, which means that a customer's reservation prices for the bundled products are negatively correlated (Stigler, 1963; Adams and Yellen, 1976). For that reason, however, bundling has raised anti-competitive concerns as it is seen as a kind of price discrimination (Motta, 2004).

Another example of motivation to bundle is that, for instance, a two-product firm that is a monopolist in one market but a duopolist in a second market may drive its competitor out of the market by bundling. Such a set-up or related ones are usually modeled and analyzed in the so-called *leverage theory* (see e.g. Bowman Jr, 1957; Carbajo et al., 1990; Whinston, 1990; Martin, 1999; Choi and Stefanadis, 2001; Nalebuff, 2004; Simpson and Wickelgren, 2007; Peitz, 2008; Chung et al., 2013). The potential monopolization of a another product market also contributes to bundling being seen as potentially welfare harming (Martin, 2002). In a seminal paper of the leverage theory, Carbajo et al. (1990) find that in their framework, bundling is always profitable under price competition for a two-product firm, that is a monopolist in one market but has one competitor in a second product market. Given there is quantity competition in the duopoly, selling the products separately might be the preferred option for the two-product firm. Carbajo et

al. further observe that bundling always reduces consumer surplus but its influence on overall welfare is ambiguous. Martin (1999) demonstrates in a similar set-up as Carbajo et al. (1990) that bundling can change or create substitutability between products. In his model, bundling always reduces consumer surplus and overall welfare.
In reality, many downstream firms bundle their products. For example, Netflix supplies its whole content at a monthly fee and thus plays a pure bundling strategy (Bhargava, 2012). Next to the digital markets we also observe downstream bundling in more traditional industries: grocery stores sometimes bundle different kinds of beverages such as the Classical Coca Cola with the Coke Zero (Chung et al., 2013). Downstream bundling could induce upstream firms to raise their prices in comparison to separate selling and hence aggravate a double marginalization problem in a channel, finally making separate selling more profitable than bundling (Bhargava, 2012). Moreover, a leverage theory set-up can sometimes be found in downstream markets. Take Netflix again as an example. Netflix has certain exclusive products in its library making it a downstream monopolist for these goods. However, Netflix also supplies certain goods that are supplied by its competitors as well and are therefore sold in a downstream oligopoly. Chapters 4 and 5 analyze the profitability and the allocative effects of downstream bundling in a leverage theory framework that is related to Carbajo et al. (1990) and Martin (1999).
Chapter 6 of this thesis also relates to downstream bundling, but differs in the bundling process. In this chapter, one downstream firm composes several inputs into a new and single product, which we denote as a *composition*. We regard compositions as a special kind of bundle such as a car, where the components of the car (tires, body, engine etc.) are very complementary and the composition of them generates a completely new product. Another example for such a special kind of bundle is a fruit smoothie, which is a composition of fruits and sometimes further ingredients, which might be considered complementary and substitutable components. A fruit smoothie additionally has the feature that it cannot be unbundled anymore. Compositions of either of the two described types are the focus of Chapter 6.

## 1.2 Chapter Overview

In the next step, we shortly summarize the research focus and the main findings of each of the following five chapters of this thesis.
Chapter 2, titled **"Credence Goods Markets with Heterogeneous Experts"**, analyzes a credence goods market, building upon the models of Wolinsky (1993) and Sülzle and Wambach (2005), where we assume experts to be physicians, customers to be patients and treatment prices to be regulated. Unlike Wolinsky (1993) and Sülzle and Wambach (2005), we consider the experts to be heterogeneous in their productivity. More precisely, there is a fraction of experts (the *low-cost experts*) that treats customers that suffer from

small problems at lower treatment cost than the remaining experts (the *high-cost experts*). We examine how the heterogeneity in treatment costs affects the experts' level of overcharging, the customers' search incentives with respect to second opinions and the overall welfare.

We find that the influence of introducing heterogeneity on market results is ambiguous. We always observe an increase in welfare in comparison to the homogeneous reference market of Wolinsky (1993) and Sülzle and Wambach (2005) with solely high-cost experts. However, in some cases welfare is raised only because a reduction in treatment costs leads ceteris paribus to a higher expert surplus and not because of fewer second opinions. Yet, when we introduce a sufficiently large share of low-cost experts, the customers' search rate always diminishes given it is not already minimized.

Sülzle and Wambach (2005) identify three equilibria in the homogeneous market, which they denote $A$, $B$ and $C$. When the homogeneous market is in the pure-strategy equilibrium $A$ with maximum fraud and no search, then implementing reduced treatment costs for a fraction of experts does not affect the search or fraud rate. If the homogeneous market is in the mixed-strategy equilibrium $B$ with relatively little fraud and a medium search rate, or in the mixed-strategy equilibrium $C$ with relatively much fraud and a high search rate, then introducing a *small cost advantage* for a share of experts does not affect the fraud level, but may mitigate the search rate. By contrast, given we have a *large cost advantage*, fraud is always maximized and search is always minimized if the fraction of imposed low-cost experts is relatively large. Given the reference market is in equilibrium $C$ and we insert a medium share of low-cost experts with a large cost advantage, fraud could be lowered or raised depending on the new equilibrium. The fraud level (or the search rate) in $B$ can only be changed by introducing a large share of low-cost physicians but can never be reduced.

In sum, intuitively one would expect the fraud level and thus the search level to decrease when we introduce a fraction of low-cost experts that have mostly weaker fraud incentives than the high-cost experts. Yet, we sometimes observe counterintuitive effects. For instance, there is no influence at all of incorporating heterogeneity on expert fraud or customer search in some cases and there can even be an increase in fraud as a consequence of a reduction in treatment costs. In some situations, the high-cost experts compensate the low-cost experts' honest behavior by defrauding more on average and therefore fraud remains unchanged. Also, the fraud profit is raised by a cost reduction, resulting in strong fraud incentives if customers do not search a lot for second opinions. Additionally, we show that implementing a small cost advantage for many experts may be more effective in enhancing market efficiency than a large cost advantage for few experts.

Chapter 3, titled **"Credence Goods Markets with Fair and Opportunistic Experts"**, strongly relates to the second chapter because it also studies a credence goods market adjusted to health care with regulated prices, building upon the models of Wolin-

sky (1993) and Sülzle and Wambach (2005). In the third chapter, we suppose the experts to be heterogeneous in their fairness concerns but homogeneous in their treatment efficiency. We assume that a fraction of experts (the *opportunistic experts*) cares only about monetary incentives, whereas the complementary fraction (the *fair experts*) cares about monetary and non-monetary incentives when trading-off between cheating and being honest. The non-monetary incentives are characterized by an additional utility (called *fairness utility*) that is received when a fair expert treats a customer honestly whom the expert could have overcharged. We again regard the homogeneous market of Wolinsky (1993) as well as Sülzle and Wambach (2005) with solely opportunistic experts and the according equilibria as the reference case.

Similar to in the second chapter, the effects of introducing heterogeneity on market results are ambiguous and sometimes counterintuitive in the third chapter. One difference to the second chapter is that the fairness utility does not raise the overcharging payoff in contrast to a cost reduction and that we here have a case where a fraction of experts is honest in any case due to strong fairness concerns. Hence, with sufficiently large fairness concerns, we reproduce the findings of Sülzle and Wambach (2005) regarding heterogeneous experts. This means that, among others, we have one setting where a mixed-strategy equilibrium is the unique equilibrium and another setting where an equilibrium with no search and almost no fraud is the unique equilibrium.

Furthermore, if the homogeneous market is in equilibrium $A$, introducing fairness concerns of a small or medium degree for a share of experts does not affect the equilibrium concerning the fraud or search rate. If we start in equilibrium $B$ and introduce a large share of fair experts or if we start in equilibrium $C$ and introduce at least a medium share of fair experts, the search rate is always lowered but fraud remains unchanged if the fairness utility is small. When we are in equilibrium $C$ and implement fairness concerns of a medium degree for a medium share of physicians, fraud can be lowered or raised. When we are in $B$ or $C$, then we always maximize fraud and minimize searches given we introduce a large share of fair experts with a fairness utility of medium size.

We additionally analyze the setting, in which the fair experts obtain a guilty conscience when defrauding so that they have a reduced fraud profit contrary to the opportunistic experts. We demonstrate that the fair experts have stronger fraud incentives when they have a guilty conscience than in the setting with a good conscience, where they derive an additional utility from being honest. We also show that the good conscience market may be more efficient concerning social welfare than the guilty conscience market.

Chapter 4, titled **"Bundling in a Distribution Channel with Retail Competition"**, evaluates the bundling incentives of a downstream retailer and the welfare effects of downstream retail bundling in a decentralized vertical channel with powerful upstream producers. The distribution channel consists of two downstream retailers and two upstream manufacturers. Both upstream firms are the monopolistic producers for one good

and can have asymmetric marginal production costs. One upstream firm sells its *good 1* exclusively to one of the downstream firms, whereas the other upstream firm sells its *good 2* to both downstream firms. Consequently, one downstream firm supplies two products and is a monopolist for good 1 but competes with the other downstream firm in the second product market. This downstream market set-up relates our model to the leverage theory of bundling. The two-product downstream has the option to purely bundle the two goods or to sell them separately. We study the bundling incentives of the two-product downstream firm and the welfare effects of downstream bundling under downstream price and downstream quantity competition.

We find that with either kind of downstream competition, the double marginalization problem between the two-product downstream firm and the upstream firms is aggravated by bundling. Nevertheless, bundling can be profitable for the downstream firm given the downstream firms compete in prices. This is because bundling greatly reduces the intensity of downstream competition and leads to an extension of monopoly power for the bundling firm under downstream price competition. Whether bundling is profitable finally depends on the marginal costs of the upstream firms. For this reason, we identify the marginal costs of the upstream producers as a pivotal factor regarding the profitability of downstream bundling. Under downstream quantity competition, bundling never pays off for the downstream firm even though bundling also lowers the intensity of retail competition and may lead to an extension of monopoly power for the two-product firm in this setting. The positive effects of bundling on the two-product downstream firm's profit in the quantity competition case cannot offset the negative impact in the form of a heavier double marginalization problem.

We further demonstrate a negative impact of upstream market power on the incentives for downstream bundling. When we consider a *centralized channel*, in which the downstream firms hold all the market power, bundling is always profitable under downstream price competition and may be profitable under downstream quantity competition. This is in contrast to the decentralized channel. The bundling incentives we find in the centralized channel are in line with Carbajo et al. (1990) for a non-vertical market structure. However, it is not the presence of vertical externalities alone that weakens the rationale to bundle. To illustrate this, we keep the decentralized structure and consider that both goods are produced by a single firm such that upstream all horizontal externalities are eliminated. Then, we observe the same bundling incentives as in the centralized channel. We therefore conclude that it is a combination of vertical externalities and horizontal externalities upstream that negatively influences the profitability of downstream bundling, which is in line with Bhargava (2012).

We examine the welfare effects of bundling only under downstream price competition as we find a bundling equilibrium only in this case. We observe that bundling lowers consumer, producer and hence total welfare in the equilibrium. The consumer surplus is

reduced because bundling results in an increase in downstream prices. The reduction in producer surplus is somewhat surprising since both downstream firms and the upstream firm who sells exclusively to the two-product retailer benefit from bundling. This means that the other upstream firm loses from bundling more than the other three firms gain in combination.

Chapter 5, titled **"The Impact of Product Qualities on Downstream Bundling in a Distribution Channel"**, is based on joint work with Angelika Endres. In this project, we use the same market structure as in Chapter 4. The major contrasts to the fourth chapter are that the two traded goods can differ in quality and that the marginal costs are symmetric among the upstream firms in this chapter. In Chapter 5, we analyze the same research questions as in the fourth chapter, but concentrate on the role of heterogeneous product qualities concerning the profitability of downstream bundling and the welfare effects of downstream bundling. Moreover, we suppose the downstream firms to solely compete in prices in Chapter 5.

We observe that bundling can be profitable only when the quality of good 2 is sufficiently high such that it exceeds the quality of good 1. Bundling here, too, mitigates the intensity of the fierce downstream competition and allows the two-product firm to extend its monopoly power. A high quality of good 2 allows for a high bundle price as the customers then have a high valuation for the bundle component. Hence, the two-product firm especially benefits from the positive effects of bundling with a high quality of good 2. In sum, we in addition identify the product qualities as pivotal factors with respect to the profitability of downstream bundling. Analogous to the fourth chapter, we highlight a negative impact of upstream market power on downstream bundling. In a centralized channel, as defined above, bundling is here again always profitable for the two-product firm opposed to the decentralized set-up. We again show that it is the mix of vertical externalities and horizontal externalities upstream that weakens the bundling incentives in the channel.

We analyze the equilibrium welfare effects of bundling in the decentralized and in the centralized channel. We find that bundling diminishes consumer and producer surplus in the decentralized channel for the analogous reasoning as in the fourth chapter. By contrast, in the centralized channel, bundling might raise social welfare since it raises producer surplus but it still reduces consumer surplus. In this case, the producer surplus is enlarged because the upstream firms gain zero profits and both downstream firms benefit from bundling in any case. The consumer surplus is again reduced because of a raise in downstream prices. Since a higher quality of good 2 allows for even greater downstream prices, social welfare is reduced by bundling in the centralized channel if the quality of good 2 is sufficiently high. Otherwise, bundling actually raises social welfare.

To sum up, Chapters 4 and 5 establish that bundling may not always be the best strategy for downstream firms. The profitability of bundling can depend on different factors such

as the marginal costs of production, the product qualities, the mode of competition and the distribution of market power in a channel. Additionally, we demonstrate that downstream bundling may be welfare harming but welfare improving too, depending on the upstream market power in a vertical channel.

In Chapters 4 and 5 we consider oligopolistic downstream competition, whereas in Chapter 6 we evaluate the impact of oligopolistic upstream competition on a distribution channel. Chapter 6 is titled **"Oligopolistic Upstream Competition with Differentiated Inputs"** and is based on joint work with Simon Hoof. The channel in this chapter consists of one downstream final good producer and $n \geq 2$ upstream intermediate good producers. The upstream firms sell the inputs to the downstream firm, who composes the inputs via a constant elasticity of substitution (CES) production technology (Arrow et al., 1961) into a final good. Hence, the inputs are differentiated in the sense of being substitutes or complements, where the degree of substitutability and complementarity can vary. We analyze different kinds of settings regarding the upstream market and their impact on the market outcomes of the channel. We analyze upstream price and upstream quantity competition. In addition, we study horizontal integration upstream, horizontal and vertical integration as well as a welfare maximizing solution.

We observe that the upstream firms always set lower prices under price competition than under quantity competition. As a consequence, the upstream firms prefer price competition over quantity competition when the products are complements and vice versa when they are substitutes, because of the different demand effects. These findings are in line with Singh and Vives (1984). The input prices and thus the downstream producer's costs as well as the downstream price are always lower under price competition than under quantity competition. Hence, the downstream monopolist, the final consumers and a social planner prefer upstream price competition over upstream quantity competition, irrespective of the inputs being complements or substitutes.

Moreover, we consider full horizontal integration upstream, resulting in a multi-input upstream monopoly. We find that the downstream profit, producer surplus, consumer surplus and social welfare are greater under upstream competition than under the upstream monopoly if the inputs are substitutes because of lower input prices in the competition settings. The reverse holds true when the inputs are complements. The upstream firms are always better off with a merger to a monopoly in comparison to engaging in competition even though the monopoly prices are lower than the competition prices for complementary inputs. This is because the monopolist internalizes the cross-price effects of the inputs in contrast to the competing firms, which is consistent with Spence (1976a,b). We further show that vertical integration (a merger between the downstream firm and the upstream monopoly) yields the (constrained) welfare optimizing solution.

We additionally highlight that a rise in the number of competing upstream firms, $n$, reduces the profits of the upstream firms and hence the total upstream surplus. This holds

for substitutable as well as complementary inputs and for either mode of competition. In case the inputs are substitutes, an increase in upstream firms results in very intense competition and therefore lower prices and lower profits. If the inputs are complements, then the upstream firms raise their prices when more firms enter anticipating a stronger need for their products. This negatively affects the demand of all inputs and, consequently, upstream profits are diminished. As consumer surplus, producer surplus and hence total welfare benefit from lower input prices but suffer from greater input prices, a rise in $n$ diminishes consumer, producer and total welfare for complementary inputs but vice versa for substitutable inputs.
In conclusion, we demonstrate that the relations between oligopolistic competition modes and other market forms in non-vertical structures that were established in the seminal articles of Spence (1976a,b) and Singh and Vives (1984) are robust for the upstream oligopoly of a channel where the upstream products are differentiated via a CES production technology. We further illustrate a positive impact of vertical integration on social welfare, which is in line with the fundamentals findings of Spengler (1950).

Each research article of this thesis generates a new contribution to the theory of industrial organization by developing new theoretical models and extending the existing theory. In all research projects of this thesis, the heterogeneity of sellers and/or products plays an important role. As already indicated, the assumption of homogeneity is rather abstract but can decisively affect the theoretical results as, for example, the existence of the Bertrand paradox strongly depends on the assumption. Chapters 2 and 3 regard the expert sellers to be heterogeneous. Chapter 2 is the first article to consider expert heterogeneity in treatment costs in a credence goods market with fixed prices. Chapter 3 offers a novel contribution to the analysis of the influence of expert heterogeneity in fairness concerns in credence goods markets. In Chapter 4, the traded products can differ in their productions costs and in chapter 5 in their quality levels. In addition, in both chapters, the downstream firms are heterogeneous in their product portfolio. Chapters 4 and 5 are the first studies that examine the interplay of downstream bundling, double marginalization and leverage theory type downstream competition. The fifth chapter adds the aspect of quality differentiation between the products as a novel contribution. In Chapter 6, the upstream goods can be substitutes or complements with varying degrees of substitutability or complementarity. The sixth chapter is the first approach to analyze upstream competition with differentiated products and its impact on market outcomes in a distribution channel with a CES production function downstream.

Chapters 2 - 6 of this thesis are all written as independent research papers. For that reason, you may find some overlaps in the introduction or in other parts of the papers. Furthermore, some terms, expressions and notations could vary across chapters.

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