FAIRNESS, PROPERTY RIGHTS, AND THE MARKET FOR MEDIA: ESSAYS IN BEHAVIORAL ECONOMICS AND INDUSTRIAL ORGANIZATION

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SUSANNE KREMHELMER

Referent: Prof. Dr. Klaus M. Schmidt

Korreferent: Professor Ray Rees

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PREFACE

This doctoral dissertation was written at the University of Munich at the chair of Professor Dr. Klaus M. Schmidt from 1999 to 2004. It consists of three chapters that can be read independently.

The first two chapters of this thesis are concerned with the theory of fairness. One of the most fundamental paradigms of economic theory until the 1990's has been the so called *self-interest hypothesis*, according to which economic agents only care for their own material well-being and disregard the utility of others. This is not to say that all economists denied the existence of other-regarding preferences like reciprocity, envy or altruism.[1] Rather, it was common practice not to incorporate social preferences into economic models despite the fact that researchers knew from their personal experiences that not *everybody* is *always completely* selfish. This mainly had four reasons.

Firstly, the self-interest hypothesis is of remarkable mathematical simplicity as it generates utility functions that only have one argument, namely the vector of goods that an agent consumes. This allowed building tractable models in a unified framework.

Secondly, the results that these models generated were largely consistent with the observations that one could make in real world markets, which were at the center of interest for general equilibrium theorists. In related disciplines – such as public choice theory – the self-interest hypothesis also yielded predictions that were consistent with

[1] As one would have guessed, already Adam Smith (1759) discusses other-regarding preferences.

reality. In short, the simple assumptions that theorists made were useful for the purpose at hand.

Thirdly, imposing the restriction that economic agents have to be rational and self-interested constituted a code of conduct for economic researchers that everybody had to subdue to. By explicitly ruling out bounded rationality or "strange" preferences, researchers could not go the easy way and simply postulate an appropriate utility function in order to generate phenomena that were observed in reality. This clearly had the advantage of establishing some kind of discipline.

Finally, many of the situations where people suspected that other-regarding preferences might play a role were regarding interaction among small numbers of agents. In these situations strategic considerations clearly play an important role. But prior to the advent of game theory, such situations could not even be appropriately modeled within the self-interest framework – let alone in a more complicated environment with interdependent utility functions.

The first three arguments for restricting attention to self-interested preferences still have their merits. However, since the 1980's a pervasive amount of empirical and experimental evidence has been collected which shows that social preferences play an important role in many situations that go far beyond the private sphere. It was shown for example that firms explicitly adapt their wage policies in a way that is deemed fair by their workers (see for instance Blinder and Choi, 1990, and Bewley, 1999). Furthermore, a large number of bilateral bargaining experiments made clear that people's desire for a fair treatment sometimes made them incur substantial monetary losses in order to punish unfair (or reward fair) behavior by others (see Roth, 1995, and Camerer and Thaler, 1995, for surveys). This literature made clear that contrary to prior presumptions, other-regarding preferences were often very important in a variety of economic fields.[2]

[2] It is not our aim to give an even rudimentary overview over this burgeoning literature at this point. See Fehr and Schmidt (2003) for an extensive survey.

As a consequence, models came up that tried to capture other-regarding motives in a general way. These papers can be largely divided into two categories. One strand of the literature models fairness as reciprocal (i.e. intention-based) behavior (Rabin, 1993, Dufwenberg and Kirchsteiger, 2004). The other strand of the literature builds on models with distributive (i.e. outcome-based) fairness (Fehr and Schmidt, 1999, and Bolton and Ockenfels, 2000). Falk and Fischbacher (2000) and Charness and Rabin (2002) use elements of both types of fairness. Experiments that try to discriminate between these different views of fairness (Falk et al., 2000, Nelson, 2002, and Engelmann and Strobel, 2004) indicate that reciprocity may be the driving force behind what is regarded as fair behavior. However, it has been shown that in most economic situations the predictions of reciprocity and distributive fairness are equivalent. Hence, concepts like Fehr and Schmidt's (1999) inequity aversion, which are mathematically far more tractable than models of reciprocity, can be used as a proxy for reciprocity.

In Chapter 1 of this dissertation (which is joint work with Ernst Fehr and Klaus M. Schmidt) we apply the model of inequity aversion to a problem that has so far only been analyzed within the framework of selfish agents: the hold-up problem.[3] A hold-up problem arises when two (or more) parties engage in a common project that requires unverifiable investments, which are more valuable inside the relationship than outside. As the lack of verifiability of the investments makes it impossible to enforce an explicit contract on investments, agents may renegotiate any contract that is written at the beginning of the project. In this renegotiation agents can threaten to leave the relationship in order to reap greater benefits of the proceeds from the joint project. Ex ante, when agents have to decide on how much effort they want to invest into the project, investment incentives are affected by the expectation of this ex post bargaining. As investors fear expropriation, they tend to underinvest.

The property rights approach (pioneered by Grossman and Hart, 1986, and Hart and Moore, 1990) shows that an optimal allocation of control rights over assets can mitigate the hold-up problem by increasing the investment incentives of those agents

[3] See Hart (1995) for an overview over the literature on the hold-up problem.

whose contribution to the project is most valuable. One of the main findings of this literature is that joint ownership of assets is rarely optimal. The intuition for this is that joint ownership of an asset allows both owners to threaten blockade of the asset in the renegotiation. Hence both parties' investment incentives are diluted. If a given asset has only one owner, then at least this one agent can not be fully blocked: as the owner of the asset he can use his investment with his asset. He thus has a better bargaining position and hence better investment incentives.

Clearly, this view of the world extensively uses the properties of the self-interest model. In reality, however, joint ownership is something that can be observed in many different situations. We claim that one of the reasons for this is that fairness can be used as a contract enforcement device in joint projects.[4] If there is a sufficiently large proportion of fair-minded agents, even selfish agents may invest because they expect to have fair partners. As fair partners will invest if and only if the other agents invest also, it may be worthwhile for an egoistic agent to contribute to the joint project.

In order to investigate this matter we first construct a theoretical model inspired by Hart (1995). In this model, the self-interest hypothesis predicts that joint ownership is never optimal and that hence agents will not choose it as the ownership structure in the first place. We then show, however, that joint ownership may be the optimal form of ownership if there is a positive proportion of inequity averse agents.

Thereafter we report the results of experiments that we conducted with students who played the game that we propose in the model. The prediction of the self-interest model that joint ownership generates low investments and will never be chosen turns out to be completely wrong. Quite to the contrary, joint ownership on average generated high investments in our experiments and was the predominantly chosen form of ownership.

While Chapter 1 investigates an application of the theory of fairness to an economically interesting problem, Chapter 2 takes a closer look at the nature of fairness

[4] In different settings this has been shown to be true in the experiments conducted by Fehr, Gächter and Kirchsteiger (1997) and Fehr, Klein and Schmidt (2003).

in general. This paper presents the results of experiments that were conducted in order to evaluate how the social preferences of subjects are structured and how they are affected by different environments. We employed a series of purely distributional games where the subjects only had to decide on the payoff of other participants without any form of strategic interaction. Thus, these experiments try to shed light on the distributional aspects of fairness.

First, we investigate the impact of different experimental framings on the subjects' distributional decisions. We employ framings where there are real monetary payoffs and others where the experimental games are purely hypothetical. Also, we employ framings where people have to play an ultimatum game (which is essentially strategic) prior to the distribution games in order to set subjects in a strategic mood. Our results show that both types of framing have statistically and economically significant effects.

Having real payoffs leads people to choose more efficient allocations on average – often at the cost of the poorest person in the reference group. If the decisions are hypothetical, subjects' decisions reflect a much stronger concern for the poorest person. We argue that this change in preferences may reflect a desire to *appear* fair in a Rawlsian sense and to *act* fair in the sense of efficiency.

The effect of a strategic environment is that subjects' choices shift towards allocations that have most payoff for the poorest member of the reference group – at the expense of efficiency. Our interpretation of this phenomenon is that being dependent on other people's choices in the ultimatum game makes subjects put themselves more into the position of others in the distributional games. As in the real world distributional decisions are rarely free of strategic elements, this result suggests that experiments on distributional fairness may generally be biased towards efficiency.

Concerning the discrimination between models of distributional fairness, our experiments confirm the results of Engelmann and Strobel (2004) that distributional decisions are more affected by efficiency and maximin motives (as in Charness and

Rabin, 2002) than by inequity aversion. However, we demonstrate that more than 40 percent of the population does not consistently decide according to *any* of the theories mentioned above.

It should be stressed that the results of this chapter concern aspects of purely distributional fairness. They show that using inequity aversion as a predictive model for distributional games may be misleading. But of course, they do not say anything about the predictive power of inequity aversion in games of strategy. In fact, the theory has been tremendously successful in explaining the results of experiments with strategic content (see Fehr and Schmidt, 1999).[5]

Chapter 3 (which is joint work with Hans Zenger) analyzes a topic that is unrelated to Chapters 1 and 2. In this paper we investigate the impact of asymmetric information on the equilibrium allocation in media markets. Media markets have long been of interest for economists because media products are different in character to standard goods.[6] Arguably, the biggest difference is that media firms cater to two distinct groups, consumers that want to buy the media product and firms that want to advertise in it. Therefore, media markets are two-sided.[7] This implies that media companies, when setting their pricing policy for one side of the market, have to take into account what externalities they exert on the other side of the market. For instance, increasing the price for advertising will lower the amount of advertising and hence increase consumer's demand (if consumers dislike advertising). Chapter 3 focuses on one particular type of interaction between the two market sides; namely, the interdependence of readers' characteristics and advertising rates, and the impact of this relation on the optimal pricing policy for media firms.

Our starting point is the observation that firms that engage in advertising are willing to pay different advertising rates depending on the attractiveness of the people

[5] This is one of the reasons why we have used inequity aversion for the theoretical analysis of Chapter 1, where the experimental game is highly strategic. As will be shown below, also in this case the predictive power of inequity aversion is high.
[6] Early treatments are Corden (1953) and Reddaway (1963).
[7] See Armstrong (2004) for an overview of the two-sided market literature.

who watch the advertisement. For example, high income consumers are more attractive for firms than low income consumers. This turns out to be the main reason why direct markets for advertising show a market-unraveling as proposed by Akerlof (1970). In principle, this adverse selection problem is present in media markets as well. As rich consumers have to view less advertising in order to generate a certain amount of revenue for the media firm, low income consumers have an incentive to consume media-products that are targeted at high income types, because they contain less advertising.

In the paper, we investigate in which way media firms can mitigate this problem by screening consumers. The idea behind this is that media firms can distort their primary product (selling content) in order to alleviate the informational distortion in the secondary product (offering advertising). It turns out that media firms will use two instruments to deter low income types from consuming high type media products: (i) They will raise the price of the high type media product above first best levels. (ii) They will increase the level of quality of content of the high type bundle above first best levels. The intuition for those distortions is as follows. A price increase naturally hurts low income types more than high income types. A quality increase makes the media product more costly to produce. But since high types have greater wealth, they are likely to have a higher willingness to pay for quality improvements. Hence a quality distortion (which implies more advertising and a higher price of the media product) is less annoying for high types than for low types.

It turns out to be crucial for the results of the paper how different the valuations of quality for the two types really are. A larger difference in the preference for quality has two effects. (i) Since the two types want to consume products of more different qualities, using the quality distortion is more effective, and hence the screening instruments are gradually exchanged. (ii) As the bundles the two types prefer get more differentiated, it generally becomes easier to deter low types. Hence, the necessary distortion to achieve incentive compatibility can be reduced. Beyond some point, the second effect is so strong that the first best can be achieved.

It will be shown that the above effects occur both in monopolistic and in competitive media markets. In monopolistic markets an additional interesting observation can be made: contrary to ordinary goods markets, the monopolist will never find it optimal to ration a part of the consumers. This suggests that the inefficiencies that a monopoly generates are less severe in media markets than in standard goods markets. The intuition behind this result is that using two payment instruments to finance the product (price and advertising) makes price discrimination of types easier and hence more profitable compared to the standard case.

CHAPTER 1

FAIRNESS AND THE OPTIMAL ALLOCATION OF OWNERSHIP RIGHTS[8]

1.1 Introduction

In this chapter we take a fresh look at an old question: What is the optimal allocation of ownership rights? The modern property rights approach, pioneered by Grossman and Hart (1986) and Hart and Moore (1990) argues that in a world of incomplete contracts the allocation of ownership rights matters because it assigns residual rights of control.[9] These control rights affect the bargaining position of the involved parties when the original contract is renegotiated, which in turn affects the incentives of the involved parties to make relationship specific investments that cannot be contracted

[8] This chapter is joint work with Ernst Fehr and Klaus M. Schmidt.

[9] The early literature, starting with Coase (1960), emphasizes that it is of crucial importance for economic efficiency that property rights are well defined. However, the Coase Theorem suggests that it does not matter for economic efficiency to whom ownership rights are allocated. In the absence of any transaction costs any (well defined) allocation of ownership rights implements an efficient outcome. Williamson (1985) points out that if the parties can write complete contingent contracts, then any ownership structure can be mimicked by an appropriate set of incentive contracts, so the ownership structure is irrelevant.

upon directly. A prominent result of this literature (see e.g. Hart, 1995) is that joint ownership is rarely optimal. The reason is that if both parties own an asset, then they can prevent each other from using the asset. Thus, joint ownership minimizes the threatpoint payoffs of both parties. Giving all the ownership rights to one party increases this party's payoff if bargaining breaks down without reducing the other party's payoff. Thus the sole owner's investment incentives increase while the incentives of the non-owners are unaffected.

The property rights approach is based on the self-interest model that assumes that all parties are only interested in their own material payoffs. However, we know from many experiments and also from systematic field evidence,[10] that concerns for fairness and reciprocity play an important role in motivating the behavior of many people. Several experiments (e.g. Fehr, Gächter and Kirchsteiger, 1997, and Fehr, Klein and Schmidt, 2003) point out that if only incomplete contracts can be written, then fairness and reciprocity may act as an enforcement device that complements (and sometimes substitutes for) explicit incentives that are enforced by the courts. This chapter addresses the question whether concerns for fairness and reciprocity affect the optimal allocation of ownership rights.

In Section 1.2 we consider a very simple model based on Hart (1995). There are two parties, called A and B, who need a physical asset to produce some joint surplus in the future. The amount of this surplus is determined by some relationship specific investments that the parties can make. The question is who should own the asset. Joint ownership is never optimal if it is common knowledge that both parties are only interested in their own material payoffs. The self-interest model also predicts that there is no ownership structure that implements first best investments. However, A- or B-ownership strongly outperform joint ownership, and the parties will always agree on the efficient ownership structure ex ante. This corresponds to the results of Hart and Moore (1990) and Hart (1995) who argue that joint ownership minimizes investment incentives of both parties and that giving all ownership rights to one party is second best optimal.

[10] See Fehr and Schmidt (2003) for a recent survey on this literature.

In Section 1.3 we compare the prediction of the self-interest model to the predictions of two other approaches. The first approach assumes that it is common knowledge that all parties strongly care about fairness and reciprocity. Models of intention-based reciprocity (such as Rabin, 1993, or Dufwenberg and Kirchsteiger, 2004) as well as models of social preferences or distributional fairness (such as Bolton and Ockenfels, 2000, or Fehr and Schmidt, 1999) predict that in this case, the allocation of ownership rights does not matter. Under any allocation of ownership rights, fairness and reciprocity suffice as an enforcement device to induce both parties to invest efficiently.

The second approach acknowledges that people differ. Some people seem to care quite strongly about fairness and reciprocity while other people seem to be mainly self-interested. Furthermore, people often don't know whether they interact with a fair-minded or a self-interested opponent. Using the Fehr-Schmidt (1999) model of inequity aversion, we show that in this case, like in Hart (1995), no ownership structure implements first best investments, and that the allocation of ownership rights does matter. However, in contrast to Hart (1995), joint ownership turns out to be the second best optimal ownership structure. The players anticipate this and will choose to have joint ownership in equilibrium.

In Section 1.4 we put these theoretical predictions to an experimental test. In the experiments players first have to bargain on the allocation of ownership rights on a joint project. They can either have joint ownership, or one of the parties can be the sole owner and hire the other party as an employee. Then the two parties can make relationship specific investments that increase the joint surplus to be generated. Finally the surplus is shared according to the ex ante chosen allocation of ownership rights. We are interested in two questions: First, which ownership structure is (second-best) efficient, in the sense that it induces the most efficient investment decisions of the two parties? Second, do the experimental subjects understand what the most efficient ownership structure is and do they manage to set up this ownership structure ex ante? In order to address the second question we consider two different experimental designs. In the Joint Ownership Design (JOD) the parties start with joint ownership but one of the parties can try to sell his ownership stake to the other party. In the A-Ownership Design (AOD), A owns the project initially, but she can give away half of her ownership rights to B. Thus, we can test whether the initial allocation of ownership rights affects the final outcome or whether the parties will always manage to set up the efficient ownership structure.

In the experiments it turned out that no ownership structure can induce both parties to invest efficiently. Thus, concerns for fairness and reciprocity did not suffice as an enforcement device to achieve the first best. Furthermore, the allocation of ownership rights did matter. However, in contrast to the predictions of the self-interest model, joint ownership turned out to be second-best optimal. The large majority of the experimental subjects anticipated this and managed to achieve joint-ownership both in the Joint Ownership Design and in the A-Ownership Design. The Fehr-Schmidt (1999) model of inequity aversion is largely consistent with these observations.

An alternative approach to model reciprocal behavior is to consider repeated games models. However, this approach is plagued by multiple equilibria. Furthermore, if the parties are sufficiently patient, then there is an equilibrium that sustains efficient investments of both parties independent of the allocation of ownership rights.[11] If the parties are less patient, however, the allocation of ownership rights may matter. Halonen (2002) considers a model, where, like in Hart (1995), joint ownership maximizes hold-up problems and is the worst ownership structure of the one-shot game. In the repeated game, however, this "worst" ownership structure may be beneficial because it provides the strongest possibilities to punish if one of the parties deviates from the efficient actions. On the other hand, with this ownership structure the gain from deviation is also highest. Halonen characterizes a set of parameters where the first effect dominates the second effect and joint ownership is optimal.

[11] See Hart (2001) for a discussion of this approach applied to the theory of the firm.

There are a few theoretical models of one-shot interactions showing that joint ownership may sometimes be optimal. Rosenkranz and Schmitz (1999) consider a set-up where parties have to engage in two types of investments. They have to make relationship specific investments in their human capital but also to invest in know-how disclosure which increases the effectiveness of the investment of the other party. Rosenkranz and Schmitz show that joint ownership improves the incentives to engage in know-how disclosure which may turn joint ownership to be the optimal ownership structure. Maskin and Tirole (1999) consider a buyer-seller relationship where the seller can make a relationship specific investment to reduce his costs while the buyer can invest to increase her valuation of the good to be traded at some future date. Production requires the use of a physical asset. Maskin and Tirole show that joint ownership of this asset combined with an option to sell his or her share of the asset to the other party which is assigned with equal probabilities to each of the parties can implement first best incentives. However, this contract requires that if one party exercises the option to sell, the other party has to make a large payment to a third party. The idea is that exercising the option is advantageous if and only if the other party did not invest efficiently. However, because this contract relies on a side-payment to a third party off the equilibrium path, it is not robust against collusion. None of these papers considers the effects of fairness and reciprocity that may be generated by joint ownership.

1.2 A Simple Problem of the Allocation of Ownership Rights

Consider two players, called A and B, who can generate a joint surplus if they have access to a physical asset K.[12] The gross surplus $v(a,b)$ depends on the investments, a and b, undertaken sequentially by the two players. Investments are personally costly

[12] The physical asset may be a plant, machinery, a building, or a "soft" asset such as a patent or a client list.

with investment costs given by $c_A(a)$ and $c_B(b)$, respectively. We assume that the gross surplus function is differentiable, strictly increasing in both arguments and concave. For simplicity, let us assume that the problem is symmetric in the sense that $c^A(\cdot) = c^B(\cdot) = c(\cdot)$ and that $\frac{\partial v(a,b)}{\partial a} = \frac{\partial v(b,a)}{\partial b}$.

Suppose that B chooses his investment level first, and that A observes B's investment before she has to invest herself. Let the first best investment levels be denoted by $a*$ and $b*$,

$$(a*, b*) = \arg\max S(a,b) = \arg\max v(a,b) - c(a) - c(b),$$

and suppose that they are uniquely defined and satisfy $a* > \underline{a}$ and $b* > \underline{b}$, respectively. Symmetry implies that $a*=b*$.

The investments are assumed to be unobservable by outsiders, so that any investments above the minimum investment levels $\underline{a}$ and $\underline{b}$ cannot be contracted upon. However, at some initial date 0, the two parties can write a contract on the allocation of ownership rights on the physical asset. If one of the parties, say A, is the sole owner of the asset, then she has to hire B at a fixed wage T (transfer) as an employee. In this case monetary payoffs are given by

$$M^A = v(a,b) - T - c(a)$$
$$M^B = T - c(b).$$

If both parties jointly own the asset, then they share the gross returns of the project equally and payoffs are

$$M^A = 0.5v(a,b) - c(a) - T$$
$$M^B = 0.5v(a,b) - c(b) + T$$

where T is again a potential transfer payment that may be necessary to achieve joint ownership. Note that this is a simplified version of Hart (1995) with investments in physical rather than in human assets.[13]

The parties bargain on the allocation of ownership rights before the investments are taken. In our experiments we considered two different treatments:

- In the *Joint Ownership Design (JOD)* both parties own the asset initially. At stage 0, A can either choose to stick to joint ownership or she can offer to sell her share of the firm to B at price T.
- In the *A-Ownership Design (AOD)* player A is the single owner of the firm when the game starts. At stage 0, A can either choose to remain the sole owner of the firm and to hire B as an "employee" at a fixed wage T. Alternatively, A can choose to make B a "partner" by giving away half of the firm to him.[14]

In the experiments the two parties are restricted to choose $a, b \in \{1, ..., 10\}$. The gross surplus function is given by $v(a,b) = 22 \cdot (a+b)$, while investment costs are $c_A(a) = 12a$ and $c_B(b) = 12b$. Note that in the experiments investments are neither complements nor substitutes at the margin, so that optimal investment levels are independent of each other.

[13] If A is the owner of the asset, she gets *v(a,b)*, so she has full access to the returns of B's investment *b*, even without B's consent. If the investment was in human capital, A would not be able to realize *v(a,b)* without B's consent, but she would have to bargain with B in order to bribe him to cooperate. With investments in human capital it is never optimal to have joint ownership. With investments in physical capital, joint ownership may be optimal. However, below we will restrict attention to the case where joint ownership is not optimal with investments in physical capital either.

[14] We did not use the expressions "employee" and "partner" in the actual experiments but rather the neutral terms "participant A" and "participant B".

1.3 Theoretical Predictions

1.3.1 Common Knowledge of Self-interested Preferences

Let us first consider the case where it is common knowledge that both parties are interested only in their own monetary payoffs. In this case the analysis is straightforward. If A owns the asset, then she is full residual claimant on the margin and will choose the conditionally efficient investment level $a^*(b)$, given B's investment b. B, however, gets a marginal return of zero, so he will choose the minimum investment level $\underline{b}$. On the other hand, if there is joint ownership, then each party gets only half of the marginal return, so both parties have an incentive to underinvest.[15] Thus, there is no ownership structure that induces both parties to invest efficiently. However, not all ownership structures are equally inefficient. As Grossman and Hart (1986) emphasize, there exists a unique second best optimal ownership structure that achieves the highest social surplus that can be obtained given the contractual constraint that only contracts on the allocation of ownership rights can be written.

In the following we will restrict attention to the case where Grossman and Hart predict joint ownership to be inefficient. Suppose that $\frac{1}{2}\cdot\frac{\partial v(a,b)}{\partial a}<c'(a)$ and $\frac{1}{2}\cdot\frac{\partial v(a,b)}{\partial b}<c'(b)$ for all a,b. Then, under joint ownership, it is a dominant strategy for each party to choose the minimum investment level $\underline{a}$ and $\underline{b}$, respectively. On the other hand, if A (or B) owns the firm, this party is full residual claimant on the margin and is induced to invest efficiently, while the other party gets a constant payment and will choose not invest. Thus, standard contract theory based on the self-interest model has two implications:

[15] Due to the sequential nature of the investments the argument is slightly more complicated than in Grossman and Hart (1986). See Nöldeke and Schmidt (1998, Proposition 1).

Proposition 1.1 *If it is common knowledge that both parties are only interested in maximizing their own material payoff, then*

1. either A or B-ownership is efficient, while joint ownership is inefficient, and

2. no matter what the initial allocation of ownership rights is, the parties will trade ownership rights ex ante so as to set up the efficient ownership structure and to implement the second best optimal investment decisions.

In the set up of our experiments this implies for the

- Joint Ownership Design: A will sell her ownership stake to B at price *T=122*. B will accept this offer and choose *b=10*, while A will choose the minimum investment level *a=1*. Monetary payoffs are given by $M^A = 110$ and $M^B = 0$.
- A-Ownership Design: A will keep full ownership and hire B as an employee at wage *T=12*. B will accept this offer and choose *b=1*, while A will invest efficiently and choose *a=10*. Monetary payoffs are again $M^A = 110$ and $M^B = 0$.

1.3.2 Common Knowledge of Fair and/or Reciprocal Preferences

Consider now the case where the involved parties are not just concerned about their monetary payoffs but also care about fairness and/or reciprocity. There are several recent theories that try to capture these motivations. Some of the proposed models, in particular Rabin (1993) and Dufwenberg and Kirchsteiger (2004), adopt the concept of "psychological game theory" that had been introduced by Geanakoplos, Pearce and Stacchetti (1989) in order to model "intention-based reciprocity". In these models players have beliefs not just about the actions of their opponents but also about their intentions. They are willing to reward kind and to punish unkind intentions. While these models convey many interesting insights, they are quite complicated and it is difficult to use them in applications. Furthermore, they are often plagued by multiple equilibria. Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) follow a different approach. They assume that players care only about outcomes (and not about intentions), but that they have "social preferences" in the sense that they dislike inequitable allocations. These models do not capture "reciprocity" in a strict sense, but rather "distributional fairness" or "inequity aversion". However, these models use standard game theoretic tools and it is straightforward to apply them to any game in order to derive clearcut predictions. Furthermore, Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) show that their models are able to explain not just the qualitative, but also the quantitative results of many classes of experimental games fairly well. Finally, there are a few models that try to model preferences for fair outcomes and fair intentions simultaneously, in particular Falk and Fischbacher (2000) and Charness and Rabin (2002). These models are more general, because they combine social preferences and intention based reciprocity, but they are even less tractable for applications and again plagued by multiple equilibria.[16]

If we assume that it is common knowledge that both players are strongly concerned about distributional fairness or fair intentions, then all of these models yield very similar predictions in the context of the simple game under consideration.

Let us start with the case of joint ownership. Note that, at stage 2, A will always match B's investment and choose $a(b)=b$. The reason is that if players are inequity averse, then by choosing $a=b$ player A can equalize payoffs. If players are concerned about intentions, then a low investment level of player B can be interpreted as a hostile action that is punished by a low investment level of player A, while a high level of b will be interpreted as a kind action that is rewarded by a high level of a. Anticipating this, player B will choose the efficient investment level $b*$ at stage 1, and A will reciprocate by choosing $a = a*$. Thus, joint ownership implements first best investments.

[16] See Fehr and Schmidt (2003) for an extensive survey and critical discussion of this literature.

What about A-ownership? At stage 2, A will always invest efficiently given B's investment level b, i.e., she will choose $a=a^*(b)$. Note that with A-ownership B's payoff is unaffected by A's investment level. Thus, models of intention based reciprocity predict that A will just maximize her own payoff which is efficient. If player A has social preferences and dislikes inequality, she will also choose $a=a^*(b)$. To see this, we have to distinguish two cases depending on the fixed wage T that B receives. Either T is sufficiently large so that B is better off than A. In this case A wants to reduce the payoff difference by maximizing her own monetary payoff which requires that she invests efficiently. Or T is such that A is better off than B. In this case A may want to reduce the payoff difference by investing $a < a^*(b)$. However, if we assume with Fehr and Schmidt (1999) that A prefers to get one additional Dollar for herself rather than to throw this Dollar away in order to reduce the inequality towards B[17], she will invest efficiently.

At stage 1, B's investment b depends on the wage that A offered to him at stage 0. If T is small, B will choose a low investment level. In a model of intension based reciprocity he will do so in order to punish A for her unkind offer. In a model of social preferences he will choose a low investment level in order to reduce the payoff difference between himself and A. On the other hand, if A offered a generous wage at date 0 that gives $T = 1/2 \cdot v(a^*, b^*)$ to B, then B will choose the efficient investment level b^*, either because he wants to reward A for her generous offer or because he wants to increase A's payoff in order to reduce the inequality that is now to his advantage. Thus, at stage 0, a fair player A will make this generous wage offer that equalizes payoffs, and both parties will choose the efficient investment levels a^* and b^*, respectively.[18] The analysis of B-ownership is analogous to the case of A-ownership.

[17] I.e., $\beta < 1$. See Section 1.3.3 below.

[18] It has to be noted that this equilibrium is unique if players have social preferences, but that there are other equilibria if players care about the intentions of their opponents. For example, it is also an equilibrium that A offers a low wage because she beliefs that player B will be hostile and choose a low investment level. In equilibrium these beliefs are self-fulfilling.

Proposition 1.2 *If it is common knowledge that both parties are strongly concerned about either distributional fairness or intention based reciprocity, then the ownership structure is irrelevant. Both parties will invest efficiently no matter whether there is joint, A-, or B-ownership.*

Thus, if fairness and reciprocity are common knowledge, then they induce both parties to invest efficiently even if investments cannot be contracted upon. Reciprocal fairness suffices as an enforcement device, and the allocation of ownership rights does not play a role.

For the experiments this implies that in both designs the eventual ownership structure is indeterminate, but under any ownership structure both parties will choose a=b=10 and monetary payoffs are given by $M^A = M^B = 100$.

1.3.3 Incomplete Information

It is well known from many experiments (and everyday experience) that there are some people who seem to be very strongly concerned about fairness and reciprocity, while there are also many people who seem to behave quite selfishly. Furthermore, people often don't know whether they face a fair and trustworthy opponent or whether their opponent is going to exploit them for his own benefit. Therefore, the most interesting case is the one where there is incomplete information about the preferences of the opponent.

This case is considerably more difficult to analyze with models of intention based reciprocity. However, the Fehr-Schmidt (1999) model of inequity aversion takes the distribution of preferences and incomplete information explicitly into account and allows to analyze the game with incomplete information in a fairly straightforward manner. Therefore, in the following we will focus on the model of inequity aversion.

However, we would like to stress that we do not regard our experiments as a test of this particular model against other models of fairness.

The theory of Fehr and Schmidt (1999) has two main ingredients: First, the theory assumes that some people are not only concerned about their own material payoff but also care about inequity or, in our context, inequality.[19] Second, the theory acknowledges that people differ. Some people are very much concerned about inequality and have a high willingness to pay in order to reduce it, while others only care about their own material payoff. In the two-player case the utility function of inequity averse (fair) players is given by

$$U_i(x) = x_i - \alpha_i \cdot \max\left\{x_j - x_i, 0\right\} - \beta_i \cdot \max\left\{x_i - x_j, 0\right\},$$

$i \in \left\{1,2\right\}$, $i \neq j$, where $x = (x_1, x_2)$ denotes the vector of monetary payoffs and $\beta_i \leq \alpha_i$, $0 \leq \beta_i < 1$. In this utility function, the term weighted with α_i measures the utility loss that stems from inequality to i's disadvantage, while the term weighted with β_i measures the loss from advantageous inequality.

We use a simplified version of this theory. We assume that there are 60 percent self-interested types ($\alpha_i = \beta_i = 0$) and 40 percent "fair" types. Fair subjects exhibit $\alpha_i = 2$ and $0.5 < \beta_i < 1$, i.e., they have a willingness to pay in order to achieve equality. If the inequality is to their disadvantage, they are prepared to engage in costly "punishment" in order to reduce the payoff of their opponent. If the inequality is to their advantage, they are willing to spend resources in order to benefit the other player. Subjects with $\alpha_i \geq \beta_i > 0.5$ are willing to share the surplus of a contract equally and reject offers that give them less than 25 percent of the surplus. The evidence from many

[19] There is no generally accepted notion of *fairness*, but probably all fairness definitions imply that equals should be treated equally. In our experiments, the subjects enter the laboratory as equals. They have no information about their opponents and do not know with whom they trade. Thus, in these very simple environments, it seems natural to define *equality* as the reference point for a fair payoff distribution.

experiments seems roughly compatible with the assumption that 40 percent of all subjects fall in this category.[20]

On the basis of these assumptions, the property rights game can be analyzed using standard game theoretic tools. The full analysis is not difficult but somewhat lengthy and is therefore relegated to an appendix that can be found in Section 1.7 and on our webpage.[21] In the following, we report the main predictions for our experiments and give the intuition for them.[22]

Analysis of the Joint Ownership Design

With asymmetric information about whether the opponent is a self-interested or a fair-minded type, the contract offer made at stage 0 may signal some information about A's type. Therefore, let p denote the (endogenously determined) probability assigned by B to the event that he faces the self-interested type of A.

Suppose that A chooses to stick to joint ownership at date 0. At date 2, a self-interested type of A chooses a to maximize

$$U^{As} = \tfrac{1}{2} \cdot 22 \cdot (a+b) - 12a = 11b - a.$$

Clearly, it is optimal to choose $a^s = 1$. The fair-minded type of A chooses a to maximize

$$U^{Af} = 11b - a - \alpha \cdot \max\{11a - b - 11b + a, 0\} - \beta \cdot \max\{11b - a - 11a + b, 0\}.$$

Note that A will never choose $a > b$. If $\beta > 0.5$, the fair-minded type of A will choose $a^f = b$. Thus, not surprisingly, at the second stage the self-interested type A chooses the minimum investment level while the fair-minded type reciprocates by choosing $a = b$.

[20] See Fehr and Schmidt (1999) for a more extensive discussion of the experimental evidence on the distribution of inequity averse types. When Fehr and Schmidt calibrate their model to explain the quantitative evidence in the different games they use four different types, but aggregated they also have that 40 percent of subjects exhibit $\alpha_i \geq \beta_i > 0.5$ and that 60 percent exhibit $0.5 > \alpha_i \geq \beta_i$.

[21] Please visit: http://www.vwl.uni-muenchen.de/ls_schmidt/experiments/property_rights/index.htm .

[22] The analysis for general cost and benefit functions is omitted because with asymmetric information it would involve too many case distinctions.

Consider now stage 1. Anticipating A's reaction, the self-interested type of B chooses b to maximize

$$\begin{aligned} EU^{Bs} &= p\cdot(11a^s - b) + (1-p)\cdot(11a^f - b) \\ &= p\cdot(11-b) + (1-p)\cdot(11b-b) = 11p + 10b - 11pb. \end{aligned}$$

Thus, if $p < \frac{10}{11} = 0.91$, he chooses $b^s = 10$, if $p > 0.91$, he chooses $b^s = 1$. The fair-minded type of B, on the other hand, maximizes

$$\begin{aligned} EU^{Bf} &= p\cdot\left[11a^s - b - \alpha(12b - 12a^s)\right] + (1-p)\cdot\left[11a^f - b\right] \\ &= p\cdot\left[11 - b - \alpha(12b-12)\right] + (1-p)\cdot\left[11b - b\right] \\ &= 11p + 12\alpha p + 10b - 12b\alpha p - 11bp. \end{aligned}$$

Substituting $\alpha = 2$ and differentiating with respect to b yields

$$\frac{dEU^{Bf}}{db} = 10 - 35p.$$

Thus, if $p < \frac{10}{35} = 0.29$, the fair-minded type of B chooses $b^f = 10$, if $p > 0.29$, he chooses $b^f = 1$. This result is more surprising. It says that if there is uncertainty about A’s type, then a self-interested player B *is more likely to invest* than the fair-minded type of B. The reason is that the self-interested type of B is only interested in his expected monetary payoff. Thus, if there is a reasonable chance that he is matched with a reciprocal type of A, it is worth his while to invest. A fair-minded type of B, on the other hand, is afraid of the increased inequality that is generated if he invests and meets a self-interested type of A who does not reciprocate. Therefore, the fair-minded type behaves more cautiously and invests only if the probability of facing a reciprocal type of A is very high.

Suppose now that at date 0 A sold his ownership stake to B at price T, so B is the sole owner of the project and full residual claimant on profits. In this case it is a dominant strategy for both types of B to choose $b = 10$ at date 1. This is obvious for the self-interested type of B. The fair-minded type of B chooses b to maximize

$$U^{Bf} = 22(a+b) - 12b - T - \alpha \max\{2T - 34a - 10b, 0\} - \beta \max\{34a + 10b - 2T, 0\}$$

which is strictly increasing in b as long as $\beta < 1$. Hence, $b^f = 10$ as well. The intuition is simply that with B-ownership B's investment does not affect A's payoff, so B cannot increase A's payoff by investing less than the efficient amount.

At stage 2, the self-interest type of A clearly chooses $a^s = 1$. The fair-minded type of A chooses a to maximize

$$U^{Af} = T - 12a - \alpha \max\{34a + 10b - 2T, 0\} - \beta \max\{2T - 34a - 10b, 0\}.$$

Substituting $b = 10$, we get

$$\frac{dU^{Af}}{da} = \begin{cases} -12 - 34\alpha & \text{if } 100 + 34a - 2T \geq 0 \\ -12 + 34\beta & \text{if } 100 + 34a - 2T < 0. \end{cases}$$

Thus,

$$a^f = \begin{matrix} 1 & \text{if} & T < 67 \\ \dfrac{2T - 100}{34} & \text{if} & 67 \leq T \leq 220 \\ 10 & \text{if} & T > 220. \end{matrix}$$

Note that a fair-minded type of A will invest in order to reduce the inequality between herself and B, but only if she sold her ownership stake at a sufficiently high price to B. Hence, A's monetary payoffs under B-ownership for the self-interested and the fair-minded type are given by

$$M^{As} = T - 12$$

$$M^{Af} = \begin{cases} T - 12 & \text{if} \quad T < 67 \\ \dfrac{10T + 1200}{34} & \text{if} \quad 67 \leq T \leq 220 \\ T - 120 & \text{if} \quad T > 220, \end{cases}$$

while both types of B get

$$
\begin{aligned}
M^{Bs} = M^{Bf} = & \quad 100 - T + 22\left[p + (1-p)a^{f} \right] \\
= & \begin{cases} 122 - T & \text{if} \quad T < 67 \\ \dfrac{1200 + 10T + 2948p - 44pT}{34} & \text{if} \quad 67 \le T \le 220 \\ 320 - T - 198p & \text{if} \quad T > 220. \end{cases}
\end{aligned}
$$

We now turn to the analysis of the entire game. First, we can rule out the possibility of a separating equilibrium in which the self-interested type of A chooses one type of contract with probability 1 and the fair-minded type of A chooses another type.

Lemma 1.1 *There does not exist a separating equilibrium.*

The intuition is that the selfish type of A would always want to mimic the fair type: Suppose that the selfish type of A sells her ownership stake while the fair type chooses to stick to joint ownership. Then B would invest 10 under joint ownership which induces the selfish type of A to deviate and to stick to joint ownership as well. So suppose that the selfish type of A sticks to joint ownership while the fair-minded type offers to sell. In this case B would choose $b = 1$ if he is offered joint ownership, so the selfish type of A is better off by selling his ownership share, a contradiction.

In the game under consideration here it seems very plausible that sticking to joint ownership will not be interpreted as a signal that player A is selfish. This is captured by the following condition:

Condition 1 *If A chooses to stick to joint ownership, then B's updated belief that he faces the self-interested type of A does not increase.*

This condition implies that the game has a unique Perfect Bayesian Equilibrium outcome:

Proposition 1.3 [Joint Ownership Design] *With incomplete information about the players types there exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition 1. The equilibrium is a pooling equilibrium in which both types of A stick to joint ownership.*

- *The self-interested type of B chooses $b^s = 10$, while the fair-minded type of B chooses $b^f = 1$. The self-interested type of A chooses $a^s = 1$ and the fair-minded type of A chooses $a^f = b$ in equilibrium.*
- *Expected monetary payoffs are $M^{As} = 69.4$ for the self-interested type of A and $M^{Af} = 64$ for the fair-minded type of A, so the average monetary payoff of A is $M^A = 67.24$. The expected monetary payoff of the self-interested type of B is $M^{Bs} = 40.6$ and of the fair-minded type of B is $M^{Bf} = 10$, so in expectation $M^B = 28.36$.*

Note that Proposition 1.3 differs sharply from Propositions 1.1 and 1.2. Proposition 1.1 assumed that it is common knowledge that all players are self-interested. In this case no ownership structure implements first-best investments, but A- (or B-) ownership is strictly better than joint ownership. Proposition 1.2 assumed that all players are fair-minded. In this case any allocation of ownership rights implements first-best investment decisions and the allocation of ownership rights is indeterminate. With incomplete information about the players types, Proposition 1.3 shows, like Proposition 1.1, that first-best investments cannot be implemented, but that there is a second-best allocation of ownership rights that will obtain in equilibrium. However, this time joint ownership is optimal. Proposition 1.3 predicts that in equilibrium player B invests efficiently only if he is self-interested. If he is fair-minded, he prefers not to invest in order to reduce the inequality that arises if he is matched with a selfish player A. Player A invests efficiently only if she is fair-minded and if she is matched with a B-player who invested $b = 10$.

In the experiments we also considered a variant of the Joint Ownership Design called *JOD'*. In this treatment the game did not end when A offered to sell her share and B rejected this offer. Instead, the game continued with joint ownership. This improves B's threatpoint utility when A chooses to make an offer. This makes it less attractive for A to sell her share to B. On the other hand, it is less risky for A to make an offer, because if her offer gets rejected, the parties are just back to joint ownership. Nevertheless, it is shown in the Appendix that Proposition 1.3 still applies on the equilibrium path, so the prediction for this control experiment is exactly the same.

Analysis of the A-Ownership Design

In this design A is the sole owner of the project initially. At date 0 she can choose whether to remain the sole owner and to hire B as employee at wage T, or whether to give away half of the project to B for free in which case there is joint ownership.

If A goes for joint ownership, the analysis of the last subsection applies. So suppose that she decides to stick to A-ownership. At stage 2, a self-interested type of A chooses a to maximize

$$U^{As} = 22 \cdot (a+b) - 12a - T = 10a + 22b - T.$$

Clearly, it is optimal for her to choose $a^s = 10$. The fair-minded type of A chooses a to maximize

$$U^{Af} = 10a + 22b - T - \alpha \max\{2T - 10a - 34b, 0\} - \beta \max\{10a + 34b - 2T, 0\}.$$

Given that $\beta < 1$, the fair-minded type of A also chooses $a^f = 10$. Thus, under A-ownership, it is a dominant strategy for both types of A to choose $a = 10$.

Consider now stage 1. Anticipating A's reaction, the self-interested type of B clearly chooses $b = 1$. The fair-minded type of B maximizes

$$U^{Bf} = T - 12b - \alpha\{34b + 100 - 2T, 0\} - \beta\{2T - 34b - 100, 0\}.$$

Thus, if $T \leq 67$, the fair-minded type of B chooses $b^f = 1$. If $T > 67$ he chooses b^f so as to equalize payoffs, i.e., $b^f = \frac{2T-100}{34}$. This parallels the analysis of B-ownership in the Analysis of the *Joint Ownership Design* above.

Consider now stage 0. The self-interested type of B will accept the contract offered by A if and only if $T \geq 12$. The fair-minded type of B clearly accepts any contract with $T \geq 67$. If $T < 67$ he accepts if and only if $T - 12b - \alpha(34b + 100 - 2T) > 0$. Noting that he chooses $b^f = 1$ in this case and that $\alpha = 2$, this is equivalent to $T \geq 56$.

At stage 0, if the self-interested type of A offers $T = 12$, this will only be accepted by the self-interested type of B. If she offers $T = 56$ this will be accepted by both types of B, which yields a slightly higher payoff. It is easy to show that offering more than 56 reduces her payoff, so A will offer $T = 56$ which is accepted by both types of B. The fair-minded type of A wants to equalize payoffs and offers $T = 67$, which is also accepted by both types of B. Hence, the theory of inequity aversion predicts the same investment levels as the self-interest theory, but it differs in the prediction of the wages offered to B.

Let us now turn to the entire game. Again, if we are willing to impose a condition that parallels Condition 1, we get a unique equilibrium prediction.

Condition 1' *If A offers a joint ownership contract and gives away half of the revenues of the firm to B, then B's updated belief that he faces the self-interested type of A does not increase.*

Proposition 1.4 [A-Ownership Design] *With incomplete information about the players types there exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition 1'. The equilibrium is a pooling equilibrium in which both types of A offer a joint ownership contract which is accepted by both types of B. The equilibrium outcome is the same as under joint ownership described in Proposition 1.3.*

Thus, Propositions 1.3 and 1.4 predict that the players will always end up with joint ownership, no matter what the initial allocation of ownership rights. Joint ownership does not implement first best investment decisions. However, it still outperforms A- (or B-) ownership. Under joint ownership *both* parties invest with a significant probability, while under A- (or B-) ownership only the owner invests while the other party does not. Furthermore, under A-ownership A has to hire B as an employee, and there is a significant probability that a fair-minded type of B will reject a wage offer that he perceives to be unfair. Similarly, in the joint ownership design A has to sell her ownership stake to B and again there is some probability that this offer is going to be rejected. Therefore, the model of inequity aversion predicts that joint ownership is more efficient. This is in contrast to the self-interest model that predicts A- (or B-) ownership to be more efficient. However, both models support the Coase Theorem which suggests that the parties will adopt the ownership structure that is most efficient independent of the initial allocation of ownership rights.

1.4 Experimental Results

1.4.1 Experimental Procedures

The experiments were conducted at the University of Munich with undergraduate students of law, political science, engineering, etc. (but no students of economics or business administration). In total we conducted eight experimental sessions. Four sessions (S1–S4) implemented the Joint Ownership Design (JOD), two sessions (S5-S6) implemented the A-Ownership Design, and two additional sessions (S7 and S8) implemented a control treatment of JOD with the twist that after A's offer was rejected the game did not end but continued with joint ownership (JOD'). In each session we had

20-24 subjects, half of them in the role of player A, the other half in the role of player B. The two groups were located in separate but adjacent rooms. Before the experiment started, all subjects had to read detailed instructions and to solve several exercises to make sure that all of them understood the rules of the experiment. In each session we had ten rounds. In each round an A-player was matched with a different B-player. Thus, in each experimental session we have for each subject ten contracts with ten different anonymous contracting partners.

After each round the subjects had to compute their own payoff and the payoff of their opponent. To rule out the possibility of reputation building, the outcome of each round was strictly confidential, that is, each pair of players observed only what happened in their own relationship. They did not observe the contracts chosen by or offered to the other subjects in the room. Nor did they observe the past behavior of their current partner. Furthermore, the matching was random and anonymous. Finally, at the end of the session the subjects collected their total monetary payoffs privately and anonymously. Each session lasted for about one and a half hours. A complete set of the instructions for all our experiments can be found on our webpage.[23]

In each session all participants received an initial endowment of DM 20.00. The experimental (token) payoffs were exchanged into money at the rate of 1 token = 0.06 DM. Thus, A and B could jointly earn a maximum surplus of DM 12 (≈US $ 7.50 at the time of the experiment) in each of the ten rounds. The highest total income of one individual was DM 82.20 (≈US $52.00), an hourly wage of ≈ DM 54.80 (US $34.25). However, the subjects could also make substantial losses. In order to avoid the possibility that somebody ends up with negative earnings, a subject had to drop out of the experiment if his accumulated earnings fell below DM 2.00 (US $1.25), which never happened.

[23] The full set of all our experimental instructions, in German and translated into English, are available at http://www.vwl.uni-muenchen.de/ls_schmidt/experiments/property_rights/index.htm . As an example I included the instructions for the JOD (for player A) in Section 1.6.

1.4.2 Joint Ownership Design

We have a total of 470 observations from sessions S1 – S4 in which we conducted the joint ownership design. The large majority of A-players (300 out of 470, 63.8%) chose to stick to joint ownership, while 170 (36.2%) tried to sell their ownership stake to B. This offer was accepted in 118 cases (69.4%) and rejected in 52 cases (30.6%). Figure 1.1 shows that the fractions of contractual choices are fairly constant over time.

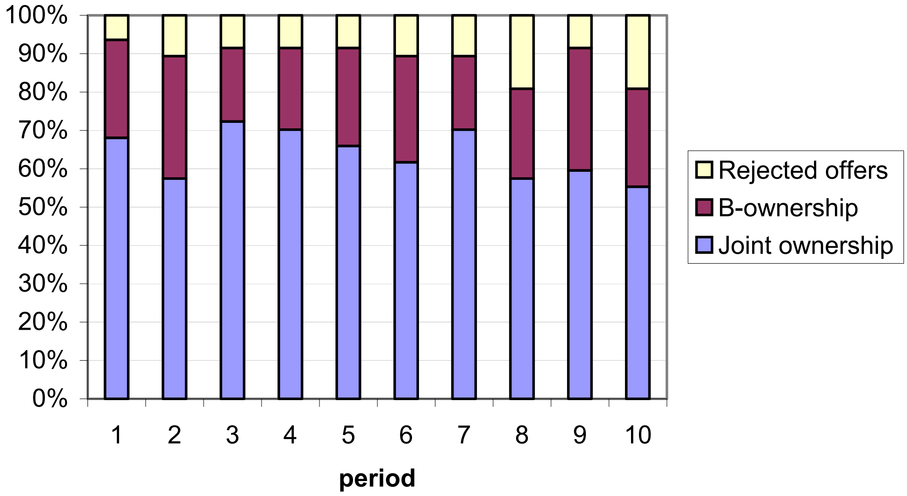

Figure 1.1: Share of joint ownership and B-ownership over time in the JOD

Consider first the cases where joint ownership prevailed. At stage 1, 60% of all B-players (180 of 300) chose the efficient investment level $b = 10$. Of the remaining 40% who chose $b < 10$, 41 (13.6%) went for the minimum investment level $b = 1$. On average, B-players invested 7.7, while A-players invested 6.7 on average. Figure 1.2 shows the average investment level of player A at stage 2 given player B's investment b at stage 1. Clearly, there is strong reciprocity in A's behavior.

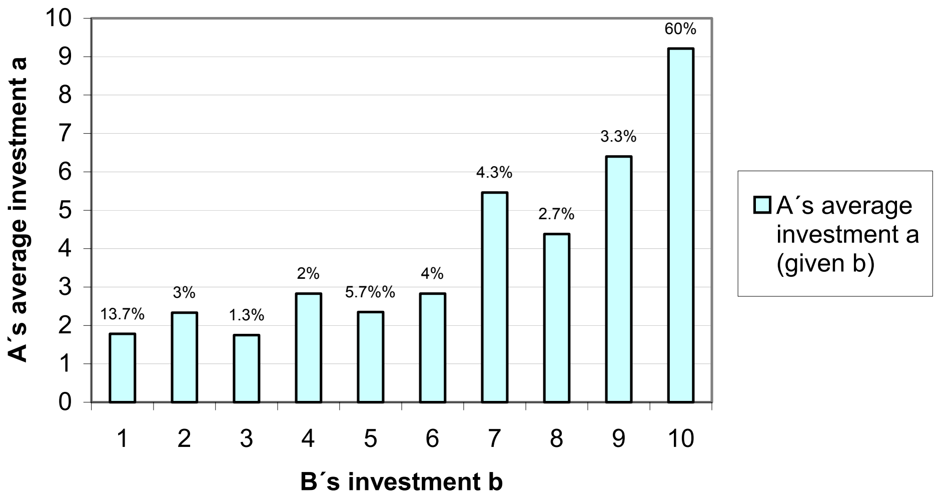

Figure 1.2: A's average investment given b and joint ownership (JOD)

A simple OLS regression with a as the endogenous variable confirms that b has a strong and highly significant impact on the choice of a.[24]

$$\begin{array}{ccccc} a & = & -0.11 & + & 0.89 \quad b \\ & & (-0.299) & & (19.862) \end{array}$$

An increase of b by one unit increased a on average by 0.89 units. Thus, if B was only interested in his monetary payoff, then choosing $b = 10$ is indeed optimal. We also included the "desired investment levels" $a*$ and $b*$ that A could mention in his contractual offer in the regression, but they are not statistically significant and it seems that the parties considered them to be "cheap talk".

A closer look at the data reveals that not all A-players reciprocated. This can be seen from Table 1.1 which shows the distribution of investment pairs (a,b). Note that 218 out of 300 (72.7%) investment choices of A are on the diagonal, i.e., given b player A has chosen $a = b$. If we exclude the 37 cases where $a = b = 1$, we still have 60.3% of reciprocal investment choices of A-players. Only 9 times did an A player invest more than B, but there are 73 cases (24.3%) where we observe $a < b$, and in 85

[24] The terms in brackets report the t values of the regression.

cases $a = 1$ which is the dominant strategy of a self-interested player A. Thus, there is a strong minority of A-players who behave selfishly. This is confirmed by a standardized questionnaire that had to filled in by all participants in which 57% of all A-players reported that the income of player B was of no or of hardly any importance to them.

a / b	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	Σ
1	37	5	2	3	10	7	3	4	3	11	85
2		3	1	1	1	1				1	8
3			1								1
4				1	2						3
5					4		1			3	8
6	1					3	3	1		3	11
7						1	5	1	1	1	9
8				1				1		2	4
9									6	2	8
10	3	1					1	1		157	163
Σ	41	9	4	6	17	12	13	8	10	180	300

Table 1.1: Investments (a, b) with joint ownership contracts in JOD

Result 1.1 *Under joint ownership there is, on average, strong reciprocity of A given B's investment. A-players can be separated in two types:*

- *Fair types choose $a = b$ (roughly 70%).*
- *Selfish types choose $a < b$ (roughly 25%).*

The majority of B-players (60%) trusted that A is going to reciprocate and chose $b = 10$.

In 170 out of 470 cases (36.2%) A tried to sell her ownership stake to B. B-players rejected these offers 52 times. The average price of the accepted offers was

120.8. Recall that if B buys A's ownership stake and invests $b=10$ while A invests only $a=1$, then B's monetary payoff is $M^B = 22(10+1) - 12 \cdot 10 - T = 122 - T$. Thus, with a price of 120.8, B is just going to break even while all of the surplus accrues to A.

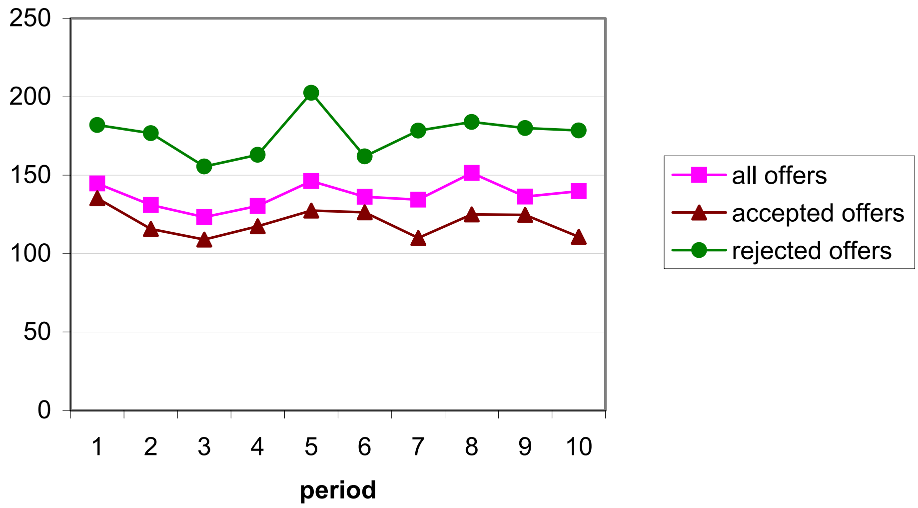

Figure 1.3: Evolution of price offers over time (JOD)

The average price of the rejected offers was 176.9. Accepting such an offer can be profitable for B only if B expects A to invest considerably more than $a=1$. Given that A sold her ownership stake, this seems unlikely. In fact, A invested $a=1$ in 85 out of the 118 cases (72%) where she sold her ownership stake successfully to B, and her average investment level in these cases was just 1.9. Thus, it is not surprising that these high price offers got rejected.

If A's offer was accepted, virtually all B-players (111 out of 118) chose $b=10$, which is a dominant strategy for self-interested and fair-minded players. A's average income under joint ownership is 77.5, while it is only 67.9 if she chose to sell her ownership stake to B. B's average income under joint ownership is 66.4, considerably more than the 12.8 that he received on average when A tried to sell him her ownership rights. Figure 1.4 shows that in all periods (except for period 1) both players were better off with joint ownership than with B-ownership and the payoff differences are also considerably smaller under joint ownership.

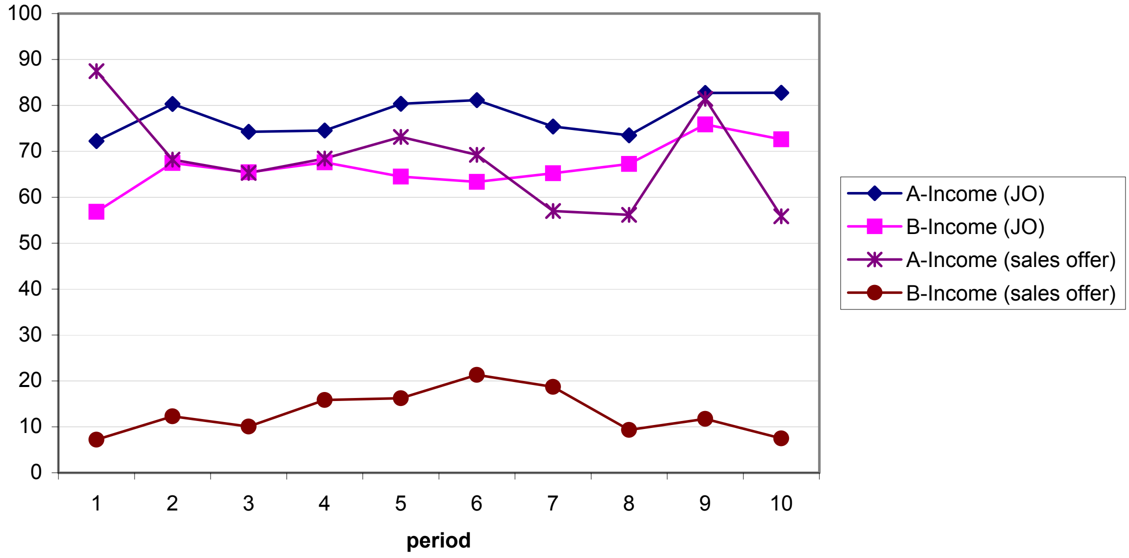

Figure 1.4: Evolution of payoffs under joint ownership and B-ownership over time (JOD)

Result 1.2 *Joint ownership is the more efficient allocation of ownership rights. Both players receive a higher average payoff if A decides to stick to joint ownership rather than to sell her ownership rights to B. Thus, even a purely self-interested player A should opt for joint ownership.*

These results clearly contradict the self-interest model. The self-interest model predicts that none of the parties is going to invest under joint ownership, that joint ownership is less efficient than A-ownership, that A-ownership maximizes player A's payoff, and that all A-players are going to stick to A-ownership. The results are also inconsistent with models that assume that all people are strongly concerned about fairness and reciprocity. These models predict that the allocation of ownership rights does not matter, because fairness and reciprocity suffice as an enforcement device to induce both players to invest efficiently no matter what the ownership structure is. The experimental results show that if player A sells her ownership stake to B, then she is not going to invest anymore. Furthermore, even if A sticks to joint ownership, the first best is not attained. There is a significant fraction of B-players who do not choose $b = 10$ at stage 1 under joint ownership, and a strong minority of A-players who do not reciprocate and choose $a < b$ at stage 2. Nevertheless, the allocation of ownership rights matters because joint ownership is clearly more efficient than A-ownership.

The theory of inequity aversion does a much better job in organizing the data. It predicts that no ownership structure implements the first best. It also predicts that the allocation of ownership rights matters, that joint ownership is more efficient than A-ownership and that all A-players should stick to joint ownership. This is largely consistent with the data. However, the quantitative predictions seem to be less convincing. The theory predicts that under joint ownership only the self-interest B-players (60%) will choose $b = 10$ while the fair-minded B-players invest $b = 1$ because they are afraid that the A-players will not reciprocate. In the experiments, the fraction of B-players who took the risk to invest 10 or a little bit less than 10 was somewhat larger. Furthermore, it predicts that only the fair-minded A-players (40%) reciprocate to high investments of player B by choosing $a = b$. In the experiments, roughly 70% of A-players reciprocated. Thus, it seems that players behaved "too fairly" in the experiment. However, we have to take into account that more than 30% of A-players tried to sell their ownership stake to B. It seems plausible that this was done mainly by self-interested A-players. In fact, 63% of all B-players reported in the questionnaire that they interpreted sticking to joint ownership as a signal that A is trustworthy and will behave fairly. Furthermore, 64% of all A-players said that they considered joint ownership to be an "invitation to cooperate". If this is the case, then the fraction of fair-minded A-players in the pool of joint ownership contracts would increase. With more fair-minded A-players it is less risky for fair-minded B-players to invest $b = 10$ and we should observe more reciprocal behavior of the A-players. Thus, overall, the quantitative predictions of the theory of inequity aversion are roughly consistent with the data.

1.4.3 A-Ownership Design

We now turn to the results of the A-ownership design where A-players could choose between sticking to A-ownership or giving away for free half of the revenues of the project to the other player. We observed a total of 230 contractual choices in sessions S5 and S6.

Result 1.3 *The overwhelming majority of A-players chooses to make B the joint owner of the project. There is no significant time trend. If anything, the share of joint ownership is increasing over time.*

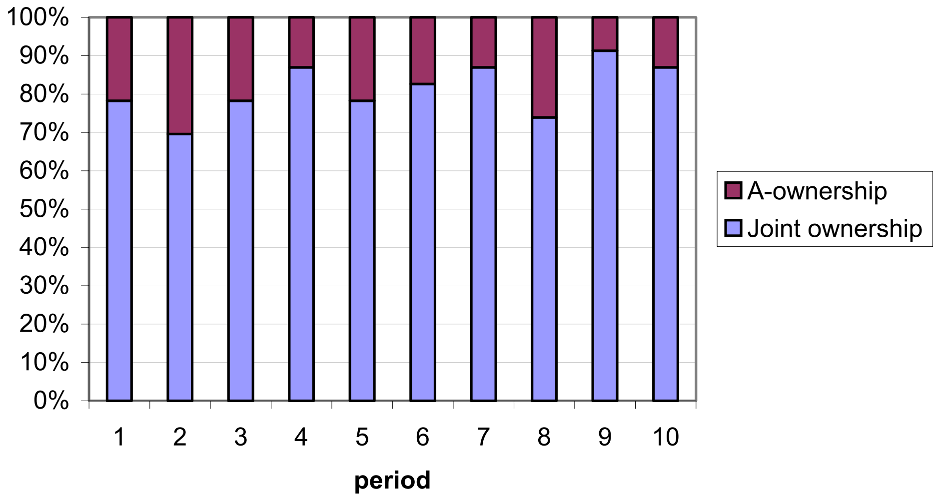

Figure 1.5: Share of joint ownership and A-ownership over time in the AOD

In total joint ownership was chosen in 81.3 % of all contractual offers (187 of 230 observations). If there is joint ownership, the investment behavior is very similar to the investment behavior in the JOD when A decided to stick to joint ownership. 135 out of 187 B-players (72.2%) choose $b = 10$. The majority of A-players reciprocated to B's investment choices. The following table shows the distribution of investment pairs (a, b).

a / b	1	2	3	4	5	6	7	8	9	10	Σ
1	9	1			3	2	5	2	3	33	58
2					1		1			2	4
3							1				1
4				1	1			1			3
5					2			1		2	5
6						1		1			2
7							3		1	1	5
8								4	2	1	7
9									5	4	9
10						1				92	93
Σ	9	1	0	1	7	4	10	9	11	135	187

Table 1.2: Investments (a, b) with joint ownership contracts in AOD

On average, B invested $b = 8.9$ while A invested $a = 6.5$ as compared to $b = 7.7$ and $a = 6.7$ when A decided to stick to joint ownership in the JOD. Again, investment choices are clearly correlated. A simple OLS regression with a as the endogenous variable confirms that b has a strong and highly significant impact on the choice of a.[25]

[25] Again, we included the "desired investment levels" $a*$ and $b*$ in the regression analysis, but they are statistically insignificant.

$$a = -0.7 + 0.81\ b$$
$$(-0.66) \quad (6.99)$$

117 out of 187 (63%) investment choices of A are on the diagonal, i.e., given b player A has chosen $a = b$. If we exclude the 9 cases where $a = b = 1$, we still have 57.8% of reciprocal investment choices of A-players. Only once did an A player invest more than B, but there are 69 cases (37%) where we observe $a < b$, and in 49 of them $a = 1$ which is the dominant strategy of a self-interested player A. Thus, there is a strong minority of A-players who behave selfishly. In fact, 39% of all A-players reported in the questionnaire that B's income was not important to them. Nevertheless, most players B seem to have anticipated reciprocal behavior: 135 out of 187 (72%) chose $b = 10$, while only 10 (5,3%) chose an investment level of 1 or 2.

Result 1.4 *Under joint ownership there is, on average, strong reciprocity of A given B's investment. A-players can be separated in two types:*

- *Fair types choose $a = b$ (roughly 60%)*
- *Selfish types choose $a < b$ (roughly 40%)*

The majority of B-players (more than 70%) trusted that A is going to reciprocate and chose $b = 10$.

In 43 out of 230 cases (18,7%) A decided to stick to A-ownership and to hire B as an employee. B-players rejected the wage offers 5 times. The average wage offer was 62.05. Recall that the theory of inequity aversion suggests that if A-players make a wage offer to B- players they should offer 56 if they are self-interested and 67 if they are fair-minded. With 60% self-interested players the expected wage offer is 60.4, which is quite close to the observation in the experiment. Under A-ownership almost all B-players chose the minimum effort level (average $b = 1.26$), while all A-players chose $a = 10$, which is a dominant strategy for both, self-interested and fair-minded types of A.

A's average income under joint ownership is 91.4, while it is only 55.0 if she chose to stick to A-ownership. B's average income under joint ownership is 62.9, while he received only 44.5 if A tried to hire him as an employee.[26]

Result 1.5 *Joint ownership is the more efficient allocation of ownership rights. Both players receive a higher average payoff if A decides to give away half of the project to player B rather than to hire B as an employee. Thus, even a purely self-interested player A should opt for joint ownership.*

Again, these results clearly contradict the predictions of the self-interest model and the predictions of models that assume that all people are strongly concerned about fairness and reciprocity. The experimental results show that if player A sticks to A-ownership and hires B as an employee, then B is not going to invest. Furthermore, even if A chooses joint ownership, the first best is not attained. There is a significant fraction of B-players who do not choose $b = 10$ at stage 1 under joint ownership, and a strong minority of A-players who do not reciprocate and choose $a < b$ at stage 2. Nevertheless, the allocation of ownership rights matters because joint ownership is clearly more efficient than A-ownership.

The theory of inequity aversion is consistent with these results. First of all, more than 80% of the A-players choose the predicted ownership structure. Second, roughly 70% of B-players (as compared to the predicted 60%) chose the efficient investment level. If we assume that those A-players who did not opt for joint ownership are mostly self-interested, then the fraction of fair-minded A-players among those who offered joint ownership contracts is larger than 40%. Therefore, it is less risky for fair-minded B-players to invest and we should observe more efficient investment choices of B-players than predicted by the model. Third, this may also explain why a larger fraction of A-players (roughly 60% as compared to the predicted 40%) reciprocated by choosing

[26] Even if we only consider those cases where B accepted A's wage offer, both parties receive a lower payoff than under joint ownership (A: 62.2, B: 50.4).

$a = b$. However, a significant fraction of A-players did not reciprocate. Finally, given the rather "fair" behavior of A- and B-players, it is not surprising that payoffs of both players are also somewhat higher than predicted by the theory.

1.4.4 Control Treatment for Joint Ownership Design (JOD')

In Session S7 and S8 we conducted a control treatment of the Joint Ownership Design in which the parties also started from joint ownership, but this time the game did not end after B rejected A's offer. Instead the game continued with joint ownership as if no offer had been made. We have a total of 240 observations for this treatment. Again, joint ownership prevailed in the majority of cases (196 of 240 observations, 81.7%). However, this time A-players tried to sell their ownership stake more often (in 134 out of 240 cases, 55.8%). It seems that making an offer was considered to be less risky by A-players because if the offer got rejected the parties would just get back to the status quo of joint ownership. In fact, the offers got rejected considerably more often (in 90 out of 134 cases, 67.2%). Let us consider the three different possibilities in turn:

- If A did not make an offer, the investment behavior is very similar to the investment behavior in the other designs when joint ownership prevailed. B-players invested on average $b = 7.0$, while A-players invested on average $a = 6.1$. The reciprocal behavior of A-players is virtually identical and the OLS regression yields

$$a = \underset{(0.23)}{0.12} + \underset{(12.91)}{0.86}\ b$$

  almost the same as what we observed under joint ownership in JOD and AOD.

- If A did make an offer that was accepted by B-players, the investment behavior is very similar to the corresponding case in the JOD. Almost all B-players invested efficiently ($b = 9.5$ on average), while almost all A-players chose the minimum investment level ($a = 1.2$ on average). However, it is interesting to note that the average price of the accepted offers was much lower than the average accepted price in the JOD ($T = 88.9$ as compared to $T = 120.8$). This reflects the fact that B's threat point payoff if he rejected the offer was not zero but to go back to the status quo of joint ownership. In fact, B's average payoff after accepting A's offer is 31.4 which is considerably higher than the 18.5 that he received on average when he accepted A's offer in the original JOD.

- Two thirds of all offers made by A-players got rejected. The average price of the rejected offers was 161.4, again somewhat lower than the average price of rejected offers in the original JOD (176.9), but still very high. After the offer was rejected the two players played the investment game under joint ownership. In these cases B invested on average only $b = 6.3$ while A invested only 3.9 on average. This is considerably less than the investment levels under joint ownership in JOD or AOD. A simple regression analysis shows that A-players reciprocated much less in these cases:

$$\begin{array}{cccc} a & = & 0.27 & + & 0.57\ b \\ & & (0.42) & & (6.66) \end{array}$$

Note that on average a increased by just 0.57 if B's investment increased by one unit, as compared to 0.89 in the JOD and 0.81 in the AOD. Furthermore, Table 1.3 shows that the fraction of A-players who chose $a = 1$ independently of the investment level of player B is much larger.

a / b	1	2	3	4	5	6	7	8	9	10	Σ
1	24	2	3	2	2	2		2	1	16	54
2			1							1	2
3			1								1
4				1							1
5					2	1					3
6						1	1			1	3
7							1		1		2
8								1		1	2
9									1		1
10										21	21
Σ	24	2	5	3	4	4	2	3	3	40	90

Table 1.3: Investments (a,b) with joint ownership after A's offer was rejected in JOD'

54 out of 90 A-players (60%) chose the minimum investment level. B-players seem to have anticipated this behavior, and only 40 out of 90 (44.4%) opted for the efficient investment level $b=10$. Thus, the fact that A-players tried to sell their ownership stake to B was interpreted by B-players as a signal that it is less likely that they face a fair-minded A-player, and this expectation turned out to be correct.

1.5 Conclusions

In this chapter we analyzed the problem of the optimal allocation of ownership rights under three different assumptions about people's preferences. First, the standard property rights approach assumes that all people are purely self-interested. In such a world, no ownership structure induces the parties to make efficient relationship specific investments. However, the allocation of ownership rights matters, because A- (or B-) ownership strongly outperforms joint ownership. Second, if all people are strongly concerned about fairness or reciprocity, then under any ownership structure reciprocal fairness suffices as an enforcement device to induce all parties to invest efficiently. Thus, the allocation of ownership rights is irrelevant. Third, the model of inequity aversion assumes that some people are strongly fair-minded while others are mainly self-interested. This model focuses on the interaction between fair-minded and self-interested players and shows that fairness alone is not sufficient to induce first best investments and that the ownership structure is very important. However, in contrast to the property rights approach, joint ownership turns out to be second-best optimal. The reason is that joint ownership makes much better (but still imperfect) use of fairness as an implicit enforcement device.

The experimental results are largely consistent with the model of inequity aversion. People clearly differ in their behavior. Joint ownership turned out to induce higher investment levels than A- (or B-) ownership and to generate higher payoffs for both parties. Furthermore, the experimental subjects seemed to understand this. They opted predominantly for joint ownership, independent of the initial ownership structure. This confirms the proposition of the Coase Theorem that the parties will always try to choose the efficient ownership structure ex ante.

In a recent paper, Oliver Hart (2001) argues that (a) "although norms are undoubtedly very important both inside and between firms, incorporating them into the theory has been very difficult and is likely to continue to be so in the near future" and

(b) "a norm-free theory of the firm and a norm-rich theory of the firm don't seem to have very different predictions". He mainly looked at models of repeated games that try to capture norms or reciprocal behavior. In this chapter we have shown that the recent advances in modeling fairness and reciprocity in one-shot games provide powerful tools to incorporate norms of fair or reciprocal behavior into contract theory. This allows us to derive important and testable predictions on the optimal allocation of ownership rights, some of which differ significantly from the standard predictions of the self-interest model. If we want to understand the incentive properties of real institutions on real people, concerns for fairness and reciprocity have to be taken into account.

1.6 Experimental Instructions

As an example for the experimental instructions, this section contains the instructions for player A in the Joint Ownership Design (JOD). Note that the original instructions were written in German.

Introductional Remarks

The experiment you are participating in today is part of a research project financed by the Deutsche Forschungsgemeinschaft. Its purpose is to analyze people´s economic decision behavior. Your income consists of an initial endowment of DM 20 that every participant gets for showing up, and a sum of money you can earn during the experiment, depending on your and your partners´ decisions. During the experiment, your income is calculated in tokens. DM are converted into tokens by the following rate:

1 token = 0.06 DM.

Your endowment of 20 DM corresponds to 333 tokens. It can be used to cover potential losses that can occur during the experiment. If your losses exceed 300 tokens, you have to leave the experiment. **By appropriately taking your own decisions you can avoid losses <u>with certainty</u>!**

At the end of the experiment all tokens resulting from your decisions during the experiment will be added together, converted in DM and, in addition to the endowment, paid to you in cash immediately.

First of all you should now carefully read these instructions. After having done so, please answer the control questions, which you find at the end of these instructions. After all participants have answered the questions correctly, the experiment, for which you need the ten decision sheets and the income tables, begins.

Without any exception, all written information you received from us is for your private use only. You are not allowed to pass over any information to other participants in the experiment. Talking during the experiment is also not permitted. Violations of these rules would force us to stop the experiment. If you have any questions, please ask us.

General information

0. The participants are split up in two types of participants, *participant A* and *participant B*. **During the whole experiment, you are playing the role of a *participant A*.** The experiment lasts for **10 periods.** In every period an A-participant is matched with a B-participant. By investing in a project, the participants can generate a total revenue *TR*. In every period, every participant has to choose an integer investment level between 1 and 10. The A-participant`s investment level is denoted by ***a***, while the B-participant`s investment level is denoted by ***b***. The total revenue is calculated in the following way:

   $$TR = 22\cdot(a+b)$$

   Generally, the more the participants invest in the project, the higher is the total revenue. Every invested unit – no matter who invested this unit, A or B - increases the total revenue by 22 tokens. If e.g. A chooses an investment of $a = 3$ and B chooses $b = 2,$ a total revenue of $TR = 22\cdot(3+2) = 22\cdot(5) = 110$ tokens is generated. If A´s investment is instead $a = 6$ and B chooses $b = 8$ they generate a total revenue of $TR = 22\cdot(6+8) = 22\cdot(14) = 308$ tokens.

   In every period each A-participant is matched with a different B-participant. This ensures that the same A- and B-participant are matched together only once in the experiment. No A-participant gets to know the identity of the matched B-participants, nor do the B-participants know the respective A-participant´s identity. Your decisions in one period are transmitted only to the B-participant matched with you in that period. No one else is informed about your decisions.

1. Every period consists of **4 stages**. At the beginning of each period both, **the A- and the B-participant hold a 50% share of the total revenue from the project.** At **stage 1** every A-participant has to decide, whether he wants to keep his 50% share, or whether he wants to sell his 50% share to the respective B-participant. If the A-participant wants to sell his share, he has to make a sales offer to the B-participant. This happens by setting a price *P* for the 50% share. If the A-participant does not make a sales offer to the B-participant, both participants keep holding a 50% share of the *TR* from the project. In addition, the A-participant has to set demanded investment levels ***a**** and ***b**** at the first stage, i.e. he announces how much he wants to invest and how much he wants the respective B-participant to invest.

2. If the A-participant did not make a sales offer at stage 1, both participants automatically keep their 50% shares.

   If the A-participant made a sales offer, the respective B-participant has to decide at **stage 2**, whether she wants to accept or reject the offer.
   - If B rejects the offer, this period is over for the respective A- and B-participant. Both participants earn nothing in that period (0 tokens).
   - If B accepts the offer, he has to pay the fixed price *P* to the A-participant. Thereafter, the B-participants holds a 100% share of the total revenue from the project.

After stage 2 is over, one knows, whether the A-participant still holds his 50% share, or whether his share was sold. If the A-participant still holds the 50% share, his income is determined by the total revenue *TR*. If on the other hand A sold his share, his income in this period is determined by the price *P*.

3. At **stage 3** the B-participant has to decide how much he actually wants to invest in the project, i.e. he has to choose his investment level *b,* if the relationship has not been ended by the rejection of a sales offer. The investment level *b* may be every integer between 1 and 10, i.e. *b* may be higher, lower, or equal to the demanded level b^*.

4. At **stage 4,** the A-participant is informed about the B-participant´s actual investment level. Now, the A-participant has to decide, how much he actually wants to invest in the project, i.e. he has to choose his investment level *a*. Please note, that also those A-participants who sold their 50% share **have to choose an investment level *a*.** The investment level *a* may be every integer between 1 and 10, i.e. *a* may be higher, lower, or equal to the announced level a^*.

For every participant, investing in the project is costly, i.e. a certain cost *C* has to be incurred. Generally, **a cost of 12 tokens has to be incurred per unit invested**. **This cost has to be incurred by that participant, who actually invested** the certain number of units. If e.g. A invests $a = 6$, this means a cost of $6 \cdot 12 = 72$ for her. If B invests $b = 8$, then he has to incur a cost of $8 \cdot 12 = 96$.

Detailed information for A-participants

Please keep to the following rules and orderings:

1. The A-participant´s decision, whether to keep his share, or to sell it at price *P*, happens by writing down the corresponding information on the decision sheet of the current period. After all A-participants have come to a decision and after additionally having set the demanded investment levels, this information is transmitted to the respective B-participants by the experimentators.
2. In case of a sales offer, the B-participant first of all has to write down on the decision sheet whether he wants to accept or to reject the offer. If B rejects the offer, this period is over and both participants earn nothing in that period (0 tokens). If B accepts the offer, he has to choose *his own* actual investment level, i.e. he has to write down his investment level *b* on the corresponding decision sheet. After all B-participants have come to a decision, the information is transmitted to the respective A-participant (and to no one else).
3. After that, those A-participants who kept their 50% share, or who succeeded in selling it to B, have to choose their actual investment levels *a*. This information is again transmitted to the respective B-participant. Thereafter, this period is over. At the beginning of the next period, the A-participants again have to decide, whether to keep their 50% share, or to make a sales offer.

Calculation of incomes at the end of a period

Incomes of the A- and B-participants at the end of a period depend on, whether both A and B hold a 50% share or A has sold his share to B. Furthermore, it depends on the chosen investment levels.

1. **If both the A-participant and the B-participant happen to hold a 50% share**, because A decided to keep his share, then both the A-participant and the B-participant get half of the total revenue from the project. The income of the participants results from their share of total revenues minus investment cost (the income of *A* is denoted by I_A, and the income of *B* is denoted by I_B):

Income of A (I_A)	=	(1/2)·total revenue [$22\cdot(a+b)$] – investment cost of A [$12a$]
Income of B (I_B)	=	(1/2)·total revenue [$22\cdot(a+b)$] – investment cost of B [$12b$]

In order to help you calculating these figures, we provided income tables on the **yellow-coloured sheet**. Therefore, on the yellow-coloured sheet you find the income tables **for the case that A holds a 50% share**.

♦ In the **upper part** of the yellow-coloured sheet you will find the feasible incomes for **participant *A***, depending on the investment levels *a* and *b*. *It is important to note, that the income of A depends on her own investment and on B's investment because A holds a 50% share*. If e.g. as before, investments are $a = 4$ and $b = 7$, one learns from the upper table that participant A earns an income of $I_A = 73$ (please check this out). If participant A were to choose $a = 1$ instead of $a = 4$, his income would rise to $I_A = 76$ (please check this out).

♦ In the **lower table** of the yellow-coloured sheet you can find the feasible incomes for **participant B**, dependent on investment levels a and b. *Again, it is important to note, that B's income depends on her own investment and on A's investment, because B holds a 50% share*. If e.g. investments are $a = 4$ and $b = 7$, one learns from the upper table that participant B earns an income of $I_B = 37$ (please check this out). If participant A were to choose $a = 1$ instead of $a = 4$, B´s income would rise to $I_B = 4$ (please check this out).

2. If the A-participant made a sales offer that was rejected by the B-participant, both participants earn 0 tokens in that period.

3. If the A-participant made a sales offer that was accepted by the assigned *B*-participant, the income of *A*, again denoted by I_A, and the income of *B*, again denoted by I_B, are given by:

Income of A (I_A)	**=**	price [P] – investment cost of A [$12a$]
Income of B (I_B)	**=**	total revenue [$22\cdot(a+b)$] – investment cost of B [$12b$] – price [P]

To make also the calculation of these incomes easier for you, we have put the income tables on the orange-coloured sheet at your disposal. Therefore, on the orange-coloured sheet you find the **income tables for the case that *A* has sold her share to *B***.

♦ In the **upper part** of the orange-coloured sheet you will find the respective feasible incomes for **participant A**, depending on the investment level a and price P. *It is important to note, that the income of A is completely independent of B's investment, because A does not hold a share anymore*. If, for example, A has sold his share for $P = 45$ (with announced investment levels $a^* = 4$ and $b^* = 4$) and the actual investments have been $a = 4$ and $b = 7$, one learns from the upper table that, at $a = 4$, participant A earns $I_A = P - 48 = 45 - 48 = = -3$ (please check this out). If participant A were to choose $a = 1$ instead of $a = 4$, his income would amount to $I_A = P - 12 = 45 - 12 = 33$ tokens (please check this out again).

♦ In the lower part of the orange-coloured sheet you may figure out the feasible incomes for participant B at different investment levels a and b and prices P. *It is important to note, that the income of B does depend on his own investments and on the investment of A, because the investment of A (a) still determines the total revenue and therefore B's income*. In the above example, where participant B has paid $P = 45$ and where investments are $a = 4$ and $b = 7$, one learns from the lower table, that the B-participant earns an income of

$$I_B = 158 - P = 158 - 45 = 113 \text{ tokens}$$

Were the A-participant to choose $a = 1$ instead of $a = 4$, the income of B would amount to

$$I_B = 92 - P = 92 - 45 = 47 \text{ tokens.}$$

Every participant knows all the details of the income calculation. So every A-participant can not only calculate her own income, but also the B-participant`s income. In addition, the B-participant is able to calculate your income.

Please remember that you have to calculate your own income and the B-participant`s income on your decision sheet at the end of each period.

If you have any questions, please ask us.

Control Questions

Please calculate your own income and, if asked for, the income of the B-participant in tokens. **Missing answers lead to the loss of all incomes** you′ll earn during this experiment. **Wrong answers have no consequences** for you. Please write down the complete calculation, not only results.

1. **a)** You have sold your share to participant B for ***P = 63*** and have set $a^* = 3$ und $b^* = 10$. Calculate the income of B under the assumption that you always choose ***a = 2*** and B chooses the following investment levels: $b = 1, b = 5, b = 10$.

   Income of B if b = 1:

   Income of B if b = 5:

   Income of B if b = 10:

   b) Calculate your own income under the same assumptions (***P = 63***, $a^* = 3, b^* = 10,$ ***a = 2***, and the respective levels of b):

   Your income if b = 1:

   Your income if b = 5:

   Your income if b = 10:

2. **a)** You have sold your share to participant B for ***P = 35*** and have set $a^* = 2$ and $b^* = 10$. Calculate B's income under the assumption that participant B always chooses ***b = 10*** and that you actually set: $a = 1, a = 5, a = 10$.

   Income of B if a = 1:

   Income of B if a = 5:

   Income of B if a = 10:

   b) Calculate your own income under the same assumptions (***P = 35***, $a^* = 2, b^* = 10,$ ***b = 10***, and the respective levels of *a*):

   Your income if a = 1:

   Your income if a = 5:

   Your income if a = 10:

3. You have made a sales offer with ***P = 55*** to the respective B-participant, that was rejected. What is your income and the income of participant B?

   Your income:

   Income of B:

4. You kept your 50% share of the *TR* and set $a^* = 10$ and $b^* = 10$. Participant B chooses ***b = 1*** and you choose ***a = 1***. What is now your income and the income of participant B?

   Your income:

   Income of B:

5. You kept your 50% share of the *TR* and set $a^* = 10$ and $b^* = 10$. Participant B chooses ***b = 10*** and you choose ***a = 10***. What is now your income and the income of participant B?

   Your income:

   Income of B:

6. You kept your 50% share of the *TR* and set $a^* = 10$ und $b^* = 10$. Participant B chooses ***b = 7***. What is your income if you choose a = 2, a = 7, a = 10.

   Your income if a = 2:

   Your income if a = 7:

   Your income if a = 10:

7. You kept your 50% share of the *TR* and set $a^* = 10$ und $b^* = 10$. You choose an actual investment of ***a = 7***. What is your income if participant B sets: b = 2, b = 7, b = 10.

   Your income if b = 2:

   Your income if b = 7:

   Your income if b = 10:

After you answered all questions correctly, please take a look at all questions and results simultaneously.
Thereafter, think carefully about your decisions in the first period.

1.7 Appendix

In this Appendix we analyze the three different experimental designs by using the Fehr-Schmidt (1999) model of inequity aversion. Throughout, we make the following assumptions:

- The utility function of each player is given by
$$U_i(x_i, x_j) = x_i - \alpha_i \cdot \max\left\{x_j - x_i, 0\right\} - \beta_i \cdot \max\left\{x_i - x_j, 0\right\},$$
- 60% of all players are self-interested with $\alpha_i = \beta_i = 0$.
- 40% of all players are fair-minded with $\alpha_i = 2$ and $0.5 < \beta_i < 1$.
- There is incomplete information about the other player's type. The initial prior of each player is given by the distribution assumed above.
- The gross surplus function is given by $v(a,b) = 22 \cdot (a+b)$ and the cost functions are given by $c_A(a) = 12a$ and $c_B(b) = 12b$, with $a \in \{1,...,10\}$ and $b \in \{1,...,10\}$.

The distribution of preferences corresponds to the distribution of preferences assumed in Fehr and Schmidt (1999) and Fehr, Klein and Schmidt (2003). The propositions of the chapter follow immediately from the propositions proved here.

1.7.1 Analysis of the A-Ownership Design (AOD)

The time structure of the "A Ownership Design" is as follows:

- Stage 0a: A decides whether to remain the sole owner and to hire B as an employee at some wage T, or whether to make B a partner who participates in 50% of the revenues of the firm.
- Stage 0b: B decides whether to accept or reject the offer. If she rejects, both parties get a payoff of 0. If she accepts, the game moves to stage 1.
- Stage 1: B decides on how much effort, b, to invest into the firm.
- Stage 2: A, after she has observed b, decides on her effort level, a.

We impose the following condition on B's beliefs.

Condition A.1 *If A offers a joint ownership contract and gives away half of the revenues of the firm to B, then B's updated belief that he faces the self-interested type of A does not increase.*

Theorem A.1 [A-Ownership Design]

There exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition A.1.

- *The equilibrium is a pooling equilibrium in which both types of A offer a joint ownership contract which is accepted by both types of B.*
- *The self-interested type of B chooses $b^s = 10$, while the fair-minded type of B chooses $b^f = 1$. The self-interested type of A chooses $a^s = 1$ and the fair-minded type of A chooses $a^f = b$ in equilibrium.*
- *Expected monetary payoffs are $M^{As} = 69.4$ for the self-interested type of A and $M^{Af} = 64$ for the fair-minded type of A, so the average monetary payoff of A is $M^A = 67.24$. The expected monetary payoff of the self-interested type of B is $M^{Bs} = 40.6$ and of the fair-minded type of B is $M^{Bf} = 10$, so in expectation $M^B = 28.36$.*

The proof is in several steps. First, we analyze the different types of contracts separately. However, because the contractual offer by A at stage 0 may be interpreted as a signal about her type, we have to do this for all possible beliefs p that B may attach to the event that he faces the self-interested type of A. Then, we analyze the full game and consider all possible equilibrium candidates.

A-Ownership: Suppose that A chose to stick to A-ownership and offered a "wage" T to B. At stage 2, a self-interested type of A chooses a to maximize

$$U^{As} = 22 \cdot (a+b) - 12a - T = 10a + 22b - T \ .$$

Clearly, it is optimal for her to choose $a^s = 10$. The fair-minded type of A chooses a to maximize

$$U^{Af} = 10a + 22b - T - \alpha \max\{2T - 10a - 34b, 0\} - \beta \max\{10a + 34b - 2T, 0\}.$$

Given that $\beta < 1$, the fair-minded type of A also chooses $a^f = 10$. Thus, under A-ownership, it is a dominant strategy for both types of A to choose $a = 10$.

Consider now stage 1. Anticipating A's reaction, the self-interested type of B chooses b to maximize

$$U^{Bs} = T - 12b$$

which implies $b^s = 1$. The fair-minded type of B maximizes

$$U^{Bf} = T - 12b - \alpha \max\{34b + 100 - 2T, 0\} - \beta \max\{2T - 34b - 100, 0\}.$$

Thus, if $T \le 67$, the fair-minded type of B chooses $b^f = 1$. If $T > 67$ he chooses b^f so as to equalize payoffs, i.e., $b^f = \dfrac{2T - 100}{34}$.

Consider now stage 0b. The self-interested type of B will accept the contract if and only if $T \ge 12$. The fair-minded type of B clearly accepts any contract with $T \ge 67$. If $T < 67$ he accepts if and only if

$$T - 12b - \alpha(34b + 100 - 2T) > 0.$$

Noting that he chooses $b^f = 1$ in this case and that $\alpha = 2$, this is equivalent to

$$T \ge \frac{12 + 268}{1 + 4} = 56.$$

At stage 0a, if the self-interested type of A offers $T = 12$, this will only be accepted by the self-interested type of B, so her expected payoff is $0.6(22 + 100 - 12) = 66$. If she offers $T = 56$, this will be accepted by both types of B, so her payoff will also be $22 + 100 - 56 = 66$. Therefore A is just indifferent between offering $T = 12$ and offering $T = 56$. Let us assume that in the case of indifference A will make an offer that is accepted by both types of B. Offering more than 56 is not worth her while, because

$$0.6(22 + 100 - T) + 0.4\left(22\frac{2T - 100}{34} + 100 - T\right)$$

is strictly decreasing in T. Hence, the self-interested type of A will offer $T^{As}=56$ which yields a monetary payoff of $M^{As}=66$ for her. Both types of B accept and get a monetary payoff of $M^{B}=56-12=44$. The fair-minded type of A wants to equalize payoffs. Hence, she will offer $T=67$ which yields a payoff of $M^{Af}=22+100-67=55$ to A for sure. $M^{B}=67-12=55$ for both types of B.

This is summarized in the following proposition:

Proposition A.1.1 [A-ownership]

(a) *A self-interested type of A offers* $T=56$*, while a fair-minded type of A offers* $T=67$*. Both offers are accepted by both types of B. Both types of B choose* $b=1$*, while both types of A choose* $a=10$*.*

(b) *The monetary payoff of the self-interested type of A is* $M^{As}=66$ *and of the fair-minded type of A is* $M^{Af}=55$*. B's monetary payoff (for both types) is* $M^{B}=44$ *if he faces the self-interested type of A and* $M^{B}=55$ *if he faces the fair-minded type of A, which gives him in expected terms* $M^{B}=p44+(1-p)55$*.*

Joint Ownership Contracts: Suppose now that A offered a joint ownership contract. At stage 2, a self-interested type of A chooses a to maximize

$$U^{As}=\frac{1}{2}\cdot 22\cdot(a+b)-12a=11b-a.$$

Thus, it is optimal to choose $a^{s}=1$. The fair-minded type of A chooses a to maximize

$$U^{Af}=11b-a-\alpha\cdot\max\{11a-b-11b+a,0\}-\beta\cdot\max\{11b-a-11a+b,0\}.$$

Clearly, A will never choose $a>b$. If $\beta>\frac{1}{12}$, the fair-minded type of A will choose $a^{f}=b$.

Consider now stage 1. Anticipating A's reaction, the self-interested type of B chooses b to maximize

$$\begin{aligned} EU^{Bs} &= p \cdot (11a^s - b) + (1-p) \cdot (11a^f - b) \\ &= p \cdot (11 - b) + (1-p) \cdot (11b - b) = 11p + 10b - 11pb. \end{aligned}$$

Thus, if $p < \frac{10}{11}$, he chooses $b^s = 10$, if $p > \frac{10}{11}$, he chooses $b^s = 1$. The fair-minded type of B, on the other hand, maximizes

$$\begin{aligned} EU^{Bf} &= p \cdot \left[11a^s - b - \alpha(12b - 12a^s)\right] + (1-p) \cdot \left[11a^f - b\right] \\ &= p \cdot \left[11 - b - \alpha(12b - 12)\right] + (1-p) \cdot \left[11b - b\right] \\ &= 11p + 12\alpha p + 10b - 12b\alpha p - 11bp. \end{aligned}$$

Substituting $\alpha = 2$ and differentiating with respect to b yields

$$\frac{dEU^{Bf}}{db} = 10 - 35p.$$

Thus, if $p < \frac{10}{35}$, the fair-minded type of B chooses $b^f = 10$, if $p > \frac{10}{35}$, he chooses $b^f = 1$.

The next proposition summarizes the equilibrium of the continuation game with joint ownership:

Proposition A.1.2 [Joint Ownership]

The self-interested type of A always chooses $a^s = 1$, while the fair-minded type of A chooses $a^f = b$. Depending on B's belief about the probability that he faces a self-interested type of A, we have to distinguish five cases.

1. *If $0 \le p < \frac{10}{35}$, both, the fair-minded and the self-interested type of B choose $b^f = b^s = 10$. In this case the monetary payoffs are $M^{As} = 109$ for the self-interested type of A and $M^{Af} = 100$ for the fair-minded type of A.*
2. *If $p = \frac{10}{35}$, the fair-minded type of B is indifferent between all levels of b and the self-interested type of B chooses $b^s = 10$.*

3. *If* $\frac{10}{35} < p < \frac{10}{11}$*, the fair-minded type of B chooses* $b^f = 1$ *and the self-interested type of B chooses* $b^s = 10$*. In this case the monetary payoffs of A are* $M^{As} = 69.4$ *for the self-interested type of A and* $M^{Af} = 64$ *for the fair-minded type of A.*
4. *If* $p = \frac{10}{11}$*, the fair-minded type of B chooses* $b^f = 1$ *and the self-interested type of B is indifferent between all levels of* b*.*
5. *If* $\frac{10}{11} < p \leq 1$*, the fair-minded type of B chooses* $b^f = 1$ *and the self-interested type of B chooses* $b^s = 1$*. In this case the monetary payoffs are* $M^{As} = 10$ *for the self-interested type of A and* $M^{Af} = 10$ *for the fair-minded type of A.*

We now turn to the analysis of the entire game.

Lemma A.1 *There does not exist a separating equilibrium.*

Proof: Suppose there is a separating equilibrium in which the self-interested type of A chooses A-ownership and the fair-minded type of A chooses joint ownership. In such an equilibrium the self-interested type of A would get a payoff of 66. However, if she offers a joint ownership contract, B believes that he faces a fair-minded type of A with probability one. Therefore, by Proposition A.1.2, both types of B choose $b = 10$, and the self-interested type of A could get a monetary payoff 109. Hence, the self-interested type of A has an incentive to deviate, a contradiction.

Similarly, suppose that there is a separating equilibrium in which the self-interested type of A chooses joint ownership while the fair-minded type of A chooses A-ownership. In this case B believes that he faces the self-interested type of A with probability one if he is offered joint ownership, so both types of B will choose $b = 1$ and the self-interested type of A gets a payoff of 10. If she deviates and sticks to A-ownership, she can guarantee herself a payoff of 66. Hence, she has an incentive to deviate, a contradiction. *Q.E.D.*

Lemma A.2 *There does not exist a pooling equilibrium satisfying Condition A.1 in which both types of A stick to A-ownership.*

Proof: Suppose to the contrary that both types of A stick to A-ownership in equilibrium. In this case the fair-minded type of A will get a payoff of 55. If she deviates and offers joint ownership, B's belief that he faces a self-interested type of A cannot increase (by Condition A.1), so $p \leq 0.6$. Hence, the fair-minded type of A will get a payoff of at least 64 from joint ownership, which induces her to deviate, a contradiction. *Q.E.D.*

Lemma A.3 *There does not exist a semi-separating equilibrium satisfying Condition A.1 in which the self-interested type of A chooses one type of ownership with probability one and the fair-minded type of A chooses this type of ownership with a probability smaller than one.*

Proof: Suppose the self-interested type of A chooses A-ownership with probability one, while the fair-minded type of A chooses A-ownership with probability q and joint ownership with probability $1-q$, $0<q<1$. If B is offered joint ownership, he concludes that he faces the fair-minded type of A with probability one and chooses $b=10$ which induces the self-interested type of A to deviate.

Now suppose that the self-interested type of A chooses joint ownership with probability one, while the fair-minded type of A chooses A-ownership with probability $q>0$ and joint ownership with probability $1-q$. Then, by Bayes' rule, if B is offered joint ownership, he must conclude that the probability that he faces the self-interested type of A is larger than 0.6, a contradiction to Condition A.1. *Q.E.D.*

Lemma A.4 *There does not exist a semi-separating equilibrium satisfying Condition A.1 in which the fair-minded type of A chooses one type of ownership with probability one and the self-interested type of A chooses this type of ownership with a probability smaller than one.*

Proof: Suppose the fair-minded type of A chooses A-ownership with probability one, while the self-interested type of A chooses A-ownership with probability q and joint ownership with probability $1-q$, $0<q<1$. If B is offered joint ownership, he concludes that he faces the self-interested type of A with probability one, so the self-interested type of A would get a payoff of 10, less than the 66 that she could guarantee herself from offering a wage contract, a contradiction to the assumption that the self-interested type of A is indifferent between A- and joint ownership.

Suppose finally that the fair-minded type of A chooses joint ownership with probability one, while the self-interested type of A chooses A-ownership with probability $q>0$ and joint ownership with probability $1-q$. If B observes joint ownership, the updated probability that he faces the self-interested type of A is smaller than 0.6. Hence, by Proposition A.1.2, the self-interested type of A gets a payoff from joint ownership that is at least 69.4, while she only gets 66 from sticking to A-ownership, a contradiction to the assumption that she is indifferent between the two ownership structures. *Q.E.D.*

Hence, the only remaining equilibrium candidate satisfying Condition A.1 is the pooling equilibrium described in Theorem A.1. It remains to check that this is indeed an equilibrium.

Suppose that in equilibrium both types of A choose joint ownership with probability one. Thus, if joint ownership is offered, B still believes that he faces the self-interested type of A with probability $p=0.6$. Hence, by Proposition A.1.2, the self-interested type of A gets an expected monetary payoff of $M^{As}=69.4$. The fair-minded type of A chooses $a^f=b$, so that there is no inequality and her utility equals her monetary payoff of $M^{Af}=64$. If A deviates and chooses to stick to A-ownership, then, independent of B's updated belief about A's type, the self-interested type of A gets a payoff of 66 and the fair-minded type of A gets a payoff of 55 (see Proposition A.1.1). Hence, neither of them has an incentive to deviate. This completes the proof of Theorem A.1.

1.7.2 Analysis of the Joint Ownership Design (JOD)

Consider the following sequence of events:

- Stage 0a: A may either offer to sell her share of the firm to B at a fixed price T or to stick with joint ownership where each party gets 50% of the revenues.
- Stage 0b: If A offered to sell her share, B has to decide whether to accept or to reject the offer. If he accepts, we have B-ownership and A gets a fixed payment T. If he rejects, the game ends and both players get a payoff of 0.
- Stage 1: B chooses b.
- Stage 2: A chooses a.

We impose the following condition which corresponds to Condition A.1:

Condition A.2 *If A chooses to stick to joint ownership, then B's updated belief that he faces the self-interested type of A does not increase.*

Theorem A.2 [Joint Ownership Design]
There exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition A.2.

- *The equilibrium is a pooling equilibrium in which both types of A stick to joint ownership.*
- *The self-interested type of B chooses $b^s = 10$, while the fair-minded type of B chooses $b^f = 1$. The self-interested type of A chooses $a^s = 1$ and the fair-minded type of A chooses $a^f = b$ in equilibrium.*
- *Expected monetary payoffs are $M^{As} = 69.4$ for the self-interested type of A and $M^{Af} = 64$ for the fair-minded type of A, so the average monetary payoff of A is $M^A = 67.24$. The expected monetary payoff of the self-interested type of B is $M^{Bs} = 40.6$ and of the fair-minded type of B is $M^{Bf} = 10$, which gives on average $M^B = 28.36$ for player B.*

To prove the theorem consider first a continuation game with joint ownership. Let p denote the probability assigned by B to the event that A is self-interested. Note that, as in Section 1.6.1, p is determined endogenously because B may learn something about A's type when he observes that A did not sell her share. In fact, the analysis is exactly the same as the analysis of the joint ownership game in Section 1.6.1, and Proposition A.1.2 applies.

Consider now the continuation game after B accepted to buy A's share of the firm at price T. Note that the analysis here is slightly different from the analysis of "A-ownership" in the first section, because now B (who moves first in the investment game) is full residual claimant on the margin. However, as will become transparent in a moment, this is not going to affect the results.

At stage 1 it is a dominant strategy for both types of B to choose $b = 10$, no matter what A does at stage 2. If B is self-interested, then his payoff is given by

$$U^{Bs} = 22\left(a+b\right) - 12b - T = 22a + 10b - T$$

so it is clearly optimal to choose $b^s = 10$. If B is fair-minded, then he chooses b to maximize

$$U^{Bf} = 22(a+b) - 12b - T - \alpha \max\left\{2T - 34a - 10b, 0\right\} - \beta \max\left\{34a + 10b - 2T, 0\right\}$$

which is strictly increasing in b as long as $\beta < 1$. Hence, $b^f = 10$ as well.

At stage 2, the self-interested type of A always chooses $a^s = 1$. The fair-minded type of A chooses a to maximize

$$U^{Af} = T - 12a - \alpha \max\left\{34a + 10b - 2T, 0\right\} - \beta \max\left\{2T - 34a - 10b, 0\right\}.$$

Substituting $b = 10$, we get

$$\frac{dU^{Af}}{da^f} = \begin{cases} -12 - 34\alpha & if\, 100 + 34a - 2T \geq 0 \\ -12 + 34\beta & if\, 100 + 34a - 2T < 0. \end{cases}$$

Thus, we get

$$a^f = \begin{cases} 1 & if \quad T < 67 \\ \dfrac{2T-100}{34} & if \quad 67 \le T \le 220 \\ 10 & if \quad T > 220. \end{cases}$$

Hence, monetary payoffs under B-ownership are given by

$$M^{As} = T - 12,$$

$$M^{Af} = \begin{cases} T-12 & if \quad T < 67 \\ \dfrac{10T+1200}{34} & if \quad 67 \le T \le 220 \\ T-120 & if \quad T > 220 \end{cases}$$

$$M^{Bs} = M^{Bf} = 100 - T + 22\left[p + (1-p)a^f\right]$$

$$= \begin{cases} 122-T & if \quad T < 67 \\ \dfrac{1200+10T+2948p-44pT}{34} & if \quad 67 \le T \le 220 \\ 320-T-198p & if \quad T > 220. \end{cases}$$

We now turn to the analysis of the entire game.

Lemma A.5 *There does not exist a separating equilibrium.*

Proof: Suppose there is a separating equilibrium in which the self-interested type of A offers to sell at price T and the fair-minded type of A chooses to stick to joint ownership. If A sticks to joint ownership, B knows for sure that he faces the fair-minded type of A, so $p = 0$, and B will choose $b = 10$. Hence, if the self-interested type of A mimics the fair-minded type and chooses to stick to joint ownership as well, she would get a payoff of 109 (see Proposition A.1.2). On the other hand, if A offers to sell at price T, B knows that she faces the self-interested type with probability 1. If B rejects the offer, both players get a monetary payoff of 0. Therefore, the self-interested type of B accepts T if and only if

$$122 - T \ge 0 \Leftrightarrow T \le 122.$$

The fair-minded type of B accepts T if and only if

$$122 - T - \alpha\left[T - 12 - 122 + T\right] \geq 0.$$

Substituting $\alpha = 2$, the fair-minded type of B accepts T if and only if

$$T \leq 78.$$

Thus, A is just indifferent whether to offer a price $T = 78$ which is accepted by both types of B and yields a monetary payoff of $M^{As}\left(T = 78\right) = 78 - 12 = 66$ or to offer $T = 122$ which is accepted only by the self-interested agent and yields an expected monetary payoff of $M^{As}\left(T = 122\right) = 0.6\left(122 - 12\right) + 0.4 \cdot 0 = 66$. However, 66 is strictly smaller than 109 which she could get by mimicking the fair-minded type, a contradiction.

Similarly, suppose that there is a separating equilibrium in which the self-interested type of A chooses to stick to joint ownership while the fair-minded type of A offers to sell at price T. In this case B infers from not getting an offer T that he faces the self-interested type of A with probability 1, so the outcome of the joint ownership game yields a payoff of 10 for each party. On the other hand, we have just seen that the self-interested type of A could guarantee himself a payoff of 66 by offering to sell her share to B at price $T = 78$ which would be accepted by both types of B, even if this offer revealed that A is self-interested. Hence, the self-interested type of A has an incentive to deviate, a contradiction. *Q.E.D.*

Lemma A.6 *There does not exist a pooling equilibrium satisfying Condition A.2 in which both types of A offer to sell their share of the firm.*

Proof: Suppose now that both types of A offer to sell their share in equilibrium. Note first, that it cannot be the case that the self-interested type of A tries to sell at a different price than the fair-minded type of A. In this case the self-interested type of A would get a payoff of at most 66. If she deviates and sticks to joint ownership, Condition A.2 implies that B's updated probability that he faces the self-interested type of A cannot go up. Therefore, by Proposition A.1.2, the self-interested type of A would get an expected payoff of 69.4, which induces her to deviate.

Hence, selling their share can only be an equilibrium if both types of A sell at the same price T. It turns out that the highest price at which the fair-minded type of B is willing to buy is $T = 86.1$, while the highest price at which the self-interested type of B is willing to buy is $T = 181.02$. Suppose both types of A offer to sell at $T = 86$. In this case both types of B accept and choose $b = 10$. The self-interested type of A chooses $a^s = 1$ and gets $M^{As} = 74$. The fair-minded type of A chooses $a^f = \frac{2T - 100}{34} = 2.1$ (which equalizes payoffs) and gets $M^{Af} = 85 - 24 = 62$. However, if the fair-minded type would deviate and stick to joint ownership, then B's belief that he faces the self-interested type cannot be larger than 0.6 (by Condition A.2), so the fair-minded type of player A would get a payoff of 64, which is strictly larger than 62, a contradiction. Finally, suppose that both types of A offer $T = 181$. This would only be accepted by the self-interested type of B. The fair-minded type of B would reject and force payoffs of 0 for both parties. If A's offer was accepted, a fair-minded A would choose $a^f = \frac{2 \cdot 181 - 100}{34} = 7.7$ and get $181 - 7.7 \cdot 12 = 88.6$. Hence, her expected payoff would be $M^{Af} = 0.6 \cdot 88.6 + 0.4 \cdot 0 = 53.16$ which is strictly less than what she would get if she sticks to joint ownership at stage 0, a contradiction. *Q.E.D.*

Lemma A.7 *There does not exist a semi-separating equilibrium satisfying Condition A.2 in which the self-interested type of A chooses one contract with probability one and the fair-minded type of A chooses this contract with a probability smaller than one.*

<u>Proof:</u> Suppose the self-interested type of A chooses to sell her share with probability one, while the fair-minded type of A chooses to sell with probability q and to stick to joint ownership with probability $1-q$, $0 < q < 1$. If B is offered the joint ownership

contract, he concludes that he faces the fair-minded type of A with probability one and chooses $b = 10$ which induces the self-interested type of A to deviate.

Suppose that the self-interested type of A chooses to stick to joint ownership with probability one, while the fair-minded type of A chooses to sell with probability q and to stick to joint ownership contract with probability $1-q$. Thus, by Bayes' rule, if A sticks to joint ownership, B must conclude that the probability that she faces the self-interested type of A must be larger than 0.6, a contradiction to Condition A.2. *Q.E.D.*

Lemma A.8 *There does not exist a semi-separating equilibrium satisfying Condition A.2 in which the fair-minded type of A chooses one contract with probability one and the self-interested type of A chooses this contract with a probability smaller than one.*

Proof: Suppose the fair-minded type of A chooses to sell with probability one, while the self-interested type chooses to sell with probability q and to stick to joint ownership with probability $1-q$, $0 < q < 1$. If A sticks to joint ownership, B concludes that she faces the self-interested type of A with probability one, so the self-interested type of A would get a payoff of 10, less than the 66 that she could guarantee herself from offering to sell her share at price $T = 78$, a contradiction to the assumption that the self-interested type of A is indifferent between selling and sticking to joint ownership.

Suppose that the fair-minded type of A chooses to stick to joint ownership with probability one, while the self-interested type of A offers to sell with probability q and to stick to joint ownership with probability $1-q$. If A sticks to joint ownership, the updated probability that B faces the self-interested type of A is smaller than 0.6. Hence, by Proposition A.1.2, the self-interested type of A gets a payoff from a joint ownership contract that is at least 69.4, while she only gets 66 from offering to sell her share, a contradiction to the assumption that she is indifferent between her two options. *Q.E.D.*

Hence, the only remaining equilibrium candidate satisfying Condition A.2 is the pooling equilibrium described in Theorem A.2. It remains to check that this is indeed an equilibrium.

Suppose that in equilibrium both types of A choose to stick to joint ownership with probability one. Thus, if A sticks to joint ownership B continues to believes that he faces the self-interested type of A with probability $p = 0.6$. Hence, by Proposition A.1.2, the self-interested type of A will get an expected monetary payoff of $M^{As} = 69.4$. The fair-minded type of A will choose $a^f = b$, so there is no inequality and her utility equals her monetary payoff of $M^{Af} = 64$.

Now suppose that as soon as B observes a deviation from equilibrium, i.e. A makes a sales offer at stage 0, B's up-dated belief that he faces a self-interested type of A is equal to one. Given this out of equilibrium belief, no type of A has an incentive to deviate from the equilibrium. The self-interested type of A would - in case of a deviation - offer $T = 78$, which is accepted by both types of B and yields a payoff of 66. 66 however is less than 69.4, what he gets in equilibrium. The fair-minded type of A would - in case of a deviation - also offer $T = 78$, which is accepted by both types of B and yields a payoff strictly between 57.2 and 58, depending on β. This however is less than 64, what he gets in equilibrium. Hence, neither of the two types has an incentive to deviate. This completes the proof of Theorem A.2.

1.7.3 Analysis of the Control Treatment of the Joint Ownership Design (JOD')

The time structure of this game is as follows:

- Stage 0a: A may either offer to sell her share of the firm to B at a fixed price T or to stick with joint ownership where each party gets 50% of the revenues.
- Stage 0b: If A offered to sell her share, B has to decide whether to accept or to reject the offer. If he accepts, we have B-ownership and A gets a fixed payment T. If he rejects, or if A did not offer to sell her share of the firm, we have joint ownership.
- Stage 1: B chooses b.
- Stage 2: A chooses a.

Theorem A.3 [Joint Ownership Design]

There exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition A.2.

- *The equilibrium is a pooling equilibrium in which both types of A stick to joint ownership.*
- *The self-interested type of B chooses $b^s = 10$, while the fair-minded type of B chooses $b^f = 1$. The self-interested type of A chooses $a^s = 1$ and the fair-minded type of A chooses $a^f = b$ in equilibrium.*
- *Expected monetary payoffs are $M^{As} = 69.4$ for the self-interested type of A and $M^{Af} = 64$ for the fair-minded type of A, so the average monetary payoff of A is $M^A = 67.24$. The expected monetary payoff of the self-interested type of B is $M^{Bs} = 40.6$ and of the fair-minded type of B is $M^{Bf} = 10$, which gives on average $M^B = 28.36$ for player B.*

To prove the theorem consider first a continuation game with joint ownership. Let p denote the probability assigned by B to the event that A is self-interested. Note that, as in Section 1.6.1, p may differ depending on whether this continuation game was reached after B rejected an offer by A or whether it was reached because A chose to have joint ownership. In fact, the analysis is exactly the same as the analysis of the joint ownership game in Section 1.6.1, and Proposition A.1.2 applies.

Consider now the continuation game after B accepted to buy A's share of the firm at price T. Note that the analysis here is slightly different from the analysis of "A-ownership" in the previous section 1.6.1, because now B (who moves first in the investment game) is full residual claimant on the margin. Furthermore, if B rejects the offer, the game does not end with payoffs of zero for both players as was the case in section 1.6.2, but we are rather back to joint ownership. However, as will become transparent in a moment, this is not going to affect the results.

At stage 1 it is a dominant strategy for both types of B to choose $b = 10$, no matter what A does at stage 2. If B is self-interested, then his payoff is given by

$$U^{Bs} = 22(a+b) - 12b - T = 22a + 10b - T$$

so it is clearly optimal to choose $b^s = 10$. If B is fair-minded, then he chooses b to maximize

$$U^{Bf} = 22(a+b) - 12b - T - \alpha \max\{2T - 34a - 10b, 0\} - \beta \max\{34a + 10b - 2T, 0\}$$

which is strictly increasing in b as long as $\beta < 1$. Hence, $b^f = 10$ as well.

At stage 2, the self-interested type of A always chooses $a^s = 1$. The fair-minded type of A chooses a to maximize

$$U^{Af} = T - 12a - \alpha \max\{34a + 10b - 2T, 0\} - \beta \max\{2T - 34a - 10b, 0\}.$$

Substituting $b = 10$, we get

$$\frac{dU^{Af}}{da^f} = \begin{cases} -12 - 34\alpha & \text{if } 100 + 34a - 2T \geq 0 \\ -12 + 34\beta & \text{if } 100 + 34a - 2T < 0. \end{cases}$$

Thus, we get

$$a^f = \begin{cases} 1 & \text{if} \quad T < 67 \\ \dfrac{2T - 100}{34} & \text{if} \quad 67 \leq T \leq 220 \\ 10 & \text{if} \quad T > 220. \end{cases}$$

Hence, monetary payoffs under B-ownership are given by

$$M^{As} = T - 12,$$

$$M^{Af} = \begin{cases} T - 12 & \text{if} \quad T < 67 \\ \dfrac{10T + 1200}{34} & \text{if} \quad 67 \leq T \leq 220 \\ T - 120 & \text{if} \quad T > 220 \end{cases}$$

$$\begin{aligned} M^{Bs} = M^{Bf} &= 100 - T + 22\left[p + (1-p)a^f\right] \\ &= \begin{cases} 122 - T & \text{if} \quad T < 67 \\ \dfrac{1200 + 10T + 2948p - 44pT}{34} & \text{if} \quad 67 \leq T \leq 220 \\ 320 - T - 198p & \text{if} \quad T > 220. \end{cases} \end{aligned}$$

We now turn to the analysis of the entire game.

Lemma A.9 *There does not exist a separating equilibrium.*

Proof: Suppose there is a separating equilibrium in which the self-interested type of A offers to sell at price T and the fair-minded type of A chooses to stick to joint ownership. If A sticks to joint ownership, B knows for sure that he faces the fair-minded type of A, so $p=0$, and B will choose $b=10$. Hence, if the self-interested type of A mimics the fair-minded type and chooses to stick to joint ownership as well, she would get a payoff of 109 (see Proposition A.1.2). On the other hand, if A offers to sell at price T, B knows that she faces the self-interested type with probability 1. If B rejects the offer, we are in a continuation game with joint ownership and $p=1$, so (by Proposition A.1.2) both players get a monetary payoff of 10. Therefore, the self-interested type of B accepts T if and only if

$$122-T \geq 10 \Leftrightarrow T \leq 112.$$

The fair-minded type of B accepts T if and only if

$$122-T-\alpha\left[T-12-122+T\right] \geq 10.$$

Substituting $\alpha=2$, the fair-minded type of B accepts T if and only if

$$T \leq 76.$$

Thus, A is indifferent between offering a price $T=76$ which is accepted by both types of B and yields a monetary payoff of $M^{As}\left(T=76\right)=76-12=64$ or to offer $T=112$ which is accepted only by the self-interested agent and yields an expected monetary payoff of $M^{As}\left(T=112\right)=0.6\left(112-12\right)+0.4\cdot 10=64$. However, any of these payoffs is strictly smaller than 109 which she could get by mimicking the fair-minded type, a contradiction.

Similarly, suppose that there is a separating equilibrium in which the self-interested type of A chooses to stick to joint ownership while the fair-minded type of A offers to sell at price T. In this case B infers from not getting an offer T that he faces the self-interested type of A with probability 1, so the outcome of the joint ownership game yields a payoff of 10 for each party. On the other hand, we have just seen that the self-interested type of A could guarantee himself a payoff of 64 by offering to sell her share to B at price $T = 76$ which would be accepted by both types of B, even if this offer revealed that A is self-interested. Hence, the self-interested type of A has an incentive to deviate, a contradiction. *Q.E.D.*

Lemma A.10 *There does not exist a pooling equilibrium satisfying Condition A.2 in which both types of A offer to sell their share of the firm.*

Proof: Suppose now that both types of A offer to sell their share in equilibrium. It cannot be the case that the self-interested type of A tries to sell at a different price than the fair-minded type of A. In this case the self-interested type of A would get a payoff of 64 by offering $T = 76$. If she deviates and sticks to joint ownership, Condition A.2 implies that B's updated probability that he faces the self-interested type of A cannot go up. Therefore, by Proposition A.1.2, the self-interested type of A would get an expected payoff of 69.4, which induces her to deviate.

Hence, selling their share can only be an equilibrium if both types of A sell at the same price T. It turns out that the highest price at which the fair-minded type of B is willing to buy is $T = 82.6$, while the highest price at which the self-interested type of B is willing to buy is $T = 160.3$. Suppose both types of A offer to sell at $T = 82$. In this case both types of B accept and choose $b = 10$. The self-interested type of A chooses $a^s = 1$ and gets $M^{As} = 70$. The fair-minded type of A chooses $a^f = \frac{2T - 100}{34} = 1.88$ (which equalizes payoffs) and gets $M^{Af} = 82 - 12 \cdot 1.88 = 59.44$. However, if the fair-minded type would deviate and stick to joint ownership, then B's belief that he faces the self-interested type cannot be larger than 0.6 (by Condition A.2), so the fair-minded type of player A would get a payoff of 64, which is strictly larger than 59.44, a contradiction. Finally, suppose that both types of A offer $T = 160$. This would only be accepted by the self-interested type of B. The fair-minded type of B would reject and then choose $b^f = 1$ in the continuation game with joint ownership. Hence, in this continuation game, the fair-minded type of A would get 10. If her offer was accepted, she would choose $a^f = \frac{2 \cdot 160 - 100}{34} = 6.4$ and get $160 - 6.4 \cdot 12 = 83.2$. Hence, her expected payoff would be $M^{Af} = 0.6 \cdot 83.2 + 0.4 \cdot 10 = 53.92$ which is strictly less than what she would get if she sticks to joint ownership at stage 0, a contradiction. *Q.E.D.*

Lemma A.11 *There does not exist a semi-separating equilibrium satisfying Condition A.2 in which the self-interested type of A chooses one contract with probability one and the fair-minded type of A chooses this contract with a probability smaller than one.*

Proof: Suppose the self-interested type of A chooses to sell her share with probability one, while the fair-minded type of A chooses to sell with probability q and to stick to joint ownership with probability $1-q$, $0<q<1$. If B is offered the joint ownership contract, he concludes that he faces the fair-minded type of A with probability one and chooses $b=10$ which induces the self-interested type of A to deviate.

Suppose that the self-interested type of A chooses to stick to joint ownership with probability one, while the fair-minded type of A chooses to sell with probability q and to stick to joint ownership contract with probability $1-q$. Thus, by Bayes' rule, if A sticks to joint ownership, B must conclude that the probability that she faces the self-interested type of A must be larger than 0.6, a contradiction to Condition A.2. *Q.E.D.*

Lemma A.12 *There does not exist a semi-separating equilibrium satisfying Condition A.2 in which the fair-minded type of A chooses one contract with probability one and the self-interested type of A chooses this contract with a probability smaller than one.*

Proof: Suppose the fair-minded type of A chooses to sell with probability one, while the self-interested type chooses to sell with probability q and to stick to joint ownership with probability $1-q$, $0<q<1$. If A sticks to joint ownership, B concludes that she faces the self-interested type of A with probability one, so the self-interested type of A would get a payoff of 10, less than the 64 that she could guarantee herself from offering to sell her share at price $T=76$, a contradiction to the assumption that the self-interested type of A is indifferent between selling and sticking to joint ownership.

Suppose that the fair-minded type of A chooses to stick to joint ownership with probability one, while the self-interested type of A offers to sell with probability q and to stick to joint ownership with probability $1-q$. If A sticks to joint ownership, the updated probability that B faces the self-interested type of A is smaller than 0.6. Hence, by Proposition A.1.2, the self-interested type of A gets a payoff from a joint ownership contract that is at least 69.4, while she only gets 64 from offering to sell her share, a contradiction to the assumption that she is indifferent between her two options. *Q.E.D.*

Hence, the only remaining equilibrium candidate satisfying Condition A.2 is the pooling equilibrium described in Theorem A.3. It remains to check that this is indeed an equilibrium.

Suppose that in equilibrium both types of A choose to stick to joint ownership with probability one. Thus, if A sticks to joint ownership B continues to believes that he faces the self-interested type of A with probability $p=0.6$. Hence, by Proposition A.1.2, the self-interested type of A will get an expected monetary payoff of $M^{As}=69.4$. The fair-minded type of A will choose $a^f=b$, so there is no inequality and her utility equals her monetary payoff of $M^{Af}=64$.

Now suppose that as soon as B observes a deviation from equilibrium, i.e. A makes a sales offer at stage 0, B's up-dated belief that he faces a self-interested type of A is equal to one. Given this out-of-equilibrium belief, no type of A has an incentive to deviate from the equilibrium.

The self-interested type of A would - in case of a deviation - offer $T=76$, which is accepted by both types of B and yields a payoff of 64. 64 however is less than 69.4, what he gets in equilibrium. The fair-minded type of A would - in case of a deviation - also offer $T=76$, which is accepted by both types of B and yields a payoff strictly between 57 and 57.5, depending on β. This however is less than 64, what he gets in equilibrium. Hence, neither type of A has an incentive to deviate. This completes the proof of Theorem A.3.

CHAPTER 2

DISTRIBUTIONAL FAIRNESS, EFFICIENCY, AND THE EFFECT OF A STRATEGIC ENVIRONMENT

2.1 Introduction

Theories of social preferences have attracted a lot of attention recently. These theories provide a framework to account for the growing experimental evidence of the importance of fairness motives in human behavior. Among the most significant contributions are models based on reciprocity (Rabin, 1993, and Dufwenberg and Kirchsteiger, 2004), as well as models of inequity aversion which are based on distributional concerns (Fehr and Schmidt, 1999, henceforth FS, and Bolton and Ockenfels, 2000). Falk and Fischbacher (2000) and Charness and Rabin (2002, henceforth CR) provide a combination of reciprocal and distributional preferences.

Some researchers have taken those theories back to the experimental laboratories in order to test which of them reflect human behavior more accurately. Among those are Engelmann and Strobel (2004, henceforth ES), Falk et al. (2000) and Nelson (2002). One testable dimension along which the above mentioned theories differ is their treatment of distributional fairness.[27] In order to separate purely distributional concerns from reciprocity (i.e. intention-based fairness), ES construct experiments in which subjects have to decide between different allocations without any strategic interaction. They decide on how much money *other* players will get, with their own payoffs being fixed. This allows ES to take a direct look at distributional concerns. They find that, among the models of inequity aversion, FS does significantly better than Bolton and Ockenfels. Particularly, agents seem to suffer from disutility when their payoff differs from individual payoffs of members of their reference group (rather than from payoff-difference to the *average* payoff of the reference group). Overall, however, a combination of concerns for efficiency and maximin preferences (as modeled by Charness and Rabin in an intention-free context) outperforms inequity aversion in their experimental games.

This chapter tries to take a closer look at the workings of distributional fairness, using the results of experiments that we conducted at the University of Munich in 2003. In our experiments we employ three purely distributional games in the spirit of ES. We want to analyze how different experimental framings alter revealed preference for efficiency, equity and maximin. The chapter's purpose is threefold.

Firstly, we want to analyze how distributional fairness changes when there is real money at stake compared to a situation where payoffs are hypothetical. This is interesting because it investigates the question whether there is a difference between the way people theorize about fairness and the way they act when their doing actually has consequences. Furthermore, it sheds light on the controversy between economists and

[27] *Distributional* fairness describes how people evaluate the distributional outcome of an allocation (say, the amount of money that each individual in a society has). *Reciprocal* fairness describes how people evaluate the *intentions* that lead to actions that determine an allocation. Both types of fairness-considerations can induce people to sacrifice own payoffs: in the former case to achieve a fairer distribution, in the latter case to react in a fair way to the suspected intentions.

psychologists whether hypothetical experiments are acceptable devices in order to evaluate human behavior.

Secondly, we investigate a possible bias that abstract distribution experiments may have: in reality, even if purely distributional decisions without any strategic component were conceivable, they certainly would be preceded and followed by decisions that have strategic content as (arguably) most decisions in life are of that kind. In order to analyze whether putting subjects in a strategic environment alters the way they decide in distributional games, we let them play an otherwise unrelated strategic game, the ultimatum game, prior to the distribution games.

Our findings are that if real monetary payoffs are at stake, the efficient allocation was chosen significantly more often than the allocation that is best for maximin preferences. Our interpretation is that some people like to appear concerned about the poorest individual, but actually have a different view about what constitutes a fair allocation. Those people may decide for the maximin allocation if their doing has no material consequences, but may be tempted to go for more efficient allocations when this is not the case.

If subjects were put in a strategic environment, they played efficient allocations significantly less often, while they played maximin allocations significantly more often. That is, creating a "strategic mood" altered behavior insofar as concerns for the poorest increased. This implies that preferences for maximin may be stronger in reality than suggested by previous experimental studies.

Thirdly, we analyze the consistency of the decisions of each subject across different distribution games. The question here is whether there are patterns of play that make it possible to sort players into homogeneous groups. We find that 31.2% of the participants chose the efficient allocation in all games they played. 24.6% of the participants chose the maximin allocation in all games. Only 4.5% consistently went for the allocation that is most attractive for inequity averse players.[28]

This suggests that the theory of CR most accurately predicts people's preferences in pure distribution games. Along the lines of their paper one could argue that, if we do not take concerns for reciprocity into account, people have utility functions that are a weighted average of an efficiency term and a maximin term. Indeed, 55.8% of the subjects have a very strong preference for either efficiency or maximin. The rest could be interpreted as having intermediate preferences, where either maximin or efficiency may dominate, depending on the game at hand. It turns out, however, that this is not correct. We included a decision where efficiency and maximin call for the same choice by the participants. Contrary to the above claim, only 44.6% actually chose this allocation. This suggests that this interpretation of the intermediate group is not valid. Hence, we have a puzzle insofar as none of the leading theories of fairness is capable of explaining a substantive amount of choices by participants.

As a byproduct our experimental data confirm the previously established observation that males behave more efficiently than females. Female participants on the other hand act more in line with maximin preferences. This holds for distributional as well as for strategic fairness.

The outline of this chapter is as follows. In the next section we will introduce the experimental set-up. Section 2.3 presents the experimental results concerning the treatment effects. Section 2.4 then takes a look at the consistency of decisions within the distribution games. The last section concludes.

[28] This failure of inequity aversion to account for the experimental results in purely distributional settings not only shows up at this instance but also at various other points in this chapter. E.g. the change in allocations caused by different framing effects was always driven by efficiency and maximin preferences, but never by inequity aversion.

2.2 Experimental Set-up

The experiments reported in this chapter were conducted in January 2003 at the University of Munich with first year undergraduate students of economics and business administration. We did not recruit participants in advance. Instead, we visited several first year undergraduate economics classes at the beginning of class and asked for voluntary participation directly after class. As all students in the classes took part, there is no bias towards fairness among the participating subjects. Including an introductory speech and the explanation of the experimental instructions each session took about 15 to 25 minutes, depending on the treatment.

We conducted four different treatments that are explained in detail below. There were altogether 509 participants, at least 100 subjects per treatment. Each participant had to indicate his or her major subject of study and sex. We had 256 (51%) male and 246 (49%) female participants.[29] 129 students took part in treatment 1 (T1), 109 in treatment 2 (T2), 101 subjects participated in treatment 3 (T3) and lastly 170 participants took part in treatment 4 (T4).

The experiments consist of three distribution games that are identical in each treatment. But the setting and frame in which these games are played is varied. In some treatments participants played for money (while in other treatments no money could be earned)[30] and in some treatments an ultimatum game had to be played on a first stage.

In treatment T1 only three distribution games were played and participants were not paid off with money. In the second treatment, T2, again only the distribution games were played, but here some randomly drawn participants were paid off with money. The third and fourth treatment (T3 and T4) consist of an ultimatum game that was played at

[29] See Appendix A.2.1 for a detailed overview of the number of male and female participants in each treatment.
[30] Note that this is a crucial difference to the experiments by Engelmann and Strobel (2004), who paid off *all* participants.

stage one, followed again by the distribution games. In T3 no monetary payoffs were made, while in T4, some participants were really paid off.

We now describe in detail the distribution games, the ultimatum game (for T3 and T4) and also the payoff method we used in the real payoff treatments T2 and T4.

In all distribution games participants hypothetically form groups of three people. In each distribution game, *all* participants take the role of a decision maker. The decision maker has to select one of three different allocations. Allocations determine payoffs. By choosing allocation A, B or C the decision maker determines how much money the other two group members get. The decision maker takes the role of Person 2, who gets the same payoff in all three allocations. He can therefore never influence his own payoff with his decision.

Allocations differ with respect to the sum of payoffs and the distribution of payoffs between the three persons. We call allocations that maximize the sum of payoffs to the group efficient. Concerning the distribution of payoffs, we can distinguish between allocations that are fair in the sense of Fehr and Schmidt's inequity aversion and those that are fair in the sense of maximizing the lowest payoff, i.e. the poorest person´s payoff (maximin motive). We indicated the sum of payoffs and also the average payoffs of persons 1 and 3 as additional information and computational help on the decision sheets. A series of control experiments conducted at the University of Munich in summer 2002 show that this information has no significant influence on subjects' choices. In particular, there is no bias towards more efficient choices.[31]

The three distribution games are structured similarly, but they differ concerning the absolute levels and the distribution of payoffs.

Table 2.1 shows the first game. It was invented by Engelmann and Strobel (2004) and is called the taxation game. Person 2, the decider, gets an intermediate payoff in all three allocations A, B and C. The most efficient allocation (A) that

[31] Some results and a number of chi-squared tests that confirm this observation are listed in Appendix A.2.2.

maximizes the sum of payoffs is also the most unequal distribution. By choosing allocation B or C the decider can redistribute payoffs from the rich person to the poor person and thereby increase the equality of payoffs. Note that redistribution happens at the cost of efficiency as the rich person's payoff decreases by more than the poor person´s payoff is increased. Payoffs are most equal in allocation C. Therefore allocation C goes in line with Fehr-Schmidt preferences (FS) of inequity aversion. Allocation C also coincides with maximin preferences (MM), as the poorest person´s payoff (5) is maximal here. FS preferences coincide with MM preferences and contradict efficiency (E) in the taxation game.

	Game 1		
Allocation	**A**	**B**	**C**
Person 1	**21**	**17**	**13**
Person 2	**9**	**9**	**9**
Person 3	**3**	**4**	**5**
Total	33	30	27
Average 1,3	12	10.5	9
Efficient	A		
FS			C
Maximin			C

Table 2.1: Taxation game.

The second distribution game, shown in Table 2.2, is the so called poor game. The decision maker, person 2, gets the lowest payoff in the group. As always, the decision maker's payoff is held constant across all allocations within the game. Since she is the poorest person in this game, the poor game is neutral for maximin preferences. As in game 1, the least unequal allocation (C) coincides with FS preferences and contradicts efficiency.

Game 2			
Allocation	**A**	**B**	**C**
Person 1	**14**	**11**	**8**
Person 2	**4**	**4**	**4**
Person 3	**5**	**6**	**7**
Total	23	21	19
Average 1,3	9.5	8.5	7.5
Efficient	A		
FS			C
Maximin	A	B	or C

Table 2.2: Poor game.

Table 2.3 shows the last distribution game, game 3. It is the so called rich game. Person 2, the decision maker, gets the highest payoff of all group members. In this game, the most efficient allocation (A) is also the least unequal allocation. Here efficiency and inequity aversion predict the same allocation, which contradicts maximin motives (allocation C).

Game 3			
Allocation	**A**	**B**	**C**
Person 1	**11**	**8**	**5**
Person 2	**12**	**12**	**12**
Person 3	**2**	**3**	**4**
Total	25	23	21
Average 1,3	6.5	5.5	4.5
Efficient	A		
FS	A		
Maximin			C

Table 2.3: Rich game.

The sequence of the distribution games is the same in all treatments. We are aware of the fact that the sequence of games might influence the decisions and that therefore decisions should not be regarded as independent. We conducted a number of control treatments where we changed the sequence of the distribution games.[32] These experiments show that the sequence of distribution games does not change the results significantly.

In order to create a strategic context in T3 and T4, we chose to let the subjects play the ultimatum game before they took their decisions in the distribution games.[33] Although the ultimatum game is highly strategic, it has a simple and therefore easy to understand structure. It is well documented from numerous experiments how subjects behave in ultimatum games.[34] In the ultimatum game we used a variation of the strategy method. Every participant was told that she was in the role of the proposer. In that role she had to decide how to divide an amount of € 10 between her and an anonymous responder. Thereafter every participant hypothetically had to take the role of the responder. In that role she had to announce a minimal acceptable offer, below which she would reject.[35] We made clear to the participants that in case of a rejection of the proposal, i.e. in case of a proposed share below the minimal acceptable offer, the hypothetical contract between the partners would fail and that both partners would get a payoff of zero in that case. This of course was of practical relevance only in treatments with real monetary payments. A full set of experimental instructions can be found in Appendix A.2.10.

In all sessions, after the participants quietly and anonymously had taken their decisions, they folded the decision sheets and put them into a box. For T1 and T3 the experiment was over after all subjects had handed in their decision sheets. In T2 and T4 some participants were randomly drawn and paid off afterwards. We organized the following payoff procedure: For every decision game that was played in a treatment, we

[32] We conducted three different variations of T1 (no ultimatum game and no payments). First the sequence of games was "Taxation-, Poor-, Rich Game" as in the original treatment T1 (T1org). Then we changed the sequence to "Poor-, Rich-, Taxation Game" (T1var1) and finally we chose the sequence "Rich-, Poor-, Taxation Game" (T1var2). The results of these control treatments are reported in Appendix A.2.3.

[33] The ultimatum game was invented by Güth et al. (1982).

[34] For an overview see e.g. Camerer and Thaler (1995) and Roth (1995).

[35] Note that with the original strategy method, responders have to specify a full strategy for all possible proposals of their partner. A further difference here is that each subject had to take both roles (proposer and responder) in the game.

drew the respective number of involved persons. Remember that T2 consists of three games while T4 consists of four games, the ultimatum game and three distribution games, i.e. for T2 we drew 9 participants (three persons for three games) while for T4 we drew 11 participants (two for the ultimatum game and three for the each of the three distribution games). The sequence of draws was important, as it assigned the role of the drawn participants. In the ultimatum game, real payoffs could only be achieved if proposed and accepted offers were compatible, i.e. if the proposer offered at least what the responder announced as just acceptable. In the distribution games, the first drawn subject was assigned the role of person 1 in game 1, the second was person 2 in game 1 etc. The participant who was assigned the role of person 2 in the respective game determined by his decision the actual payoffs for persons 1 and 3 in the game.[36] After payoffs had been determined we put the money in sealed envelopes that only had the subject´s ID-number on them. We mixed up the sequence of numbers and then called the participants via their ID-numbers. This method generated the highest possible degree of anonymity. Not even the drawn subjects themselves knew which role in which game they had played[37] and only the receiver of the envelope got to know the amount of money she earned.

We are aware of the fact that this design creates what is called "role uncertainty". The own payoff is never influenced by the own decision (as person 2's payoff is the same in all three allocations). But it is well possible that one is being drawn as person 1 or 3, i.e. somebody else determines the own payoff. So at the moment of choosing an allocation, there is uncertainty about the role that one will be assigned later. This feature was also a reason for using the strategy method in the ultimatum game. Thereby, we created a situation in which participants were unaware of their role in the strategic game as well.

One could conjecture that role uncertainty creates a bias towards the efficient or the maximin allocation. However, Engelmann and Strobel (2004) show in a number of

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[36] The decisions taken by persons 1 and 3 were irrelevant.
[37] Only for a rejected offer in the ultimatum game they would have known this with certainty, as the payoff would be zero only in that case. However, this case never occured.

experiments with and without role uncertainty that this feature does not influence subjects´ choices significantly.

Another important feature of our experiments has to be mentioned. The participants in our experiments were students of business administration and economics exclusively. Students of these subjects are known to be more concerned about efficiency than other students. We therefore conducted control treatments of T2 and T4 with students of other subjects.[38] We thereby tested whether the effect of the strategic context also holds with a different subject pool. Our control treatments strongly confirm the efficiency bias of business and economics students. But they also show that the effect of a strategic context persists.[39]

2.3 Treatment Effects

In the following section we present the experimental results in detail. We will analyze how behavior changes, if the environment in which the distribution games are played is varied. In particular, we investigate the effect of real payments and the effect of the ultimatum game on the outcome in the distribution games. By comparing the decisions in the distribution games across the four different treatments we can analyze if and how decisions change when the framing of the experiment is changed.

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[38] The results of these control treatments are reported in Appendix A.2.4.
[39] See Fehr and Schmidt (2004) for more details on the subject pool effect.

2.3.1 Effect of Monetary Payoffs

In order to see whether real payoffs have any effect on subjects' behavior in the distribution games we have to compare the results in T1 to the results in T2 (both treatments without ultimatum game but in T2 people are really paid off) and the results in T3 to those of T4 (both treatments with ultimatum game, but only in T4 participants are really paid off). This allows not only to check for the existence of a treatment effect but also for the direction and the consistency of the changes.[40]

We detect the following significant and consistent change in behavior: If people are really paid off, the efficient allocation is chosen more often while the maximin allocation is chosen less often in all three distribution games, both comparing T1 to T2 and T3 to T4. This means that we observe a consistent effect of real payments concerning the efficient and the maximin allocation. This does not hold true for the Fehr-Schmidt inequity aversion allocation. Concerning FS, the change depends on whether the FS allocation coincides with the efficient or with the maximin allocation.

For an overview of absolute and relative choices and the changes across the different treatments see Table 2.4 below.

[40] Of course we are not the first who think about the effects of monetary incentives in experiments. The discussion was started by Smith (1962). By now it is well established to use monetary incentives in experiments, although the evidence on the effects is mixed. Camerer and Hogarth (1999) for instance show that in experiments with easy tasks, paying money does not affect experimental results.

	Game 1 (Tax)			**Game 2** (Poor)			**Game 3** (Rich)		
Allocation	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Person 1	**21**	**17**	**13**	**14**	**11**	**8**	**11**	**8**	**5**
Person 2	**9**	**9**	**9**	**4**	**4**	**4**	**12**	**12**	**12**
Person 3	**3**	**4**	**5**	**5**	**6**	**7**	**2**	**3**	**4**
Total	33	30	27	23	21	19	25	23	21
Average 1,3	12	10.5	9	9.5	8.5	7.5	6.5	5.5	4.5
Efficient	A			A			A		
FS			C			C	A		
Maximin			C	A	B	or C			C
T1									
choices (abs.)	47	23	59	52	24	53	53	24	52
choices (%)	**36.4**	**17.9**	**45.7**	**40.3**	**18.6**	**41.1**	**41.1**	**18.6**	**40.3**
T2									
choices (abs.)	72	12	25	63	16	30	70	14	25
choices (%)	**66.1**	**11.0**	**22.9**	**57.8**	**14.7**	**27.5**	**64.2**	**12.8**	**22.9**
T3									
choices (abs.)	37	8	56	39	11	51	43	17	41
choices (%)	**36.6**	**8.0**	**55.4**	**38.6**	**10.9**	**50.5**	**42.6**	**16.8**	**40.6**
T4									
choices (abs.)	69	28	73	73	36	61	72	40	58
choices (%)	**40.6**	**16.5**	**42.9**	**42.9**	**21.2**	**35.9**	**42.4**	**23.5**	**34.1**

Table 2.4: The effect of real payments.

To begin with, consider game 1, the taxation game. In T1, the majority of people (45.7%) chose allocation C that corresponds to maximin preferences as well as to FS preferences. A significant fraction of people (36.4%) also chose the efficient allocation A. Now compare these results to the decisions taken in T2 that exactly equals T1 with the only difference of having the chance to earn real money. Here an overwhelming majority of people (66.1%) chose the efficient allocation A, while only 22.9% of participants chose the MM and FS allocation C. The percentage of choices for the efficient allocation nearly doubled from 36.4% to 66.1%, while the percentage of choices for the MM allocation sharply decreased. The same effects can be observed when we look at the decisions taken in game 1 in the treatments with ultimatum game.

Compare T3 (without payment) to T4 (with payment). In T3 a clear majority of participants (55.4%) chose the maximin allocation C and 36.6% chose the efficient allocation A. In the real payoff treatment T4 the fraction of the maximin allocation C decreases to 42.9% while again the efficient allocation is chosen more often now (we observe an increase from 36.6% to 40.6%).

In order to get a first confirmation of the significance of these effects we conducted a number of simple chi-squared tests (and additionally Fisher's exact test). We thereby test whether the differences in the fractions with which the allocations A, B and C were chosen in the respective treatments are significant.[41] For T1 versus T2 we get $\chi^2 = 20.94$, $p > .000$ (Fisher's exact test: $p > .000$) where p is the respective level of significance. For T3 versus T4 we get $\chi^2 = 5.82$, $p > .054$ (Fisher's exact test: $p > .058$). Thus, indeed the differences between the treatments are highly significant.

Now take a look at game 2, the so called poor game, that is neutral for maximin preferences. Again we observe that in treatments with real money payments (T2 and T4) the efficient allocation A was chosen more often than in the treatments without real payoffs (T1 and T3 respectively). Compare T1 to T2. In T1 (T3) the efficient allocation is chosen by 40.3% (38.6%) of the participants while in T2 (T4), with real payments, it is chosen by a fraction of 57.8% (42.9%). Allocation C, which is the least unequal allocation and therefore coincides with FS preferences of inequity aversion, goes in line with maximin preferences but contradicts efficiency. Consequently, allocation C gets less important in treatments with real payoffs. In T1 (T3) 41.1% (50.5%) of the participants chose C while in T2 (T4), this fraction decreases to 27.5% (35.9%).[42]

Lastly, consider distribution game 3. The efficient allocation A is also the least unequal allocation and therefore coincides with FS preferences. Hence, in this game the

[41] More precisely we test the hypothesis that the distribution of choices in T1 and T2 (say) is generated by subsets of subjects from the same statistical population.

[42] Again a simple chi-squared test and Fisher's exact test show that the differences in the fractions between T1 and T2, and also between T3 and T4 are significant. For T1 versus T2 it yields $\chi^2 = 7.40$, $p > .025$ (Fisher's exact test: $p > .025$). For T3 versus T4 we get $\chi^2 = 7.43$, $p > .024$ (Fisher's exact test: $p > .025$).

maximin allocation C contradicts the FS allocation. For the comparison of T1 to T2 the results just carry over from the first two distribution games. The efficient allocation gets chosen more often in the real payoff treatment (41.1% in T1 and 64.2% in T2) while the maximin allocation is less important in the real payoff treatment (40.3% in T1 but only 22.9% in T2). The FS allocation coincides with efficiency in this game and gets chosen more often with real payoffs. Concerning the effect of real money in these treatments with ultimatum game, again the maximin allocation gets less important with real payoffs (40.6% of participants chose C in T3, while only a 34.1% fraction chose it in T4). Concerning the efficient allocation there is nearly no effect here. 42.6% of subjects chose the efficient allocation A in the treatment without payoff (T3) and a 42.4% fraction (so this time slightly less) chose it in T4. But as can be concluded from the chi-squared test, this difference is far from being statistically significant.[43]

Consider now the change in the importance of the FS allocations in all three games. We observe that this change depends on whether the FS allocation coincides with the maximin allocation (as is the case in games 1 and 2) or with the efficient allocation (as in game 3). If FS coincides with maximin, it gets less important with real payoffs, while if it coincides with the efficient allocation, it is chosen more often with real payments. In other words the change in importance of FS preferences is not consistent.

[43] For T3 versus T4 we get $\chi^2 = 2.08$, $p > .354$ (Fisher's exact test: $p > .354$), i.e. the difference is indeed not significant, while for T1 versus T2 we get $\chi^2 = 12.86$, $p > .002$ (Fisher's exact test: $p > .001$), i.e. the differences here are highly significant.

The following result summarizes our observations.

Result 2.1 *There is a significant and consistent effect of the existence of real monetary payments in the purely distributional games. Real payoffs increase the fraction of choices of the efficient allocations and decrease the fraction of choices of the maximin allocations. The fraction of choices of the Fehr-Schmidt allocations changes inconsistently, as it depends on whether the FS allocations coincide with maximin allocations or with efficient allocations.*

From this we conclude that as soon as real money is at stake, efficiency, i.e. the sum of payoffs, becomes a more important motive for people´s behavior in a purely distributional context. Their concern for the poorest (maximin preferences) on the other hand becomes less important with real money. For an interpretation of these results see Section 2.3.3 below.

2.3.2 Effect of a Strategic Environment

Next we want to analyze the effect that a more strategic environment has on the subjects' behavior. In order to create a strategic context we extended the experimental set-up. Before the participants played the distribution games (game 1 to game 3) they were asked to play the ultimatum game. As described above, for practical reasons and for consistency concerning role uncertainty in *all* games we used the strategy method here.[44]

In order to detect a possible treatment effect we have to compare the results in T1 to the results in T3 (both treatments without real payments but T3 with the

[44] First, each participant had to propose what share of an amount of € 10 she wanted to propose to an anonymous partner. Thereafter she took the role of a responder and had to announce a minimal acceptable offer.

ultimatum game at the beginning) and the results in T2 to those in T4 (both with real payments and again T4 in the strategic context). This comparison will also allow to check for the direction and the consistency of possible changes.

Although the distribution games are exactly the same as before, i.e. they are not at all strategic, it turns out that decisions in the distribution games change if they are to be taken in a strategic context. We detect the following change in behavior: If participants felt in a more strategic "mood", the maximin allocations (in all three distribution games) were chosen more often, while the efficient allocations were chosen less often. Concerning the FS allocation the change, as before, depends on whether the FS allocations coincide with the efficient or the maximin allocations.

By comparing the respective treatments we detect an important feature. The effect of the ultimatum game on decisions in the distribution games is much stronger in the treatments with real money payoffs (T2 versus T4) than in the treatments without real payments. But as is shown in a series of probit estimates discussed below, the effect of the strategic context is significant across all treatments (not only T2 and T4). Probit estimates for the treatments without real payments (T1 and T3) alone show that the effect still goes in the same direction (i.e. the ultimatum game increases the probability of the maximin allocations being chosen and it decreases the probability of the efficient allocations being chosen, apart from the third distribution game). However, the effect is not significant.[45]

For an overview over the absolute and relative choices and the changes across the different treatments see Table 2.5 below.

[45]See Appendix A.2.5 for two examples of those probit estimates.

	Game 1 (Tax)			**Game 2** (Poor)			**Game 3** (Rich)		
Allocation	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Person 1	**21**	**17**	**13**	**14**	**11**	**8**	**11**	**8**	**5**
Person 2	**9**	**9**	**9**	**4**	**4**	**4**	**12**	**12**	**12**
Person 3	**3**	**4**	**5**	**5**	**6**	**7**	**2**	**3**	**4**
Total	33	30	27	23	21	19	25	23	21
Average 1,3	12	10.5	9	9.5	8.5	7.5	6.5	5.5	4.5
Efficient	A			A			A		
FS			C			C	A		
Maximin			C	A	B	or C			C
T1									
choices (abs.)	47	23	59	52	24	53	53	24	52
choices (%)	**36.4**	**17.9**	**45.7**	**40.3**	**18.6**	**41.1**	**41.1**	**18.6**	**40.3**
T3									
choices (abs.)	37	8	56	39	11	51	43	17	41
choices (%)	**36.6**	**8.0**	**55.4**	**38.6**	**10.9**	**50.5**	**42.6**	**16.8**	**40.6**
T2									
choices (abs.)	72	12	25	63	16	30	70	14	25
choices (%)	**66.1**	**11.0**	**22.9**	**57.8**	**14.7**	**27.5**	**64.2**	**12.8**	**22.9**
T4									
choices (abs.)	69	28	73	73	36	61	72	40	58
choices (%)	**40.6**	**16.5**	**42.9**	**42.9**	**21.2**	**35.9**	**42.4**	**23.5**	**34.1**

Table 2.5: The effect of a strategic context (ultimatum game).

Consider game 1 and focus first on the comparison of treatments with real money payoffs (T2 versus T4). While in the treatment without strategic context an overwhelming majority of participants chose the efficient allocation A (66.1% of participants), this fraction decreases to only 40.6% in T4, the treatment with ultimatum game. Correspondingly, in T2 only a small fraction of people (22.9%) chose the maximin allocation (that coincides with the FS allocation), while in T4 42.9% of choices were for the maximin allocation.[46]

[46] In order to check the significance of the observed changes we again look at the results of a chi-squared and of an exact Fisher test: $\chi^2 = 17.47$, and $p > .000$ (Fisher's exact test: $p > .000$), i.e. the effects are highly significant here.

Concerning the maximin allocation the effect exactly carries over to the comparison of T1 to T3. In T1 45.7% of participants chose the maximin allocation C while in T3, this fraction increased to 55.4%. As FS coincides with maximin here, its fraction also increased. For the efficient allocation there is only a very small effect, that goes in the contrary direction. In T1 36.4% of participants chose the efficient allocation. In the ultimatum game treatment T3 a slightly higher fraction, namely 36.6% of the subjects chose the efficient allocation. Concerning magnitude and significance, this effect is negligible: $\chi^2 = 5.20$, $p > .074$ (Fisher's exact test: p > .071). Summing up the significant effects for game 1 we found that the ultimatum game decreased the fraction of efficient choices and increased the fraction of maximin choices. As the FS allocation coincides with the maximin allocation here, the fraction of choices of the FS allocation also increased with the ultimatum game.

Now let us consider game 2. For the treatments without real payments (T1 versus T3) as well as for the treatments with real payoffs (T2 versus T4) we observe the following effects: introducing the ultimatum game decreased the efficient choices and increased the FS choices. Remember that the poor game is neutral for maximin preferences, i.e. FS coincides with maximin and contradicts efficiency. In T2 a fraction of 57.8% participants chose the efficient allocation A. With the ultimatum game in T4 this fraction decreased to 42.9%. The FS allocation was chosen by 27.5% of the people in T2. In T4 this figure increased to 35.9%.[47] Comparing T1 to T3 the effects are similar. In T1 40.3% of the choices were for the efficient allocation. This fraction decreased to 38.6% in T3. The FS allocation was chosen by 41.1% of the participants in T1 and by 50.5% in the ultimatum game treatment T3.[48]

Finally consider game 3. Concerning the comparison of real payment treatments T2 to T4, the effects are large and highly significant. In T2 64.2% of the participants chose the efficient allocation A, while only 42.2% chose that allocation in the ultimatum

[47] The effects are significant: $\chi^2 = 5.93$, $p > .051$ (Fisher's exact test: $p > .054$).
[48] The direction of the effects is well in line with the rest of our results, although the effects are not statistically significant: $\chi^2 = 3.37$, $p > .186$ (Fisher's exact test: $p > .184$).

game treatment T4. In game 3 the efficient allocation is in line with FS preferences of inequity aversion, i.e. the FS allocation also got chosen less in the strategic context. The maximin allocation C that is in contrast to FS, was chosen by only 22.9% of the people in T2. But this fraction rose to 34.1% in T4 with the ultimatum game.[49] Comparing the treatments without real payments there is hardly any effect to be detected. In T1 41.1% of the subjects chose the efficient allocation. This fraction increased to 42.6% in T3, contrary to what we observed in the other games and treatments. Concerning the maximin allocation, 40.3% chose it in T1 and a slightly higher fraction (40.6%) chose it in T3, but those effects are far from being significant.[50]

The following result summarizes our observations.

Result 2.2 *There is a significant and consistent effect of a strategic environment on the decisions taken in the purely distributional games. In a strategic context, the efficient allocations are chosen less often and the maximin allocations are chosen more often. The fraction of choices of the Fehr-Schmidt allocations changes inconsistently, as it depends on whether the FS allocations coincide with maximin allocations or with efficient allocations.*

In addition to the simple statistical tests reported above, we conducted a number of probit estimates in order to check the significance of the treatment effects of real money payoff and the ultimatum game. These probit estimates use the micro data we have collected across all treatments. They show that the probability of an efficient allocation being chosen is higher if there are real payoffs and it is lower in the presence of the ultimatum game. On the other hand the probit estimates show that the probability of a maximin allocation being chosen is lower if there are real payoffs and it is higher in the presence of the ultimatum game. As all subjects had to indicate their sex on the

[49] These differences are highly significant: $\chi^2 = 12.95$, $p > .002$ (Fisher's exact test: $p > .002$).
[50] $\chi^2 = 0.1311$, $p > .937$ (Fisher's exact test: $p > .953$).

decision sheets we can additionally check for the effect of the decision maker´s gender on the choice taken in the distribution games. We find that the probability of an efficient allocation being chosen is higher, if the decider is male, while the probability of a maximin allocation being chosen is lower if the decider is male.

Table 2.6 reports the results of a probit estimation that estimates how the probability of allocation A1 (A1 denotes the efficient allocation A in distribution game 1) being chosen depends on the decision maker being male, the presence of the ultimatum game and the presence of real monetary payoffs.[51]

	Explanatory Variables			
	Constant	**Male**	**UG**	**Payoff**
A1	-.358***	.331***	-.379***	.444***
	(.115)	*(.115)*	*(.117)*	*(.117)*

Table 2.6: Probit estimation of treatment effects for A1.

All coefficients are highly significant here. The coefficient of the dummy variable "*male*" is positive, i.e. the probability of the efficient allocation A1 being chosen rises if the decision maker is male. The coefficient of the dummy variable "*ultimatum game*" (UG) is negative, i.e. the probability of A1 being chosen falls if there is an ultimatum game. Lastly the coefficient of the dummy variable "*payoff*" is positive, i.e. the probability of A1 being chosen falls if there is real money at stake. These results carry over to the probit estimates for the other efficient allocations, A2 (allocation A in game 2) and A3 (allocation A in game 3) that can be found in Appendix A.2.6.

Next consider the probit estimation for the maximin allocation C1, i.e. allocation C in distribution game 1 that is reported in Table 2.7.

[51] For all probit estimates asteriks denote statistical significance at the 10% (*), 5% (**), or 1% (***) level. Estimated standard errors appear in parentheses.

	Explanatory Variables			
	Constant	**Male**	**UG**	**Payoff**
C1	-.037	-.284**	.423***	-.482***
	(.113)	*(.115)*	*(.118)*	*(.118)*

Table 2.7: Probit estimation of treatment effects for C1.

This probit estimation shows that the probability of the maximin allocation being chosen falls significantly if the decider is male, it rises significantly in the presence of an ultimatum game and falls, again significantly, if there are real money payments.[52]

2.3.3 Discussion of Treatment Effects

We found that the analyzed changes in the experimental framing caused consistent and significant changes in the importance of efficiency and maximin preferences, but they did not lead to consistent changes concerning the importance of FS preferences of inequity aversion.

How can these results be interpreted? As soon as real money is at stake, efficiency concerns become more important. It seems that people sacrifice their concerns for the poorest in order to maximize the total payoff to society (which corresponds to the group of three participants in our experiments).[53]

One interesting aspect concerns the decision maker herself. There exists an established literature on what is called the warm glow effect of doing good things. This literature claims that doing something good to others has a positive effect on one's own utility (see Andreoni, 1995, for experimental evidence on the warm glow effect).

[52] The results of the probit estimates for the other maximin allocations, C2 (allocation C in game 2) and C3 (allocation C in game 3) that can be found in Appendix A.2.7.

[53] Of course maximizing the total payoff to society should not be considerd unfair, although it coincides with a more unequal distribution of payoffs in some games. Maximizing the total payoff could also be interpreted as some kind of fairness towards society as a whole. And from the perspective of society as a whole it is indeed costly, in the presence of real monetary payoffs, to choose more equal allocations.

Without real money a warm glow that is caused by caring for the poorest comes for free. As long as it is costless to be fair in the sense of maximin preferences, people indeed prefer to be fair and therefore choose the maximin allocation. But as soon as it gets costly (at least from the perspective of society) the warm glow seems not to be big enough to outweigh the costs to society. It seems that the effect has to come rather cheap in order to really affect behavior.

Another effect that is well connected to the warm glow effect could play a role here. This is the so called positive-self-image effect.[54] Its asserters claim that people strongly want to have a nice image of themselves, e.g. to appear caring for the poor in front of themselves. As long as it is costless (from the viewpoint of society) to appear fair in front of oneself, people definitely want to appear nice.

An additional explanation for the increasing importance of efficiency could be that as soon as there are real monetary payments, the subjects consider themselves as one big group playing against the experimentator. If the subjects try to extract as much money as possible from the experimentator, they could do so by choosing the efficient allocations in the distribution games.

The ultimatum game at the first stage forces subjects to think strategically. Other players become potential opponents or partners. When deciding on their proposal, players have to take into account the responder´s reaction. If proposed offers are too low, they run the risk of getting their offer rejected and therefore of getting a payoff of zero. Using the strategy method enforces this strategic thinking, as people really have to think through both roles, that of the proposer and that of the responder. Players who want to be treated fairly by their partners might also be willing to treat them in a fair way while concerns for efficiency become less important. Although the outcome in the ultimatum game does not at all influence payoffs in the distribution games, and although the distribution games are not at all strategic, the presence of the ultimatum game changes results in the distribution games. After having played the ultimatum

[54] See e.g. Farwell and Weiner (1996) and Singh et al. (1998) for more on the positive self-image effect.

game, the concern for the poorest clearly increases. In the distribution games the maximin allocations are then chosen more often, although the poorest have no influence on the real payoffs, as the distribution games are dictatorship games, i.e. nobody has the right to reject person two´s choice. The efficient allocations are chosen less often. Note that this effect is stronger if there is real money at stake. With real money, in order not to lose the opportunity to earn something from the ultimatum game, it is important to offer not too little to the responder. This effect carries over to the distribution games. Obviously once the strategic context is created people do not stop to think in this strategic way even in perfectly non-strategic set-ups.

There are two things we can conclude from these results. The first is that framing effects and subjects´ experiences strongly influence their behavior. The second is that, at least in the limited frame of our experiments, efficiency and maximin motives play a big role in the process of decision taking. Inequity aversion, however, cannot be shown to have a significant influence on subjects´ choices.

An additional insight we got from these results concerns the different behavior of male and female participants. It is well known from previous research and also well confirmed in our data that female participants choose more according to maximin motives and inequity aversion than male participants, who choose efficient allocations more frequently and who also decide more efficiently in ultimatum games.[55] From this one might conjecture that our postulated effects of real payoffs and strategic context might (at least to some part) be due to different fractions of male and female participants in the respective treatments. It is rather easy to see that this is not the case. Consider the effect of real payments in treatments T3 versus T4 in game 1. With real payments (T4) the efficient allocation gets chosen more often (40.6% in T4 versus 36.6% in T3) although the fraction of female participants in T4 (53%) was much higher than in T3 (39%). For the effect of a strategic context consider T1 (no UG) versus T3. Consider game 1 again. In T3 the maximin allocation is chosen more often (55.4% in

[55] See Andreoni and Vesterlund (2001) and Eckel and Grossman (1998, 2001) for experimental evidence on gender effects concerning fairness.

T3 versus 45.7% in T1) although the fraction of females is only 39% in T3 but 55% in T1.[56]

2.4 Consistency within the Distribution Games

In addition to the analysis of the treatment effects described in Section 2.3 there are several other interesting insights to get out of the experimental data. Let us first have a closer look at the correlation of choices within the three different distribution games. How are the choices of the efficient, the maximin and the FS allocations in the distribution games correlated for the different treatments? While in Section 2.3 we looked at changes in the decisions in each of the games across the treatments we now look at the changes in decisions across games. Is the preference for efficiency and maximin or the inequity aversion that people reveal influenced by their position relative to the other group members? Does it make a difference whether we play the taxation game (where the decision maker gets an intermediate payoff), the poor game (where the decision maker is the poorest member) or the rich game (where the decider gets the highest payoff)? The preference for an even distribution might be higher when the decider is the poorest member. This is reasonable if people suffer more from disadvantageous inequality than from inequality to their advantage. On the other hand one could think of people caring more about inequality if they are the richest members in a society because they feel some kind of duty for charity.

In order to get an idea of the correlation between decisions in the different games we look at the Pearson correlation coefficients between the respective allocations. We calculated these coefficients separately for every treatment. For an overview see Table 2.8 below that indicates the correlation coefficients for treatment

[56] In order to get the results more clear cut and to control for the gender effect completely we analyzed all effects for male and female participants separately. The results are shown in Appendix A.2.8.

1.[57] It turns out that the efficient allocations in the distribution game are positively correlated. Also the maximin allocations are highly positively correlated. The FS allocations are correlated inconsistently, depending on whether they coincide with the efficient or the maximin allocation in the respective games. Note that a correlation coefficient of zero indicates that a chosen allocation in a certain game has no influence on the choice of a certain allocation in another game. In contrast a correlation coefficient of plus or minus one indicates that the decisions are perfectly (positive or negative) correlated. We concentrate on allocations A and C in the distribution games and do not indicate correlation coefficients for the "intermediate" B allocations.

T1	A1	C1	A2	C2	A3	C3
A1	1					
C1		1				
A2	**0.659***	*-0.564****	1			
C2	*-0.469****	**0.562***		1		
A3	**0.645***	*-0.450****	**0.663***	-0.409***	1	
C3	*-0.425****	**0.483***	*-0.418****	**0.406***		1

Table 2.8: Pearson correlation coefficients in treatment 1.[58]

Take a closer look at Table 2.8. First consider the efficient allocations A1 (A in game 1), A2 and A3. All of them are positively correlated and the coefficients are highly significant. The correlation coefficient between A1 and A2 is *0.659*, between A1 and A3 it is *0.645* and between A2 and A3 it is *0.663*. This means that, on average, if the efficient allocation was chosen in distribution game 1, it is very likely that also in games 2 and 3 the efficient allocation was chosen. The same positive and significant correlation can be observed for the maximin allocations C1, C2 and C3: the correlation coefficient between C1 and C2 is *0.562*, between C1 and C3 it is *0.483* and between C2 and C3 it is *0.406*. Correlations between efficient and maximin allocations are negative

[57] The respective tables for treatments two, three and four, as well as a table with the correlation coefficients across all treatments can be found in Appendix A.2.9.
[58] Significance of the respective correlation coefficients is marked by stars where (two sided) significance at the 1% level is indicated by three stars and (two sided) significance at the 5% level by two stars.

and significant.[59] Consequently the correlation between Fehr-Schmidt allocations differs in sign, as FS coincides with maximin in game 1 and 2 but coincides with efficiency in game 3. So the correlation coefficient between the FS allocations C1 and C2 is positive, but between C2 and A3 as well as between C1 and A3 it is negative. The conclusion we can draw from these results is that it does not seem to play much of a role in what relative position the decision maker is, i.e. what type of distribution game was played. Regardless of being the poorest or the richest member of society, choosing a certain type of allocation in one game is highly positively correlated with choosing that type of allocation in the other games. This does not hold for the FS allocations.

These results give interesting insights regarding the relationship between the allocations on an average level. But it may be even more interesting to look at the cases of perfect correlation. In what follows we analyze how many subjects persistently chose the efficient (or the maximin or the FS) allocations in all three distribution games. Let us call participants who chose the efficient allocations in all games pure "E-types", those who chose maximin allocations in all games pure "MM-types" and those who chose according to Fehr-Schmidt´s inequity aversion pure "FS-types", respectively. Table 2.9 gives an overview of the absolute and relative numbers. These numbers give a hint at the relative importance of the different types of preferences.

	all	T1	T2	T3	T4
pure E-types					
absolute number	159	37	47	28	47
%	31.2	28.7	43.1	27.7	27.6
pure MM-types					
absolute number	125	39	12	35	39
%	24.6	30.2	11.0	34.7	22.9
pure FS-types					
absolute number	23	7	4	9	3
%	4.5	5.4	3.7	8.9	1.8

Table 2.9: Pure types.

[59] Note that in game 2 all allocations are maximin allocations. But here the efficient allocation, i.e. allocation A2 is not positively correlated with the maximin allocations in game 1 and 3, i.e. A1 and A3.

Remember that there were altogether 509 participants in our experiments. 159 subjects chose the efficient allocations throughout all games. This is substantial fraction of 31.2 % pure E-types. The highest fraction of pure efficiency types can be found in T2. As we concluded from Section 2.3.1, real money payments and a non-strategic context (T2) are most favourable for choosing efficient allocations.[60] 125 participants chose maximin allocations in all distribution games, i.e. there is a fraction of 24.6% pure MM-types.[61] The highest fraction of MM-types (34.7%) appears in T3, the treatment without real monetary payments but with a strategic context.[62] Remember that these are the features that strengthen maximin motives. Only 23 out of 509 subjects consistently behaved according to inequity averse preferences, i.e. there is only a 4.5% fraction of pure FS-types.

60.3% of all participants (307 out of 509) chose consistently according to efficiency, maximin or inequity aversion motives. This leaves a fraction of 39.7% (202 out of 509) participants who did not behave according to one of these three motives in all three games, i.e. their decisions can not be explained consistently by one of these motives. We therefore call this group of people "unexplained types". Within this group of unexplained choices there are no dominant patterns to be observed. 18 participants (a fraction of 3.5% of all 509 participants) chose the intermediate allocation B in all three games. Another 25 subjects (a fraction of 4.9% of all participants) chose the combination C1, C2, B3. They chose the maximin allocations in games 1 and 2 but in game 3 (the rich game) they chose the intermediate allocation B.

More than half of the decisions made in the experiments (55.8%) can be explained by efficiency and maximin motives, only 4.5% can be explained by inequity

[60] Note that in T2 the fraction of male participants was 55% and that of females 45%. In T2 the fraction of pure efficiency types was highest, although there are treatments with a higher fraction of males and correspondingly a lower fraction of females.
[61] Note that pure maximin types could choose any allocation in game 2, as game 2 is neutral for maximin allocations. If we consider only those participants as pure MM-types who chose the non efficient allocations in game 2, i.e. C2 or C3 we still get a number of 115 subjects, i.e. a fraction of 22.6% of pure MM-types. If we only count those participants who chose C in all games, we get a number of 97, i.e. still a fraction of 19.1%.
[62] Although the fraction of males was as high as 61% with a corresponding fraction of only 39% female participants.

aversion. This indicates a rather weak performance of inequity aversion in these simple distribution games. A huge number of results in interactive strategic experiments can be well explained by inequity aversion (see Fehr and Schmidt, 1999, 2003, for a detailed overview of experimental evidence). A feature of most of these strategic experiments is that it is difficult to distinguish between motives of pure inequity aversion, i.e. distributional fairness and motives of reciprocity, i.e. intention based fairness. In our distribution games intentions do not play any role as there is no strategic interaction. In this intention free setting, FS performs rather poorly. The results concerning the absolute performance of FS preferences are well in line with previous research (Engelmann and Strobel, 2004). We saw from the analysis of the treatment effects in Section 2.3 that the performance of inequity aversion preferences is bad not only in an absolute but also in a marginal sense: with changes in the environment (treatment effects) the (marginal) change concerning the importance of efficiency and maximin preferences is consistent, but it is not consistent concerning FS preferences. This indicates that people´s distributional preferences are driven by other forces than inequity aversion, while inequity aversion seems to be a very good proxy for intention-based behavior, which matters in strategic games.

The fact that efficiency and maximin motives play a dominant role in distribution games clearly hints to a strong explanatory power of the theory of social-welfare preferences by Charness and Rabin (2002). CR suggest that behavior in a multi-person context is driven by a combination of reciprocity and quasi-maximin preferences, i.e. a combination of efficiency and maximin motives (in addition to self-interest). In an intention free environment this reduces to pure "quasi-maximin" preferences (again in addition to self-interest).[63]

[63] Charness and Rabin define the following social-welfare preferences utility function in a multi-person intention free setting: $V_i(\pi_1, \pi_2 ... \pi_n) \equiv (1-\chi)\pi_i + \chi\left[\delta \cdot min(\pi_1, \pi_2 ... \pi_n) + (1-\delta)(\pi_1 + \pi_2 + ... + \pi_n)\right]$ where π_i denotes the payoff of player *i* and $\chi \in [0,1]$ and $\delta \in [0,1]$ are constants. Utility increases in the subject´s own payoff, as well as in a weighted combination of how much the poorest person gets (maximin motive) and how much the society as a whole gets (efficiency motive).

In our experiments the decisions of the unexplained deciders could well be in line with CR, as social-welfare preferences do not call for always choosing the efficient or maximin allocations. One is tempted to suspect that there are three groups of people: one with a strong bias towards efficiency, one with a strong bias towards maximin and a third one with intermediate weights on efficiency and maximin, whose members decide in a seemingly inconsistent way. This intuition turns out to be plainly wrong, however.

Remember the second distribution game, the so called poor game, that is neutral for maximin preferences. Here efficiency and maximin coincide, so CR make a clear forecast independent of the parameters that would in general influence the relative importance of maximin versus efficiency motives: all subjects who act according to social-welfare preferences should choose allocation A (that is efficient) here. Table 2.10 gives an overview over the choices made in game 2 across all treatments.

	Game 2 (Poor)		
Allocation	A	B	C
Person 1	14	11	8
Person 2	4	4	4
Person 3	5	6	7
Total	23	21	19
Efficient	A		
F&S			C
Maximin	A	B	or C
All treatments			
absolute numbers	227	87	195
%	**44.6**	**17.1**	**38.3**

Table 2.10: Choices in the poor game.

A fraction of 44.6% of all participants (227 out of 509) indeed chose the efficient and maximin (and therefore social-welfare) allocation A. This indicates that there are at most 44.6% subjects who have social-welfare preferences.[64] If a substantial fraction of the unexplained choices indeed consisted of quasi-maximizers, the fraction of choices for allocation A in game 2 should be much bigger than it actually is. Although efficiency and maximin play a dominant role in these distribution games the combination of both, i.e. "quasi-maximin" preferences, is not able to explain even half of the decisions. In this intention free context also CR does not perform too convincing.

The following result summarizes our observations.

Result 2.3 *There is consistency concerning the choice of efficient and maximin preferences within the distribution games in every treatment, for a majority of subjects. FS preferences perform rather poorly in the purely distributional context. We observe a puzzle as more than 40% of the subjects did not consistently choose according to any of the leading theories.*

[64] Possibly this fraction is much lower, as also the pure E-types chose A here and even some pure MM-types. Of course we can not rule out that some of those subjects who appear as pure E- or pure MM-types are actually CR-types, but probably that does not hold for all of them.

2.5 Summary and Conclusion

We report on a series of simple distribution experiments in the spirit of Engelmann and Strobel (2004), that allow to compare the relative importance of efficiency, maximin preferences and inequity aversion in a purely distributional context. We investigated the effect of different experimental "framings" and the effect of a strategic environment on the subjects´ revealed preferences. Our experimental results show that in a strategic environment maximin preferences become more important. On the other hand as soon as "real money" is at stake, efficiency plays a more important role. Inequity aversion, however, cannot be shown to have a significant influence on the subjects´ choices. In addition to the observed treatment effects we analyzed whether revealed preferences are consistent across the distribution games.

From this we conclude that, although a huge number of experimental results in interactive strategic games may be correctly predicted and well explained by inequity aversion, FS preferences may play a less important role in purely distributional settings.

An important question, that is not investigated in this chapter, concerns the substantial fraction of choices that were not in line with either of the three motives efficiency, maximin or inequity aversion. It remains a topic for future research to find out more about what drives these unexplained choices and to detect consistent patterns.

A wide range of further control experiments is of need and interest here. It should be interesting to check whether an increase in the probability of being paid off increases the concerns for efficiency even more, or whether the mere existence of a small probability of being paid off is enough to strengthen the importance of efficiency concerns as we observed. One could also control for the influence of the sequence of games and therefore conduct the distribution games in isolated experimental sessions. Furthermore it is of interest to find out whether our results are robust in a hot version of the game, i.e. the ultimatum game played with real instead of hypothetical interaction. Lastly an interesting question is, whether the type of strategic game plays a role. Does it make a difference whether we let subjects play the trust game instead of the ultimatum game before they come to play the distribution games?

A further interesting extension of our experiments would be a set-up where the decider´s payoff varies with different allocations. In such a setting, choosing, for instance the maximin allocation could be personally costly to the decider. This allows to take selfishness as a component of motivation explicitly into account. It should be investigated whether this strengthens or weakens the observed effects.

2.6 Appendix

A.2.1 Overview of Participants

	all	male	female
T1	129	58 **45%**	71 **55%**
T2	109	58 **55%**	48 **45%**
T3	101	62 **61%**	39 **39%**
T4	170	78 **47%**	88 **53%**
All	509	256 **51%**	246 **49%**

Table A.2.1: Overview of participants.

A.2.2 Chi-squared tests

We test here whether there are significant differences in treatments with and without the information of total and average payoffs. The following data is taken from experiments that we conducted in summer 2002 at the University of Munich. We played only two distribution games here, namely the poor game and the taxation game. There were no real payoffs. Tables A.2.2.1 and A.2.2.2 show the experimental results.

	Poor Game			
Allocation	**A**	**B**	**C**	
absolute number				sum
Economists (with)	8	4	20	32
Economists (without)	5	5	20	30
Economists (all)	**13**	**9**	**40**	62
Others (with)	9	10	36	55
Others (without)	7	8	40	55
Others (all)	**16**	**18**	**76**	110
Sociologists (with)	0	4	24	28
Sociologists (without)	2	4	18	24
Sociologists (all)	2	8	42	52
Munich 2002 (all)	**32**	**35**	**130**	**197**

Table A.2.2.1: Results of the poor game.

	Rich Game			
Allocation	**A**	**B**	**C**	
absolute number				sum
Economists (with)	6	4	22	32
Economists (without)	7	3	19	29
Economists (all)	**13**	**7**	**41**	61
Others (with)	14	8	32	54
Others (without)	12	5	38	55
Others (all)	**26**	**13**	**70**	109
Sociologists (with)	7	2	18	27
Sociologists (without)	4	3	17	24
Sociologists (all)	11	5	35	51
Munich 2002 (all)	**42**	**27**	**126**	**195**

Table A.2.2.2: Results of the taxation game.

The chi-squared tests for the poor game (with versus without additional information) gave the following results:

Economists: $\chi^2 = 0.74$, $p > .691$ (Fisher's exact test: $p > .754$)
Others: $\chi^2 = 0.68$, $p > .711$ (Fisher's exact test: $p > .734$)
Sociologists: $\chi^2 = 2.57$, $p > .277$ (Fisher's exact test: $p > .282$)

These tests show that there is no significant difference between treatments with and without the information on the sum of payoffs and the average payoffs.

The chi-squared test for the taxation game (with versus without additional information) gave the following results:

Economists: $\chi^2 = 0.29$, $p > .864$ (Fisher's exact test: $p > .926$)
Others: $\chi^2 = 1.35$, $p > .509$ (Fisher's exact test: $p > .486$)
Sociologists: $\chi^2 = 0.873$, $p > .646$ (Fisher's exact test: $p > .680$)

Again, there is no significant difference between treatments with and without the information on the sum of payoffs and the average payoffs for each allocation.

A.2.3 Control experiments "sequence of games"

T1org	**taxA**	**taxB**	**taxC**	**poorA**	**poorB**	**poorC**	**richA**	**richB**	**richC**	**sum**
choices (abs.)	9	10	13	9	9	14	9	7	16	32
choices (%)	28.1	31.3	40.6	28.1	28.1	43.8	28.1	21.9	50.0	100
T1var1	**poorA**	**poorB**	**poorC**	**richA**	**richB**	**richC**	**taxA**	**taxB**	**taxC**	
choices (abs.)	8	7	29	12	10	22	9	10	25	44
choices (%)	18.2	15.9	65.9	27.3	22.7	50.0	20.5	22.7	56.8	100
T1var2	**richA**	**richB**	**richC**	**taxA**	**taxB**	**taxC**	**poorA**	**poorB**	**poorC**	
choices (abs.)	20	7	18	20	8	17	19	5	21	45
choices (%)	44.4	15.6	40.0	44.4	17.8	37.8	42.2	11.1	46.7	100
T1	**taxA**	**taxB**	**taxC**	**poorA**	**poorB**	**poorC**	**richA**	**richB**	**richC**	**sum**
choices (abs.)	47	23	59	52	24	53	53	24	52	129
choices (%)	36.4	17.8	45.7	40.3	18.6	41.1	41.1	18.6	40.3	100

Table A.2.3: Results of the control experiments "sequence of games".

Table A.2.3 reports the results of the control treatments. T1 is the original experiment conducted in January 2003.The chi-squared tests listed below show that the sequence of distribution games does not change the behavior significantly. Seven out of nine chi-squared tests do not show any significant differences in how often the respective allocations are chosen in the respective games. Probit estimates, testing whether and how the probability of a certain allocation being chosen depends on the treatment also confirm this result.

Taxation games:

T1org vs. T1var1: χ^2 = 1.94, $p > .378$ (Fisher's exact test: $p > .391$)

T1org vs. T1var2: χ^2 = 2.81, $p > .245$ (Fisher's exact test: $p > .246$)

T1var1 vs. T1var2: χ^2 = 5.91, $p > .052$ (Fisher's exact test: $p > .056$) (significant difference)

Poor games:

T1org vs. T1var1: χ^2 = 3.74, $p > .154$ (Fisher's exact test: $p > .164$)

T1org vs. T1var2: χ^2 = 4.03, $p > .133$ (Fisher's exact test: $p > .144$)

T1var1 vs. T1var2: χ^2 = 6.08, $p > .048$ (Fisher's exact test: $p > .054$) (significant difference)

Rich games:

T1org vs. T1var1: χ^2 = 0.01, p > .995 (Fisher's exact test: p >1 .000)
T1org vs. T1var2: χ^2 = 2.16, p > .340 (Fisher's exact test: p > .334)
T1var1 vs. T1var2: χ^2 = 2.92, p > .232 (Fisher's exact test: p > .244)

A.2.4 Control experiments "subject pool effects"

In what follows we compare the results of treatments T2 and T4 with economics and business students (pool 1) conducted in January 2003 to results of the same experiments with sociologists and other students who chose economics as a minor subject in their studies (pool 2). We conducted these control experiments T2var and T4var in April 2003 during a basic economics course for sociologists and other minor subject students at the University of Munich. We had 83 participants in T2var (42 sociologists and 41 other studies; 31 male and 52 female) and 77 participants in T4var (40 sociologists and 37 other studies; 36 male and 41 female).

Table A.2.4 reports the results of the original treatments T2 and T4 with subject pool 1 and the results of the control treatments T2var and T4var with subject pool 2.

	Game 1 (Tax)			**Game 2** (Poor)			**Game 3** (Rich)		
Allocation	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Person 1	**21**	**17**	**13**	**14**	**11**	**8**	**11**	**8**	**5**
Person 2	**9**	**9**	**9**	**4**	**4**	**4**	**12**	**12**	**12**
Person 3	**3**	**4**	**5**	**5**	**6**	**7**	**2**	**3**	**4**
Total	33	30	27	23	21	19	25	23	21
Average 1,3	12	10.5	9	9.5	8.5	7.5	6.5	5.5	4.5
Efficient	A			A			A		
FS			C			C	A		
Maximin			C	A	B	or C			C
T2									
choices (abs.)	72	12	25	63	16	30	70	14	25
choices (%)	**66.1**	**11.0**	**22.9**	**57.8**	**14.7**	**27.5**	**64.2**	**12.8**	**22.9**
T4									
choices (abs.)	69	28	73	73	36	61	72	40	58
choices (%)	**40.6**	**16.5**	**42.9**	**42.9**	**21.2**	**35.9**	**42.4**	**23.5**	**34.1**
T2var									
choices (abs.)	22	13	48	21	17	45	33	19	31
choices (%)	**26.5**	**15.7**	**57.8**	**25.3**	**20.5**	**54.2**	**39.8**	**22.9**	**37.3**
T4var									
choices (abs.)	16	17	44	18	11	48	17	16	44
choices (%)	**20.8**	**22.1**	**57.1**	**23.4**	**14.3**	**62.3**	**22.1**	**20.8**	**57.1**

Table A.2.4: T2 and T4 with pool 1 and pool 2.

Effects of a strategic context (ultimatum game)

As can be seen, the treatment effect of the strategic context goes in the same direction for both groups of subjects. In the strategic context, maximin preferences become more important in the control treatments, while efficiency motives become less important. Concerning FS preferences of inequity aversion the effect is inconsistent. Note that with students of non-economic the effect is less strong. This is probably due to the subject pool effect. Non-economic students chose less efficient in treatment 2 (T2var) as well. Therefore the effect of a strategic environment (comparing T2var to T4var) is less strong in absolute numbers.

First compare the original T2 to T4. The following chi-squared tests have been made:

Tax: $\chi^2 = 17.47, p > .000$ (Fisher's exact test: $p > .000$)

Poor: $\chi^2 = 5.93, p > .051$ (Fisher's exact test: $p > .054$)

Rich: $\chi^2 = 12.95, p > .002$ (Fisher's exact test: $p > .002$)

Hence, all differences are highly significant (i.e. we observe a strong treatment effect).

Next compare the control treatments T2var to T4var:

Tax: $\chi^2 = 1.43, p > .489$ (Fisher's exact test: $p > .502$)

Poor: $\chi^2 = 1.39, p > .499$ (Fisher's exact test: $p > .510$)

Rich: $\chi^2 = 7.42, p > .025$ (Fisher's exact test: $p > .025$)

Thus, only for the rich game we have a significant treatment effect.

Subject pool effect (T2 versus T2var and T4 versus T4var)

As is visible in Table A.2.4.we observe a strong subject pool effect. Economics and business students are highly biased towards efficiency whereas sociologists and others seem to choose very much according to maximin motives. The significance of this difference is confirmed in a number of chi-squared tests, as can be seen below.

First compare T2 to T2var:

Tax: $\chi^2 = 30.93, p > .000$ (Fisher's exact test: $p > .000$)

Poor: $\chi^2 = 20.89, p > .000$ (Fisher's exact test: $p > .000$)

Rich: $\chi^2 = 11.38, p > .003$ (Fisher's exact test: $p > .003$)

All differences are highly significant (i.e. we observe a strong subject pool influence).

Next compare T4 to T4var:

Tax: $\chi^2 = 9.21, p > .010$ (Fisher's exact test: $p > .008$)

Poor: $\chi^2 = 15.23, p > .000$ (Fisher's exact test: $p > .001$)

Rich: $\chi^2 = 13.03, p > .001$ (Fisher's exact test: $p > .002$)

Again all differences are highly significant (i.e. again we observe a strong subject pool influence).

A.2.5 Probit estimates for T1 and T3 only[65]

	Explanatory Variables		
	Constant	**Male**	**UG**
A1	-.530***	.393**	-.059
	(.140)	*(.173)*	*(.174)*
C1	-.028	-.177	.274
	(.134)	*(.169)*	*(.170)*

Table A.2.5: Probit estimates for T1 and T3.

A.2.6 Probit estimates

	Explanatory Variables			
	Constant	**Male**	**UG**	**Payoff**
A2	-.302***	.243**	-.209*	.271**
	(.114)	*(.113)*	*(.115)*	*(.115)*
A3	-.222**	.273**	-.296***	.305***
	(.113)	*(.113)*	*(.115)*	*(.115)*

Table A.2.6: Probit estimates for efficient allocations A2 and A3.

Please note that here the dummy variable *UG* is not of high significance, but remember that A2 is not only the efficient but also a maximin allocation in game 2.

A.2.7 Probit estimates

	Explanatory Variables			
	Constant	**Male**	**UG**	**Payoff**
C2	-.194*	-.047	.223*	-.369***
	(.113)	*(.115)*	*(.117)*	*(.117)*
C3	-.365***	.090	.172	-.351***
	(.115)	*(.116)*	*(.119)*	*(.118)*

Table A.2.7: Probit estimates for maximin allocations C2 and C3.

[65] For all probit estimates please note that asteriks denote statistical significance at the 10% (*). 5% (**), or 1% (***) level. Estimated standard errors appear in parentheses.

Again the variable *UG* is not of high significance, but C2 is not the only maximin allocation in game 2, as game 2 is neutral for maximin allocation A2 also coincides with maximin motives. Note that the dummy variable *UG* is not significant here.

A.2.8 Separate analysis of male and female participants

In order to get the results more clear cut and to control for the gender effect completely, we analyzed all effects discussed in Section 2.3.1 for male and female participants separately. The results and chi-squared tests listed below confirm that all effects also hold in the separate analysis.

Table A.2.8.1 shows the results for the subset of male subjects.

	Game 1 (Tax)			**Game 2** (Poor)			**Game 3** (Rich)		
Allocation	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Person 1	**21**	**17**	**13**	**14**	**11**	**8**	**11**	**8**	**5**
Person 2	**9**	**9**	**9**	**4**	**4**	**4**	**12**	**12**	**12**
Person 3	**3**	**4**	**5**	**5**	**6**	**7**	**2**	**3**	**4**
Total	33	30	27	23	21	19	25	23	21
Average 1,3	12	10.5	9	9.5	8.5	7.5	6.5	5.5	4.5
Efficient	A			A			A		
FS			C			C	A		
Maximin			C	A	B	or C			C
T1									
choices (abs.)	26	6	26	26	8	24	28	6	24
choices (%)	**44.8**	**10.3**	**44.8**	**44.8**	**13.8**	**41.4**	**48.3**	**10.3**	**41.4**
T2									
choices (abs.)	41	6	11	39	6	13	43	4	11
choices (%)	**70.7**	**10.3**	**19.0**	**67.2**	**10.3**	**22.4**	**74.1**	**6.9**	**19.0**
T3									
choices (abs.)	26	5	31	26	8	28	25	9	28
choices (%)	**41.9**	**8.1**	**50.0**	**41.9**	**12.9**	**45.2**	**40.3**	**14.5**	**45.2**
T4									
choices (abs.)	35	16	27	34	12	32	37	12	29
choices (%)	**44.9**	**20.5**	**34.6**	**43.6**	**15.4**	**41.0**	**47.4**	**15.4**	**37.2**

Table A.2.8.1: Male participants.

In what follows, we report the corresponding chi-squared tests for the effect of real payments.

T1 versus T2:

Tax: $\chi^2 = 9.44$, $p > .009$ (Fisher's exact test: $p > .010$)

Poor: $\chi^2 = 6.16$, $p > .046$ (Fisher's exact test: $p > .043$)

Rich: $\chi^2 = 8.40$, $p > .015$ (Fisher's exact test: $p > .014$)

T3 versus T4:

Tax: $\chi^2 = 5.61$, $p > .060$ (Fisher's exact test: $p > .063$)

Poor: $\chi^2 = 0.31$, $p > .857$ (Fisher's exact test: $p > .919$)

Rich: $\chi^2 = 0.953$, $p > .621$ (Fisher's exact test: $p > .626$)

Next, consider the chi-squared tests for the effect of the ultimatum game.

T1 versus T3:

Tax: $\chi^2 = 0.40$, $p > .820$ (Fisher's exact test: $p > .828$)

Poor: $\chi^2 = 0.175$, $p > .916$ (Fisher's exact test: $p > .918$)

Rich: $\chi^2 = 0.945$, $p > .623$ (Fisher's exact test: $p > .668$)

T2 versus T4:

Tax: $\chi^2 = 9.01$, $p > .011$ (Fisher's exact test: $p > .012$)

Poor: $\chi^2 = 7.59$, $p > .023$ (Fisher's exact test: $p > .022$)

Rich: $\chi^2 = 9.82$, $p > .007$ (Fisher's exact test: $p > .008$)

Table A.2.8.2 shows the results for the subset of female subjects.

	Game 1 (Tax)			**Game 2** (Poor)			**Game 3** (Rich)		
Allocation	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Person 1	**21**	**17**	**13**	**14**	**11**	**8**	**11**	**8**	**5**
Person 2	**9**	**9**	**9**	**4**	**4**	**4**	**12**	**12**	**12**
Person 3	**3**	**4**	**5**	**5**	**6**	**7**	**2**	**3**	**4**
Total	33	30	27	23	21	19	25	23	21
Average 1,3	12	10.5	9	9.5	8.5	7.5	6.5	5.5	4.5
Efficient	A			A			A		
FS			C			C	A		
Maximin			C	A	B	or C			C
T1									
choices (abs.)	21	17	33	26	16	29	25	18	28
choices (%)	**29.6**	**23.9**	**46.5**	**36.6**	**22.5**	**40.8**	**35.2**	**25.3**	**39.4**
T2									
choices (abs.)	30	5	13	21	10	17	26	10	12
choices (%)	**62.5**	**10.4**	**27.1**	**43.8**	**20.8**	**35.4**	**54.2**	**20.8**	**25.0**
T3									
choices (abs.)	11	3	25	13	3	23	18	8	13
choices (%)	**28.2**	**7.7**	**64.1**	**33.3**	**7.7**	**59.0**	**46.2**	**20.5**	**33.3**
T4									
choices (abs.)	32	12	44	38	23	27	34	28	26
choices (%)	**36.4**	**13.6**	**50.0**	**43.2**	**26.1**	**30.7**	**38.6**	**31.8**	**29.5**

Table A.2.8.2: Female participants.

In what follows, we report the corresponding chi-squared tests for the effect of real payments.

T1 versus T2:

Tax: $\chi^2 = 12.87$, $p > .002$ (Fisher's exact test: $p > .002$)

Poor: $\chi^2 = 0.63$, $p > .732$ (Fisher's exact test: $p > .720$)

Rich: $\chi^2 = 4.43$, $p > .109$ (Fisher's exact test: $p > .113$)

T3 versus T4:

Tax: $\chi^2 = 2.33$, $p > .312$ (Fisher's exact test: $p > .348$)

Poor: $\chi^2 = 10.64$, $p > .005$ (Fisher's exact test: $p > .005$)

Rich: $\chi^2 = 1.72$, $p > .424$ (Fisher's exact test: $p > .412$)

Next, consider the chi-squared tests for the effect of the ultimatum game.

T1 versus T3:

Tax: $\chi^2 = 5.16, p > .076$ (Fisher's exact test: $p > .068$)

Poor: $\chi^2 = 5.04, p > .081$ (Fisher's exact test: $p > .082$)

Rich: $\chi^2 = 1.27, p > .529$ (Fisher's exact test: $p > .530$)

T2 versus T4:

Tax: $\chi^2 = 8.80, p > .012$ (Fisher's exact test: $p > .011$)

Poor: $\chi^2 = 0.58, p > .749$ (Fisher's exact test: $p > .741$)

Rich: $\chi^2 = 3.27, p > .195$ (Fisher's exact test: $p > .223$)

A.2.9 Correlation coefficients[66]

T2	A1	C1	A2	C2	A3	C3
A1	1					
C1		1				
A2	0.486***	-0.418***	1			
C2	-0.382***	0.397***		1		
A3	0.435***	-0.321***	0.408***	-0.354***	1	
C3	-0.392***	0.325***	-0.285***	0.299***		1

Table A.2.9.1: Pearson correlation coefficients in treatment 2.

T3	prop	minacc	A1	C1	A2	C2	A3	C3
prop	1							
minacc	0.494***	1						
A1	-0.267***	-0.174	1					
C1	0.146	0.128		1				
A2	-0.234**	-0.153	0.748***	-0.680***	1			
C2	0.142	0.060	-0.562***	0.626***		1		
A3	-0.217**	-0.063	0.509***	-0.477***	0.592***	-0.509***	1	
C3	0.035	-0.081	-0.377***	0.498***	-0.449***	0.496***		1

Table A.2.9.2: Pearson correlation coefficients in treatment 3.

[66] For all Peason correlation coefficients calculated here, significance of the respective correlation coefficients is marked by stars, where (two sided) significance at the 1% level is indicated by three stars and (two sided) significance at the 5% level by two stars.

T4	prop	minacc	A1	C1	A2	C2	A3	C3
prop	1							
minacc	**0.258*** **	1						
A1	-0.126	-0.227***	1					
C1	0.136	0.145		1				
A2	-0.121	-0.175**	**0.590*** **	*-0.464****	1			
C2	0.058	0.143	*-0.369****	**0.441*** **		1		
A3	-0.135	-0.260***	**0.625*** **	*-0.503****	**0.531*** **	*-0.368****	1	
C3	0.045	0.135	*-0.393****	**0.353*** **	*-0.323****	**0.367*** **		1

Table A.2.9.3: Pearson correlation coefficients in treatment 4.

all	prop	minacc	A1	C1	A2	C2	A3	C3	UG	pay
prop	1									
minacc	**0.363*** **	1								
A1	-0.173***	-0.205***	1							
C1	0.110	0.135**		1						
A2	-0.156***	-0.165***	**0.626*** **	*-0.537****	1					
C2	0.063	0.105	*-0.449****	**0.519*** **		1				
A3	-0.166***	-0.181***	**0.585*** **	-0.468***	**0.561*** **	**-0.415*** **	1			
C3	0.026	0.045	*-0.414****	**0.430*** **	*-0.378****	**0.404*** **		1		
UG			-0.109**	0.124***	-0.070	0.066	-0.092**	0.044	1	
payoff	0.204***	0.017	0.140***	-0.150***	0.092**	-0.129***	0.091**	-0.122**	0.170***	1

Table A.2.9.4: Pearson correlation coefficients across all treatments.

A.2.10 Instructions

We chose to include the instructions for treatment T4 in this Appendix as T4 includes the ultimatum game as well as monetary payments.

Experiment

Ident. No.: _______________

I kindly would like to ask you to participate in the four hypothetical decision problems on the attached decision sheets.
Decision problem 1 is a two person game, in which you have to decide how to allocate a certain amount of money between you and another person. In this problem you, as well as the other person, have to make a decision.
Decision problems 2, 3 and 4 are all structured identically. For each problem, please imagine that you are part of a three-person group. In each case you have to decide between different allocations of monetary payoffs among the 3 persons. You are always assigned the role of person 2. The other two persons do not have the possibility to make any decisions. In each decision problem the different payoff allocations are labeled allocation A, allocation B and allocation C.

You do not know the identity of the other two persons in the group and the other group members will not be informed about your identity.

After collecting all the decision sheets, we will randomly select for each of the four decision problems two (decision problem 1) and three persons for decision problems 2, 3 and 4. In all decision problems the order of the selection determines the role of the selected persons (i.e. person 1 to 3 for decision problems 2, 3 and 4). These persons are paid the monetary payoffs, which were determined by the decision of person 2. In the case you are randomly selected you could be in the role of either person 1, 2 or 3. **The identity of the selected persons and the monetary payoffs are kept secret to the other participants.** Please keep the sheet with your identification number. Without this sheet we cannot give you the money.

Please make your decisions privately without contacting your neighbor or discussing your decision with other people. We are interested in your independent decision. When you have made all decisions please fold the decision sheet and put it in the box. This ensures the anonymity of your decisions.
Before we start with the experiment we would like to ask you for the following personal information:

Major, Year: ________________________________
sex: ☐ **male** ☐ **female**

Decision Problem 1:

Consider the following two person decision problem:
You are person 1 and you can now decide how to allocate € 10 between you and an anonymous person 2. You could propose any arbitrary amount of money *x* between € *0* and € *10* for the share of person 2. If person 2 accepts your proposal, you are paid € *(10-x)* and person 2 gets € *x*.

If person 2 rejects your proposal, you both get nothing, i.e. you are paid € 0.
The decision problem is anonymous, i.e. you do not have the possibility to communicate neither before nor after the experiment with person 2.

Which amount of money do you propose for the share that person 2 receives?
Proposed share for person 2 € ________________________________.
Now imagine that you are in the role of person 2.
What is the smallest share, proposed to you by person 1, that you would accept?

The share must be at least € ______________ so that I would accept it as person 2.
If the share is less than the named one, I would reject it.

Note that if you are randomly selected as either person 1 or 2, you only get a positive amount of money, if your proposal is compatible with the acceptance/rejection decision of the randomly selected person 1 or person 2 respectively.

Decision problem 2:

You are person 2. You can now determine unilaterally the payoff allocation between the three persons in your group. You are the only person in the group that makes a decision. Please choose the payoff allocation that you prefer by marking the respective column.

	Payoff Allocation		
	A	**B**	**C**
Person 1	€21	€17	€13
Person 2 (YOU)	€9	€9	€9
Person 3	€3	€4	€5
Your decision	□	□	□
Average payoff of persons 1 and 3	€12	€10.5	€9
Total payoff of all three persons together	€33	€30	€27

Decision problem 3:

You are person 2. You can now determine unilaterally the payoff allocation between the three persons in your group. You are the only person in the group that makes a decision. Please choose the payoff allocation that you prefer by marking the respective column.

	Payoff Allocation		
	A	**B**	**C**
Person 1	€14	€11	€8
Person 2 (YOU)	€4	€4	€4
Person 3	€5	€6	€7
Your decision	☐	☐	☐
Average payoff of persons 1 and 3	€9.5	€8.5	€7.5
Total payoff of all three persons together	€23	€21	€19

Decision problem 4:

You are person 2. You can now determine unilaterally the payoff allocation between the three persons in your group. You are the only person in the group that makes a decision. Please choose the payoff allocation that you prefer by marking the respective column.

	Payoff Allocation		
	A	**B**	**C**
Person 1	€11	€8	€5
Person 2 (YOU)	€12	€12	€12
Person 3	€2	€3	€4
Your decision	☐	☐	☐
Average payoff of persons 1 and 3	€6.5	€5.5	€4.5
Total payoff of all three persons together	€25	€23	€21

CHAPTER 3

ADVERTISING AND THE MEDIA[67]

3.1 Introduction

The complementary view of advertising (pioneered by Becker and Murphy, 1993) holds that advertising should be seen as a good or bad that is complementary to the advertised good. This approach has been instrumental in analyzing the welfare effects of advertising (see Bagwell, 2004, for a discussion). Suppose that advertising is a bad for consumers.[68] Then firms have to pay consumers to consume their advertising. If the resulting increase in the firms' profits (via increased sales through advertising) outweighs the utility loss incurred by the consumers (due for instance to the annoyance caused by the exposure to the advertisement), then there is scope for a mutually beneficial transaction.[69]

[67] This chapter is joint work with Hans Zenger.
[68] This is the view that we will hold throughout this chapter.
[69] Note that for an analysis of the welfare effects that are involved here, one would also have to take externalities into account that the two parties exert on others. For example, if advertising simply shifts consumption of a certain good from one company to another, as is often put forward by the literature on sunk costs and market structure (for instance Sutton, 1991), then advertising may be socially inefficient even if the two parties can make a mutually beneficial trade.

However, given that advertising can be viewed as a standard good or bad consumed by economic agents, the question arises why there are hardly any direct markets on which advertising is traded. In this chapter we argue that this is mainly due to adverse selection. Clearly, firms are willing to pay different amounts of money for different consumers, depending on unobservable characteristics like income, interest in the advertised product, or past consumption. Hence, every consumer would have an incentive to claim that she has profitable characteristics. This effect is absent in most models of advertising, as it is usually assumed that consumers are homogeneous.

As an illustration of our point, consider the few marketplaces on which advertising is traded between firms and consumers which do exist. Both in the US and in Europe several websites offer consumers money for reading e-mail advertisements, viewing banners in their browser and the like. Those websites are financed by the firms that book the advertising. Some of them are paying out since several years and have managed to acquire quite impressive client bases. The German start-up Bonimail.de for instance claims to have almost 100,000 members. Still, all those websites are visibly plagued by adverse selection. Most of them pay extremely low rates (often below one euro cent for viewing an on-line advertisement for at least 30 seconds and then following a confirmation procedure). Also, the advertising that they feature is obviously targeted at low income consumers. Major advertisers are bargain-websites, loan-sharks, financial institutions offering credit cards without solvency check and dubious internet business opportunities. The market outcome is thus as proposed in Akerlof's (1970) classic lemons market: the average payout rate is too low for high income consumers, who drop out of the market, reducing the quality of the pool; this implies that the payout rate is deteriorated even more and the process repeats until only the lowest income type remains.[70]

[70] Apparently, the above webpages also have to handle a problem of moral hazard, as it is difficult to guarantee that consumers pay sufficient attention to the advertisements. However, software technologies tackle this problem quite efficiently. For instance, websites that pay for viewing banners only award credits if the user clicks a confirmation button in regular intervals, in order to prevent that the ads are run while the user is absent from the computer.

In this chapter we analyze how media firms can mitigate the adverse selection problem from which direct markets suffer. There are some obvious ways in which they do this. For instance, tennis rackets are advertised in tennis magazines. Also, high income types can be targeted by placing ads in golf magazines. There is, however, a limit to this kind of targeting. In particular, most companies want to reach broader audiences of high income types than the very small subset of those happening to read golf magazines. In addition, most products are not as target-group specific as tennis-rackets. Hence, most advertising has to rely on mass media in order to get its message across.

Mass media like television or magazines sell a bundle of products consisting of a primary product (the content) and a secondary product (the advertising). Agents have to pay a price for consuming the content and receive a reimbursement for consuming the advertising (in the form of a lower cover price or subscription fee). In trading the advertising, the media firm acts as an intermediary on behalf of the advertising companies. Since it offers both products as a bundle, it can tackle the adverse selection problem: by distorting the market for its primary product (for example by altering its price or quality) it can mitigate the distortion in the secondary market. Thus, the two-sided market nature of media firms allows achieving more efficiency in the market for advertising.

As an illustrative example of what we have in mind consider two competitive TV markets in countries *R(ich)* and *P(oor)* that broadcast the latest Hollywood movies. Suppose the film industry demands a fixed price per viewer from the TV stations that want to show their movies. Assume that people who live in *R* are rich, whereas people who live in *P* are poor. Consider the case where advertising rates are sufficiently high so that all stations are financed by advertising rather than a subscription fee. Clearly, as consumers in country *R* are more attractive to advertisers, the price for an advertisement is higher in country *R* than in country *P*. Therefore, in the competitive equilibria (where media firms earn zero profits) there is less advertising in country *R* than in country *P*. Now consider a trade liberalization which makes it possible that TV stations broadcast in both countries. Apparently, the full information competitive outcome that was just described is not stable in this new situation as all viewers in country *P* would switch to channels of country *R*, where there is less advertising. Since the TV stations in country *R* were just breaking even with the high advertising rates they received for their rich viewers, they would now make losses with the new mixed audience. A possible solution for this problem is that the channels in *R* demand a positive subscription fee and reduce their advertising. This is a helpful separating mechanism because poor viewers may suffer harder from a subscription fee than rich viewers, hence incentive compatibility can be achieved. Note that this mechanism seriously hampers price competition of media products: as lowering the price attracts low income viewers, competition for high income types will mainly be driven by the quality of the media and the amount of advertising.

We analyze both monopolistic and competitive media markets, assuming that there are high and low income consumers. The main findings of this chapter are as follows. Unless consumers' tastes for the quality of media content are very heterogeneous, first best pricing schemes for media products are not incentive compatible. In order to separate types, media firms use two instruments. By increasing the price of the high type bundle above the first best level, firms can deter low types from consuming it. The second means to separate types is increasing the quality of the high type bundle beyond first best levels. This deters low types indirectly as it involves an increase in advertising or price in order to finance the higher production costs. But as low types are likely to have a lower willingness to pay for a quality improvement than high types, the incentive constraint of low types is relaxed.

It turns out that an increase in the difference of the two types' quality preference has two effects: (i) It is cheaper to use the quality distortion as a screening instrument; hence there is more of it and less price distortion. (ii) As the preferred bundles of the two types differ more, screening becomes easier, so both types of distortion will be used less. The second effect implies that if the preferences of the two types are very different, the first best is attainable. These effects will be shown to persist both in competitive and monopolistic media markets.

Our results are well in line with empirical evidence on media markets. In particular, Thompson's (1989) and Kaiser's (2002) analyses of newspaper and magazine markets show that media firms, when considering a cover price cut, face a trade-off between increased sales and deteriorating advertising rates. This is exactly the trade-off that is generated by adverse selection in our model. A more detailed discussion of empirical results can be found in Section 3.6.

Recently, media markets have been analyzed extensively in the two-sided market literature.[71] Models in this spirit are Anderson and Coate (2004), Chaudhri (1998), Gabszewicz, Laussel, and Sonnac (2001b), Gal-Or and Dukes (2004), Häckner and Nyberg (2000) and Nilssen and Sørgard (2001). These papers offer interesting insights into the nature of competition in media markets, but do not address the question of adverse selection we are concerned with here.

The monopoly case in this chapter is closely related to the literature on monopolistic price discrimination with endogenous quality choice (most notably Mussa and Rosen, 1978, and Srinagesh and Bradburd, 1989). As should become clear below, however, the basic intuitions that were derived in this literature usually fail to hold in the case of media markets.

Our model is a model of multidimensional screening in the sense that media firms have several screening instruments at their disposal. On the other hand, it is one-dimensional in the sense that consumer types are differentiated along a single dimension alone. This feature is responsible for the fact that it does not inherit the technical difficulties that characterize general models of multidimensional screening, where often no clear ordering of types is possible (see Rochet and Stole, 2003, for an overview).

[71] See Armstrong (2004) and Rochet and Tirole (2003) for some of the general insights from this literature. They also contain some analysis of media markets.

The remainder of this chapter is organized as follows. In Section 3.2 we present the formal model. Section 3.3 characterizes the equilibrium in a monopolistic media market, whereas Section 3.4 considers a competitive media market. Section 3.5 presents some comparative statics analysis. Finally, in Section 3.6 we offer some extensions of our basic model, discuss our results and relate them to empirical work.

3.2 The Model

Consider a market for an homogeneous media product. This could be any kind of product that can be financed both via advertising and via price (for example a TV station, a newspaper or a webpage).[72] In principle, it could even be a professional sports event or a software program. There are two types of consumers: high types (denoted by subscript H) with high income, high involvement or the like and low types (denoted by subscript L). There is a continuum of consumers of measure 1. A proportion γ is of type H, while a proportion $1-\gamma$ is of type L. Consumers have unit demand and buy from the media firm providing them with the highest utility (if above zero). The utility of a consumer of type i from consumption of a given media product is

$$V_i = \bar{U}_i - \alpha - \beta_i p + v_i q \tag{1}$$

where $\alpha \geq 0$ denotes the amount of advertising, $p \geq 0$ denotes the cover price or subscription fee and $q \in \mathbb{R}$ denotes the quality of the content of the media product. "Quality" refers to some unambiguously measurable quality characteristic of the media output, say the number of color pages in a newspaper or the amount of money that a TV station spends on broadcasting rights. Naturally, price enters negatively and quality

[72] Throughout this chapter we assume that media companies have access to a technology that enables them to raise a price from consumers. If such a technology was costly, these transaction costs would bias the results in this chapter towards advertising finance of the media product (as is encountered for instance in the radio market).

enters positively in the utility function. Advertising enters negatively, that is, there are nuisance costs of advertising. This is a weak assumption in the case of television (which predominantly features persuasive advertising) but may be less innocuous in the case of newspapers (which often have a large fraction of informative advertising).[73]

$\bar{U}_i$ is a constant measuring the utility of consuming a free, base-quality media product containing no advertising. $\beta_i > 0$ measures type i's aversion to monetary expenditures.[74] Let $\beta_L > \beta_H$, implying that poor consumers suffer more from a higher price than rich consumers. $v_i \geq 0$ is an indicator of type i's willingness to pay for quality. Let $v_H \geq v_L$. With this assumption we do not want to suggest that low types have a lower appreciation for quality, but rather that their lack of wealth induces a lower marginal willingness to pay for it. We normalize $v_L = 0$ which has no impact on the quality of our results but greatly simplifies calculations.

We will differentiate between the two polar cases of a monopolistic media firm and a competitive media market with many firms. Media firms can offer media products which are characterized by the vector $C = (p, \alpha, q)$. Although media firms may have market power regarding consumers, they are assumed to be price-takers regarding the advertising side of the market. That is, there is perfect competition on the market for advertising. This means that, although a trucking magazine does not compete with a women's magazine for readers, the two *do* compete for advertising. This concords with the motivation that was given in the introduction: advertising firms can not fully reach their target groups by advertising in special interest media alone, but have to spread out their campaigns over different types of (mass) media. Accordingly, let δ_i denote the

[73] It is generally accepted that TV advertising annoys most viewers. Sometimes it is argued that newspaper advertising is not harmful to readers. Contrary to this view, Sonnac (2000) presents evidence that most European readers are ad-averse. American newspaper readers, on the other hand, seem to like advertising (Rosse, 1980). It is clear that beyond some percentage of newspaper space that is devoted to advertising, ads become annoying even to ad-lovers. As it is optimal for media firms to increase advertising beyond this threshold, the last units of advertising will cause disutility in any case.

[74] As equation (1) has been normalized with respect to α, β_i can also be interpreted as the marginal rate of substitution between watching advertising and paying a fee to finance a media good.

market price for one unit of advertising that is consumed by a consumer of type i.[75] It is natural to have $\delta_H > \delta_L$. This is supported by Fisher, McGowan and Evans (1980) who find that US broadcasting stations with high income viewers receive much more favorable advertising rates than otherwise equal stations with relatively poor audience. Thompson (1989) presents similar evidence for newspaper markets.

Consumers can remunerate media firms for obtaining the media content they desire by paying a subscription fee and/or by accepting advertising. Which form of obligation they prefer of course depends on their preferences.[76] From (1) we have that consumers of type i strictly prefer advertising-financed media to subscription-based media if $\delta_i\beta_i > 1$. If $\delta_i\beta_i = 1$, they are indifferent between the two. And if $\delta_i\beta_i < 1$, they strictly prefer paying in money rather than consuming advertisements. As this chapter is concerned with the provision of advertising, we fully concentrate on the case where $\delta_i\beta_i > 1$ for $i \in \{H, L\}$ and hence assume advertising to be the efficient form of financing for media content. We forgo the analysis of the other possible cases. Note, however, that the adverse selection problem may be less severe in alternative settings, as it is then possible that some consumers prefer subscription-based media while others prefer advertising-based media, which facilitates screening.[77]

Media firms have a cost function that consists of marginal cost $c > 0$ and fixed cost $F \geq 0$, which has to be incurred by every firm that wants to engage in the media market. This is in accordance with empirical evidence that media firms exhibit increasing returns to scale (Rosse, 1967, 1970). We assume that the provision of quality

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[75] δ_i is the price that brings demand and supply for type i advertising across media markets into equilibrium.
[76] Note that media firms' preferences concerning the form of payment are perfectly in line with consumers' in a first best world: letting consumers choose the form of payment maximizes the sum that can be extracted from them - directly via a subscription fee or indirectly via advertising revenue.
[77] In the real world, at least *some* advertising must be efficient in the sense employed above. Otherwise, we would not observe advertising, as then media firms could increase their profit by having less advertising and increasing the media price such that consumers' utility levels stay constant. As will become clear below, this argument does not hold for subscription fees. Asymmetric information might guarantee their existance even in a world where every consumer would prefer all types of media to be fully advertising-financed.

increases the marginal cost of the media product in a convex way. To be concrete, we choose quality costs to be $\frac{1}{2}\varphi q_i^2$, where $\varphi > 0$ is a parameter that measures how costly the provision of quality is. One could argue that quality costs are fixed rather than variable. We claim that this is not the case for most components of quality. For instance, arguably the most costly component of magazine quality are printing costs, which are determined by the number of pages, the extent of color-printing, the type of paper and the like. Kaiser (2002) estimates marginal costs of German women's magazines at roughly twice the cover price. Likewise, broadcasting quality-costs are variable rather than fixed: usually the prices that television stations have to pay for content from outside providers, who sell the rights to broadcast movies, sports events or the like, are sharply increasing with the number of consumers. Naturally, Belgian television pays much lower fees to obtain the broadcasting rights for the Olympic Games than a French station does.

Note that because of the above technological specifications, our model crucially differs from the view that (broadcasting) media are public goods. For instance, many undergraduate textbooks in public economics list television as an example for a pure public good, satisfying non-rivalry and non-excludability. In contrast to this we argue that media provision *is* excludable (as media firms can charge a price) and rivalrous (as additional viewers increase costs).

Putting the above together, a media product $C = (p, \alpha, q)$ that caters to a consumer of type i makes a marginal profit of

$$\pi = \alpha\delta_i + p - c - \tfrac{1}{2}\varphi q^2 \tag{2}$$

per consumer.

An interesting problem of course only arises if consumers' willingness to pay is high enough to make production of the media product efficient. The condition $\bar{U}_i / \beta_i \geq F + c$ for $i \in \{H, L\}$, which says that the willingness to pay for a media good exceeds its production costs, guarantees that production is always constrained Pareto optimal.[78] We assume this condition to hold throughout this chapter.

3.3 Monopoly Media

3.3.1 First Best

We will now analyze the equilibrium in the media market for a monopolistic media firm. As a benchmark, we first consider the market equilibrium under full information, assuming that the media firm can perfectly discriminate between types. In order to make sure that consumers buy the media product, the monopolist has to bear in mind the participation constraints

$$\bar{U}_H - \alpha_H - \beta_H p_H + v_H q_H \geq 0 \tag{3}$$

for high types and

$$\bar{U}_L - \alpha_L - \beta_L p_L \geq 0 \tag{4}$$

for low types, which follow directly from (1). Also, the monopolist has to ensure that the non-negativity constraints

$$\alpha_i \geq 0 \text{ for } i \in \{H, L\} \tag{5}$$

and

$$p_i \geq 0 \text{ for } i \in \{H, L\} \tag{6}$$

are met. The monopolist's program thus becomes to solve

[78] Remember that consumers are of measure 1.

(P1) $$\max_{\substack{\{(p_H,\alpha_H,q_H),\\(p_L,\alpha_L,q_L)\}}} \gamma\left(\alpha_H\delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right) + (1-\gamma)\left(\alpha_L\delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right) - F$$

subject to (3) to (6).

The solution to program (P1) is straightforward to find and has $p_H^{FB} = 0'$, $\alpha_H^{FB} = \bar{U}_H + (\delta_H/\varphi)v_H^2$ and $q_H^{FB} = (\delta_H/\varphi)v_H$ for the high type and $p_L^{FB} = 0$, $\alpha_L^{FB} = \bar{U}_L$ and $q_L^{FB} = 0$ for the low type. This is quite intuitive. As advertising is the efficient way of paying for the media product, prices are zero for both types and the media product is fully financed by advertising. This way, the monopolist is able to extract most rent. Low types receive zero quality as they do not care about it. High types, on the other hand, receive a positive amount of quality, which is increasing in their valuation v_H and in advertising receipts δ_H, while it is decreasing in the cost of the provision of quality φ. The monopolist provides both types with the efficient amount of quality as this maximizes the amount of rent he can extract from them. Which type has to accept more advertising depends on the two types' maximum willingness to accept advertising ($\bar{U}_L$ and $\bar{U}_H$) and on the quality preferences of the H-types. Consumers are held to zero utility.

3.3.2 Second Best

Next we turn to the case of asymmetric information with respect to consumers' types. In this case consumers are free to buy any media product that is available on the market. The monopolist has two possibilities. Either he can price discriminate and thereby sell to the whole market. Or he can offer a single bundle only and thence extract the whole rent from one type alone, while rationing the other one. Which of these strategies is optimal typically depends on the relative frequency of types. As is usual in the literature on price discrimination, we first consider the case of price discrimination without worrying about the possibility of rationing for the moment.

In this case the monopolist again maximizes her profit given participation constraints of the two types. But now she also has to consider the following incentive constraints, which guarantee that both types actually prefer the bundle that is designed for them. The high type's incentive constraint can be easily constructed from (1) as

$$\alpha_L - \alpha_H + \beta_H \left(p_L - p_H \right) - v_H \left(q_L - q_H \right) \geq 0. \tag{7}$$

Similarly, the low type's incentive constraint is

$$\alpha_H - \alpha_L + \beta_L \left(p_H - p_L \right) \geq 0. \tag{8}$$

Note that the L-type's incentive constraint is independent of the quality of the media goods because $v_L = 0$. The monopolist solves

(P2) $$\max_{\substack{\{(p_H, \alpha_H, q_H), \\ (p_L, \alpha_L, q_L)\}}} \gamma \left(\alpha_H \delta_H + p_H - c - \tfrac{1}{2} \varphi q_H^2 \right) + (1 - \gamma) \left(\alpha_L \delta_L + p_L - c - \tfrac{1}{2} \varphi q_L^2 \right) - F$$

subject to (3) to (8).

It turns out that the solution to this program is different for two distinct cases: (a) High types have a higher willingness to pay for a media good of base quality than low types (in terms of money); but low types will accept a higher maximum amount of advertising than high types. (b) One type has a higher willingness to pay in both dimensions.[79] We have argued that (compared to low types) high types find price increases relatively less worrying than an equivalent advertising increase. Situation (a) corresponds to the case where this statement does not only hold in marginal but also in absolute terms. Hence, this seems to be the natural case to consider. Accordingly, this situation will be the one that we are going to analyze here. Formally, we have $\bar{U}_L \geq \bar{U}_H$ (low types have a higher willingness to accept advertising) and $\bar{U}_H / \beta_H \geq \bar{U}_L / \beta_L$ (high types have a higher willingness to pay). We have included an analysis of case (b) in Appendix 3.7.2.

[79] It is not possible that low types have a higher willingness to pay, but a lower willingness to accept advertising. This would imply $\bar{U}_L / \beta_L \geq \bar{U}_H / \beta_H$ and $\bar{U}_H \geq \bar{U}_L$. The second inequality is equivalent to $\bar{U}_H / \beta_L \geq \bar{U}_L / \beta_L$. This, together with the first inequality, gives $\bar{U}_H / \beta_L \geq \bar{U}_H / \beta_H$, which in turn is equivalent to $\beta_H \geq \beta_L$, a contradiction to our assumptions.

Before analyzing the solution it is useful to note that the first best bundles that were determined in the previous subsection may not be incentive compatible in the second best. The reason is that - as long as high types have to endure less advertising than low types - there is always an incentive for low types to consume the high type product, which costs the same but has less advertising (and more quality).

The solution to program (P2) crucially depends on the relative frequency of types. Let us first consider the case where there are relatively many low types so that $\gamma \le \overline{\gamma}$. Propositions 3.1 formally states the solution in this case.[80]

Proposition 3.1 *In the solution to program (P2) for the case* $\gamma \le \overline{\gamma}$ *, the low type always receives his first best bundle. The high type's bundle is as follows.*

(i) *If* $v_H \in [0, \underline{v}_H)$, *then* $p_H^{SB} = \frac{\overline{U}_H - \overline{U}_L}{\beta_H - \beta_L} + \frac{1-\delta_H \beta_L}{\varphi(\beta_H - \beta_L)^2} v_H^2$,

$$\alpha_H^{SB} = \frac{\beta_H \overline{U}_L - \beta_L \overline{U}_H}{\beta_H - \beta_L} - \frac{\beta_L (1-\delta_H \beta_L)}{\varphi(\beta_H - \beta_L)^2} v_H^2 \text{ and } q_H^{SB} = \frac{1-\delta_H \beta_L}{\varphi(\beta_H - \beta_L)} v_H .$$

(ii) *If* $v_H \in [\underline{v}_H, \overline{v}_H)$, *then* $p_H^{SB} = 0$, $\alpha_H^{SB} = \overline{U}_L$ *and* $q_H^{SB} = \frac{\overline{U}_L - \overline{U}_H}{v_H}$.

(iii) *If* $v_H \in [\overline{v}_H, \infty)$, *then the high type receives his first best bundle.*

It is interesting to note that the low types receive their first best bundle, while the high types' bundle is distorted. This is not surprising as the low types have to be deterred from consuming the high type product. It is convenient to present the solution graphically as we do here in Figure 3.1, which depicts the first and second best bundle

[80] All proofs are in Appendix 3.7.1, which also contains the precise definitions for the threshold levels $\overline{\gamma}$, $\underline{v}_H$, $\underline{v}'_H$, $\overline{v}_H$ and $\overline{v}'_H$ which satisfy $\overline{\gamma} \in (0,1)$, $0 < \underline{v}_H < \overline{v}_H < \infty$, $0 < \underline{v}'_H < \overline{v}_H < \infty$ and $0 < \underline{v}_H < \overline{v}'_H < \infty$.

for high types depending on the valuation v_H. As can be seen, optimal price, advertising and quality largely depend on the size of the H-type's preference for quality v_H.

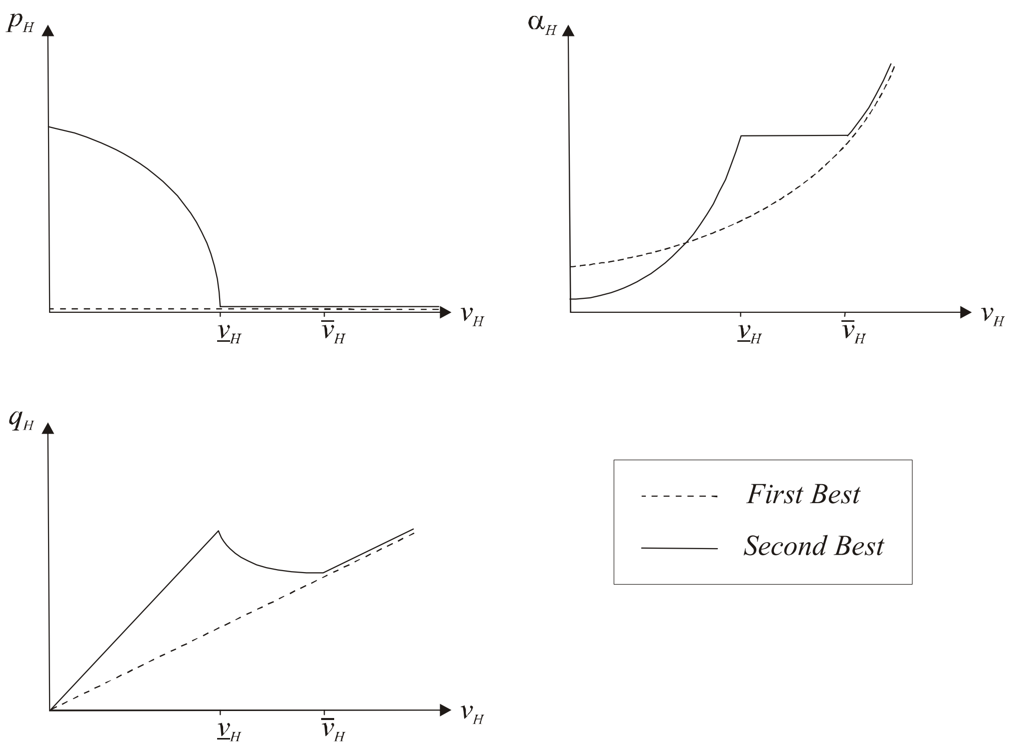

Figure 3.1: The Monopoly Case ($\gamma \leq \overline{\gamma}$)

Figure 3.1 shows that both a quality and a price distortion are used to achieve incentive compatibility. As a price increase hurts low types relatively more, the upward distortion in p_H can be used to scare away L-types from the H-bundle. The reason that an overprovision of quality is a useful screening instrument is that more quality for the H-bundle has to be financed. High types would like to have less quality, but at least they somewhat value its increase. Low types, on the other hand, have no benefit from increased quality whatsoever. And since quality has to be paid for by α_H and p_H, the quality distortion relaxes the low type's incentive constraint. The level of advertising, on the other hand, is not a screening instrument, but adapts to price and quality distortions in a way that holds the participation constraints of consumers binding.

If the difference in quality preferences of the two types is low ($v_H < \underline{v}_H$), both price and quality distortions are used by the monopolist. An increase in v_H then has two effects. The first effect is that the increasingly different preferences for quality make it more and more profitable to use q_H as a screening instrument. Hence, the high type's quality moves further away from its first best level. At the same time the price distortion is used less and less, until p_H reaches zero at $v_H = \underline{v}_H$. Hence, the first effect of a widening gap between quality-preferences is an exchange of screening instruments.

The second notable effect is that screening becomes easier overall, as the products the two types would like to consume are getting more differentiated. This effect drives the use of both screening instruments down. This process is completed if $v_H \geq \overline{v}_H$, where the first best is attained. It is straightforward to show that second best profits monotonically increase towards first best levels, which they reach at $v_H = \overline{v}_H$. Thus, the more differentiated the products are that high and low types would ideally like to consume, the easier it is for media firms to efficiently sort types.[81]

The amount of advertising for high types, α_H, is below first best for low levels of v_H. The monopolist has to do this in order to compensate high type consumers for the price distortion. As v_H increases, two forces drive α_H up: the reduction in price screening renders it possible to increase α_H and in addition to that, the rapid increase in q_H must be financed by more advertising. As a result, α_H increases above its first best level beyond some point. Finally, α_H^{SB} and α_H^{FB} approach each other again, as all distortions go down.

[81] This result is akin to a result from insurance economics. Bond and Crocker (1991) show that differential consumption of hazardous goods may allow insurance companies to reach the first best in insurance markets with adverse selection.

Note that the quality distortion that potentially occurs in monopoly media markets is quite different to the quality distortion observed in regular goods markets with price discrimination (as analyzed by Mussa and Rosen, 1978, among others). While in Mussa and Rosen (1978) quality is distorted downwards, here we have an upwards distortion. This difference occurs because in media markets (other than in goods markets) the low types have to be deterred from consuming the high type bundle. This is so even though the high types are usually the more profitable clientele for the monopolist. The crucial point is that high types generate far higher advertising receipts than low types.

Next we turn to the case where there are many high types ($\gamma > \overline{\gamma}$). Proposition 3.2 states the monopolistic equilibrium in this case.

Proposition 3.2 *In the solution to program (P2) for the case* $\gamma > \overline{\gamma}$ *, the low type always receives his first best bundle, except that* $\alpha_L^{SB} = \bar{U}_H + \left[\delta_H/\varphi + \left((1-\gamma)/\gamma\right)\left(\delta_L/\varphi\right)\right]v_H^2$ *if* $v_H \in \left[\underline{v}'_H, \overline{v}_H\right)$. *The high type's bundle is as follows.*

(i) *If* $v_H \in \left[0, \underline{v}'_H\right)$, *then* $p_H^{SB} = 0$, $\alpha_H^{SB} = \bar{U}_H + \left(\frac{\delta_H}{\varphi} + \frac{1-\gamma}{\gamma}\frac{\delta_L}{\varphi}\right)v_H^2$ *and* $q_H^{SB} = \left(\frac{\delta_H}{\varphi} + \frac{1-\gamma}{\gamma}\frac{\delta_L}{\varphi}\right)v_H$.

(ii) *If* $v_H \in \left[\underline{v}'_H, \overline{v}_H\right)$, *then* $p_H^{SB} = 0$, $\alpha_H^{SB} = \bar{U}_L$ *and* $q_H^{SB} = \frac{\bar{U}_L - \bar{U}_H}{v_H}$.

(iii) *If* $v_H \in \left[\overline{v}_H, \infty\right)$, *then the high type receives his first best bundle.*

Note that the optimal solution now not only depends on the size of v_H but also on the size of γ. Figure 3.2 represents this solution graphically. It is drawn for some given $\gamma > \overline{\gamma}$.

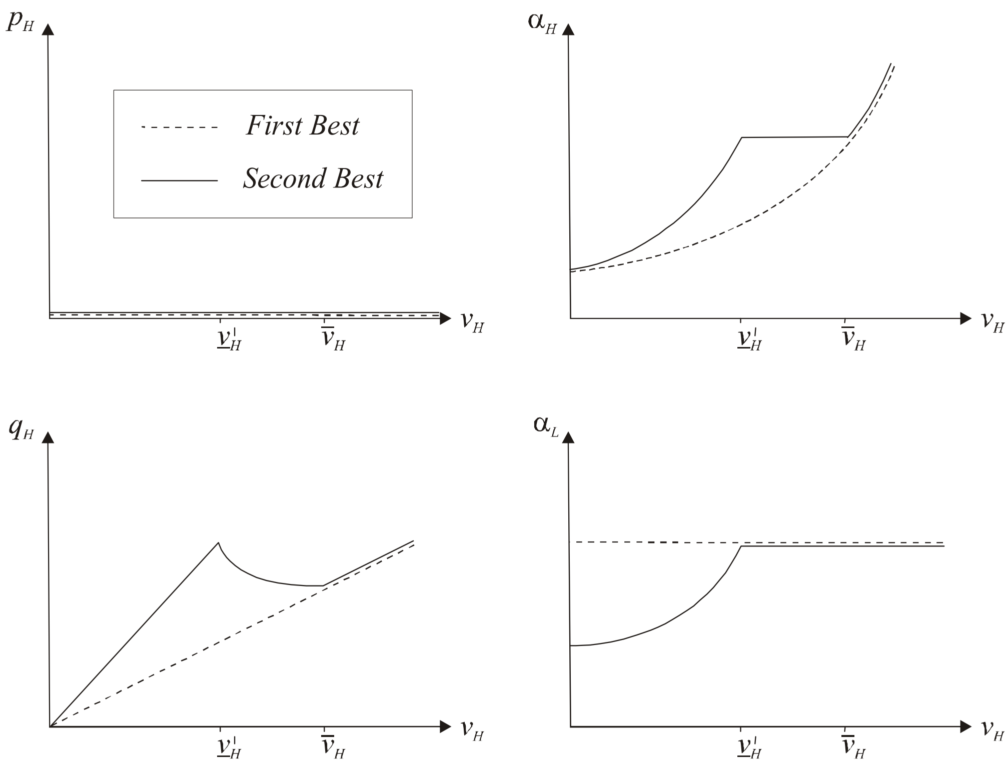

Figure 3.2: The Monopoly Case ($\gamma > \overline{\gamma}$)

Figure 3.2 reflects a sudden change in the monopolist's screening policy if γ gets larger than $\overline{\gamma}$. While the screening of the high type quality remains unchanged, the monopolist now refrains from using the price instrument. This allows her to increase the advertising of H-types. To guarantee incentive compatibility it now becomes necessary to decrease α_L below first best levels. This policy is quite intuitive: The more high types there are, the more costly it becomes for the monopolist to distort the high type bundle in order to achieve incentive compatibility. Beyond $\overline{\gamma}$, there are so few low types that it is profitable to distort the low type bundle instead, by lowering its advertising level below first best. As the low type bundle otherwise remains unchanged, this policy generates an information rent for L-types.

Figure 3.2 shows that the two effects of an increase in v_H that we observed for $\gamma \leq \overline{\gamma}$ are at work here, too. First of all, the quality instrument becomes more effective, so the advertising distortion is exchanged for the quality distortion until α_L reaches its first best level. Second of all, screening becomes easier, which decreases the use of both instruments. Again, for $v_H \geq \overline{v}_H$ the two types demand so different goods that self-selection is without costs.

Let us now analyze, how the solution changes if γ increases beyond $\overline{\gamma}$. It turns out that in this case, the remaining quality distortion of high types gets still smaller and is gradually exchanged for a further distortion of the low types' advertising.

So we have the following two observations from the monopoly case. (i) As the number of high types increases, the high type distortion gradually gets exchanged for a distortion of low types. (ii) As the differential of the types' quality preferences increases, the distortion in q_H will be used more often than the distortion in p_H (respectively α_L), in addition, screening becomes easier and the overall distortion is reduced.[82]

As was mentioned above, the solution to program (P2) only determines the optimal behavior of the monopolist if it is not preferable to ration one type of customer while extracting the whole rent from the other.

Proposition 3.3 *Independent of the size of γ, there will be no rationing of consumers. That is, the monopolist always makes her pricing decision according to Propositions 3.1 and 3.2.*

[82] Further comparative statics results can be found in section 3.5.

This is an important observation. Quite contrary to standard models of monopolistic price discrimination as Mussa and Rosen (1978), rationing in media markets is never profitable for a monopolist - irrespective of the relative frequencies of types. This means that the efficiency loss from monopolization may be smaller in media markets than in standard goods markets.[83] The difference occurs because the monopolist can use different forms of payment from different types, which gives him greater leeway in profitably separating types.

For this result to hold it is crucial that low types have a higher willingness to accept advertising for a media product of quality $q = 0$. If high types had a higher willingness to accept advertising, we would be back in a situation where rationing of low types may be profitable if there are sufficiently many high types.[84]

3.4 Competitive Media

In the case of free entry into the media market, an effectively competitive outcome involving the market presence of more than one media company requires that $F = 0$. This stems from the fact that the media products we consider here are perfectly homogeneous (except for the quality and the amount of advertising). This implies Bertrand competition of all companies that have entered the market. Hence, with increasing returns to scale a situation of natural monopoly would arise. In order to be able to analyze a competitive media market, we thus set $F = 0$. It should become clear

[83] Of course, monopolization in media markets may bring about other inefficiencies than purely economic ones. For instance, it may lead to political biases and disinformation. This alone may be enough in order to worry about media monopolies. On the other hand, competition may also lead to biased news by making it necessary to exaggerate stories in order to attract readers or viewers. See Mullainathan and Shleifer (2003) for a model that analyzes both types of media bias.

[84] See the analysis of this case in Appendix 3.7.2.

that the problems that adverse selection may pose in media markets are quite general and not driven by a specific formulation of market structure.

3.4.1 First Best

Again, we first consider the market equilibrium under full information as a benchmark. We can look at the H- and the L-market separately. It is straightforward to see that the following conditions are necessary and sufficient for a Nash equilibrium of the game that the media firms play: (i) media firms earn non-negative profits and (ii) there does not exist a contract $C=(p,\alpha,q)$ which is not offered in equilibrium but would make positive profits for a media firm offering it. In order to guarantee condition (i) we must have

$$\alpha_i\delta_i + p_i \geq c + \tfrac{1}{2}\varphi q_i^2 \text{ for } i \in \{H,L\} \tag{9}$$

from equation (2). Condition (ii) then implies that an equilibrium can be found by maximizing the agent's utility subject to these zero profit constraints. Hence, we have to solve for $i \in \{H,L\}$

(P3) $$\max_{\{(p_i,\alpha_i,q_i)\}} \bar{U}_i - \alpha_i - \beta_i p_i + v_i q_i$$
subject to (5), (6) and (9).

As in the monopoly case we forgo a proof for the solution of the first best. This solution has $p_H^{FB}=0$, $\alpha_H^{FB}=c/\delta_H+(\delta_H/2\varphi)v_H^2$ and $q_H^{FB}=(\delta_H/\varphi)v_H$ for the high type and $p_L^{FB}=0$, $\alpha_L^{FB}=c/\delta_L$ and $q_L^{FB}=0$ for the low type. Again, this is quite intuitive. As advertising is the efficient way of paying for the media product, prices are zero for both types and the media product is fully financed by advertising. Low types receive zero quality as they do not care about it. High types, on the other hand, receive a positive amount of quality, which is increasing in their valuation v_H and in advertising receipts δ_H, while it is decreasing in the cost of the provision of quality φ. Which type has to accept more advertising depends on the quality preferences of H-types. If their desire for quality is sufficiently small, high types have to endure less advertising. This is because they are more attractive to advertising firms. If their desire for quality is sufficiently large, however, they still have to accept more advertising than low types, in order to finance the additional costs of quality. The firms in the market offer two different types of bundles, one for high and one for low types, and make zero profits. The entire surplus goes to consumers.

3.4.2 Second Best

Next turn to the more realistic case of asymmetric information. Lemma 1 guarantees that we can direct our attention to separating equilibria.

Lemma 3.1 *There does not exist a pooling equilibrium in the competitive media market.*

The intuition for Lemma 3.1 is that every pooling contract can be destabilized by another contract that baits only high types, thereby ruining the advertising rate for the pooling contract.

Apart from the constraints from the first best case, we must now also guarantee incentive compatibility, as in the monopoly case. Again, we maximize the agents' utility to satisfy condition (ii) for a Nash equilibrium.

(P4)
$$\max_{\substack{\{(p_H,\alpha_H,q_H),\\ (p_L,\alpha_L,q_L)\}}} \gamma\left(\bar{U}_H-\alpha_H-\beta_H p_H+v_H q_H\right)+\left(1-\gamma\right)\left(\bar{U}_L-\alpha_L-\beta_L p_L\right)$$
subject to (5) to (9)

Proposition 3.4 formally states the solution to program (P4).

Proposition 3.4 *In the solution to program (P4), the low type always receives his first best bundle. The high type's bundle is as follows.*

(i) *If* $v_H \in [0, \underline{v}_H)$, *then* $p_H^{SB} = \dfrac{\delta_L - \delta_H}{\delta_L(1-\delta_H\beta_L)}c + \dfrac{1-\delta_H\beta_L}{2\varphi(\beta_H - \beta_L)^2}v_H^2$,

$$\alpha_H^{SB} = \frac{1-\delta_L\beta_L}{\delta_L(1-\delta_H\beta_L)}c - \frac{\beta_L(1-\delta_H\beta_L)}{2\varphi(\beta_H-\beta_L)^2}v_H^2 \text{ and } q_H^{SB} = \frac{1-\delta_H\beta_L}{\varphi(\beta_H-\beta_L)}v_H.$$

(ii) *If* $v_H \in [\underline{v}_H, \overline{v}'_H)$, *then* $p_H^{SB} = 0$, $q_H^{SB} = \sqrt{\dfrac{2(\delta_H - \delta_L)}{\varphi\delta_L}c}$ *and* $\alpha_H^{SB} = \dfrac{c}{\delta_L}$.

(iii) *If* $v_H \in [\overline{v}'_H, \infty)$, *then the high type receives his first best bundle.*

Again we proceed with the graphical representation of the solution, which can be found in Figure 3.3. A comparison of Figures 3.1 and 3.3 immediately shows that the way competitive firms deal with adverse selection almost perfectly corresponds to the way a monopolist deals with it if there are many low types. The only big difference is that in the competitive case firms make zero profits and hence there is less advertising overall. It is interesting that the solution is independent of γ. This is so because competitive firms can not use cross-subsidizing schemes. Since in equilibrium there must be zero profits for both high and low types, firms can not trade off which type they like to screen more intensively.

Again, we see that if v_H is small, both quality- and price-screening occur. As the valuations get different, there are the by now well known effects of an exchange of instruments and of a general reduction in screening. As before, beyond some threshold $\overline{v}'_H$ the first best is achieved.

It is well known that in competitive markets with adverse selection, separating pure strategy equilibria exist if and only if there is no pooling contract that has the following two properties: (a) it makes non-negative profits if offered and (b) both types

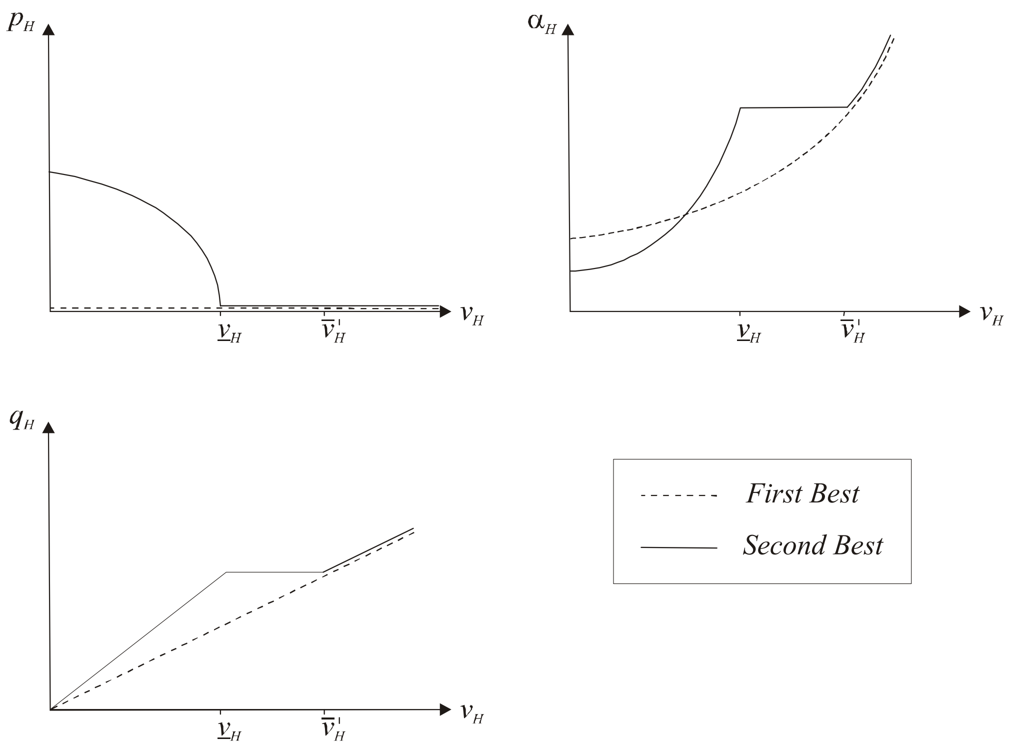

Figure 3.3: The Competitive Case

prefer it to the separating contracts that were proposed as equilibrium candidates (given here by the solution to program (P4)). Non-existence of pure-strategy equilibria is worrying because it is unclear how a mixed strategy by firms could be interpreted. The following proposition addresses the question of equilibrium existence in the context of media markets.

Proposition 3.5 *If* $v_H \in [0, \overline{v}'_H)$*, then a pure strategy equilibrium in the media market exists if and only if* $\gamma \leq \hat{\gamma}(v_H)$ *for some* $\hat{\gamma}(v_H) \in (0,1)$. $\partial\hat{\gamma}(v_H)/\partial v_H > 0$ *and* $\hat{\gamma} \to 1$ *as* $v_H \to \overline{v}'_H$. *If* $v_H \geq \overline{v}'_H$*, a pure strategy equilibrium exists for all* $\gamma \in [0,1]$.

Therefore, also in media markets, there is a problem of non-existence of pure strategy equilibria. However, the problem gets less severe as v_H increases and finally vanishes beyond some point. Note that in the case of non-existence of a pure strategy equilibrium it is known that a mixed-strategy equilibrium does exist (Dasgupta and Maskin, 1986). Also, various equilibrium refinements have been proposed by the literature in order to guarantee the existence of pure strategy equilibria. We do not want to delve into this matter, however, and refer to Hellwig (1987) for a discussion.

3.5 Comparative Statics

We will now analyze how media market distortions that are due to adverse selection are affected by a change in the exogenous parameters of the model.[85] Note that p_H^{SB} is a direct measure of the price distortion as $p_H^{FB} = 0$. In order to measure the quality distortion, let $\Delta q_H := q_H^{SB} / q_H^{FB} - 1$ denote the percentagewise distortion of quality. Unless otherwise stated, all results hold both for the monopoly and for the competitive case.

Let us first analyze a change in the marginal rate of substitution between monetary payments and advertising, β_H and β_L. It is easy to show that $\partial p_H^{SB} / \partial \beta_H \leq 0$ and $\partial \Delta q_H / \partial \beta_H > 0$. This corresponds to an exchange in screening instruments. The reason for this is that an increase in β_H means that the payment preferences of the two types get closer. Hence, screening via the price becomes more expensive. Therefore, it

[85] Accordingly, all derivatives we present here are taken at a value of v_H such that we are strictly in second best.

is optimal to use the quality instrument more intensively, while the use of the price distortion should be reduced.[86]

Secondly, consider an increase in φ, that is the provision of quality becomes more expensive. We find $\partial p_H^{SB} / \partial\varphi \geq 0$ and $\partial\Delta q_H / \partial\varphi = 0$. These changes embody two effects. First of all, the increase in φ makes screening via quality more costly. This force reduces quality screening and increases price screening. Second of all, a higher φ means that q_H is decreasing in first best, too. Since we know from above that the adverse selection problem gets worse when the quality preferences of the two types get more similar, there now has to be more screening overall. This pushes up both kinds of distortion. The net effect has the quality distortion unchanged and the price distortion increased.

Now consider a change in c. Here, the result of the comparative statics analysis depends on the market structure. We first analyze the competitive case. There, we immediately find that $\partial\Delta q_H / \partial c \geq 0$ and $\partial p_H^{SB} / \partial c \geq 0$. Hence, an increase in marginal costs implies (weakly) more use of both distortions. This is reasonable: a higher cost of the product brings about more advertising and thus it becomes more attractive for L-types to consume the H-type bundle. As a response, screening must be intensified.

In the monopoly case, the level of c does not influence the screening policy. This is a consequence of the fact that in monopoly, the amount of advertising (and hence the severity of the adverse selection problem) is determined by the consumers' valuations and not by the producers' marginal cost.

Finally, consider a change of the advertising prices δ_H and δ_L. It is well known that advertising prices change pro-cyclically and very amplified along the business cycle. This makes it a particularly interesting case to consider. It turns out that comparative statics with respect to the advertising rates again yield different results

[86] Analogously, an increase in β_L implies that more emphasis is put on the price distortion, while the quality distortion is reduced.

depending on the type of market structure. Let us first consider the competitive case. Simple calculations show that $\partial p_H^{SB} / \partial \delta_i < 0$ for $i \in \{H, L\}$ and $\partial \Delta q_H / \partial \delta_H < 0$ (and $\partial \Delta q_H / \partial \delta_L = 0$). Bad times let the adverse selection problem become more severe, which calls for more intensive distortions. This is intuitive: an economic downturn implies lower advertising rates. This increases not only the *absolute* number of advertisements α_H and α_L that a competitive media firm has to display in order to break even, but also the *difference* between α_H and α_L. Alas, this makes the low type's incentive constraint harder to fulfill, which necessitates a bigger distortion.

In the monopoly case things are different. There, the media firm always tries to have as much advertising as possible in order to extract rent. This is independent of advertising rates. Nonetheless, a change in δ_H alters the distortions in the monopoly case. It is straightforward to show that $\partial p_H^{SB} / \partial \delta_H \le 0$, $\partial p_H^{SB} / \partial \delta_L = 0$, $\partial \Delta q_H / \partial \delta_H \ge 0$ and $\partial \Delta q_H / \partial \delta_L = 0$. That is, the distortions are unaffected by the low type advertising rate. But if δ_H goes up, the price distortion decreases and the quality distortion increases. If δ_H increases, the high type wants more quality as quality has become less expensive. This makes screening via quality relatively less expensive. Hence an increase in δ_H results in an exchange of screening instruments as we have seen before. All in all, in the case of a media monopoly, economic changes have no influence on the severity of the adverse selection problem. But they do have an effect on the way this problem is tackled by the media firm.[87] The following corollary summarizes the effect of an economic crisis.

Corollary 3.1 *An economic downturn that decreases advertising rates aggravates the adverse selection problem in competitive media markets, but leaves it unchanged for a monopolist.*

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[87] This indirect effect is of course also present in the competitive market. However, it is wholly overshadowed by the direct effect that was discussed above.

3.6 Discussion

One assumption that we have made in the case of a competitive media market is that consumers' basic valuations $\bar{U}_L$ and $\bar{U}_H$ are sufficiently high compared to production costs, so that trade of the media products is efficient. Alternatively, consider the situation where only the H-type's valuation is high enough to enable trade of the media product. It is tempting to suspect that in such a case the adverse selection problem vanishes and we return to first best. This, however, turns out to be wrong. Even though low types do not find the first best low type bundle attractive, they still may have to be deterred from buying the high type bundle. This may be necessary because the high type bundle is very attractive due to its (relatively) low amount of advertising. It is straightforward to show in our basic model that whenever $\bar{U}_L$ decreases below some threshold level, production for low types becomes inefficient. As $\bar{U}_L$ decreases from this point on, the necessary distortion of the high types becomes weaker and weaker, because buying the high type bundle becomes less and less attractive to L-types. But until $\bar{U}_L$ has decreased below some second threshold level, we are strictly in second best.

The above case may be the relevant one for newspaper markets. Here the distinguishing characteristic of readers is probably the average reading time more than income. It is well known that usually only 15% or less of newspaper subscribers actually read their paper on a given day. If the price is low enough, most people want to subscribe to a newspaper, even if they do not read it very often. Naturally, advertisers pay lower rates for "readers" who do not actually see their advertisements. It is well conceivable that it would be efficient (in a first best world) to finance newspapers wholly by advertising. But given that free papers would attract subscriptions of readers who merely use the paper for checking the lottery numbers and the cinema program, newspapers are forced to distort their pricing policy.[88]

Another interesting extension of our model is to the question of the political bias of mass media. It has been argued that the reliance of mass media on advertising revenue causes a distortion of political content away from extreme views towards softer positions (see Gabszewicz, Laussel, and Sonnac, 2001a, and the references therein). According to this view, advertising reduces the heterogeneity of the media market's political spectrum and leads to a "pensée unique". Our model shows that adverse selection may work as a countervailing force against this problem. Assume that the political spectrum can be represented by a one-dimensional continuous variable (say, by a left-right index). Now, if there is some correlation between income and political opinion[89] then the political orientation of a media product may be used as a screening instrument. The consequence of this is straightforward: if the political preference of the two types is sufficiently different, the orientation of the media product suffices to separate the two types without distortion. If the political preference of the two types is not too different, however, the political orientation of high type media products will be distorted further away from the low type's preference. Hence, to the extent that there is political heterogeneity among readers, the media's political heterogeneity will be amplified as a response to adverse selection. A similar argument holds of course for content diversity. Therefore, our model also suggests a countervailing force against the problem of restricted diversity of broadcasting content (as argued by Steiner, 1952, Spence and Owen, 1977, Beebe, 1977, Anderson and Coate, 2004, and Gal-Or and Dukes, 2004).

[88] Newspapers usually raise 50 to 90% of their revenue from advertising but almost all regular papers have a positive cover price. There do exist free newspapers in some major cities. Usually these are distributed in subways and are very thin, which ensures that most readers will actually have a look at the paper. Their appearance is well in line with our theory: they can readily be recognized as a low type bundle with low quality appearance and a large amount of advertising.

[89] Such correlation is claimed by political economy models of redistributive politics. See for instance Romer (1975), Roberts (1977) or Meltzer and Richard (1981).

In the analysis so far, we have restricted ourselves to positive aspects and have refrained from engaging in welfare analysis. As we have pointed out in the introduction, interpreting a downward-distortion in the advertising market as welfare-reducing is not obvious, as advertising may exert negative externalities on competitors. In order to evaluate this question it plays a crucial role whether advertising is informative or persuasive. If advertising is informative, a downward distortion is clearly welfare-reducing. While there is a negative externality on other firms also, this externality is purely pecuniary and thus irrelevant for welfare comparisons. If advertising is persuasive, however, it may just shift consumption from one firm to another, hence the benefit of the advertising firm may just correspond to a reduction in profit for another firm, while the consumer dislikes viewing the ad and gets a comparable utility from consuming the advertised product. In this case, advertising is clearly inefficient in the sense of social welfare and any reduction in its level is desirable, while any upward distortion would be welfare reducing. In short, the welfare effects of adverse selection in advertising markets crucially depend on the type of advertising. See Bagwell (2004) for a general discussion of the welfare effects of advertising.

Our theory accords well with empirical regularities. Fisher, McGowan and Evans (1980) report the strong impact that viewer characteristics have on advertising prices in the broadcasting industry. Thompson (1989) finds similar results for newspapers. In addition to that he finds that price setting involves a trade-off between circulation and advertising revenue. If media companies decide to reduce the cover price of their medium, this increases sales but substantially deteriorates advertising rates, as many of the new readers are less attractive for advertisers. Similarly, Kaiser's (2002) empirical results for women's magazines show that increasing the circulation by one percent increases advertising revenues by far less than one percent. This implies that price cuts dramatically worsen advertising rates per reader. This effect is particularly strong for magazines which are aimed at high income women.

These facts can be easily explained within our model: high-type media firms do not compete themselves down in prices as much as possible, since lowering the price too much would attract low types, which would deteriorate advertising rates substantially. Instead, in our model high-type media compete via quality and the amount of advertising. Casual observation confirms that the proposed positive correlation between subscription fees and advertising rates is met in reality.

It is interesting to note that the classic papers in media economics already hint at problems of adverse selection in the media industry. Reddaway (1963, p. 214) observes the dangers of using cover price cuts as a competitive instrument:

"Even if the price-cut succeeded, however, there is a real risk that the new readers would be concentrated in low-income groups, and so lower A's status as an advertising medium."

In a similar vein, Corden (1953, p. 186) explains that advertising revenue increases less than proportionally with increases in circulation (caused, say, by a cover price cut):

"Firstly, as circulation increases the average income of readers usually falls; hence the quality of the advertising space to advertisers is decreased, and to some extent the increase in quality resulting from the rise in circulation itself is offset."

But while both authors already see the problem, they lack the analytical tools of modern contract theory for a proper analysis of the matter. Consequently, these issues are just asides in the non-technical parts of their papers.

It is much more difficult to find convincing evidence for an overprovision of quality in media markets. The main problem stems from the fact that there is no microeconomic foundation of what constitutes the first best. In insurance economics or in banking, where we know from first principles that full-insurance and zero collateral are efficient, we can immediately link the observation of partial insurance and collateralized loans to market failures like adverse selection or moral hazard. In the media industry, on the other hand, there is no clear-cut level of first-best quality that is easily recognizable.

We do want to mention, however, the remarks of Reddaway (1963, p. 217) on the economics of newspapers:

"[…] [There is] a question which has always puzzled me - namely, is it really *necessary for a national paper of wide appeal to spend such vast sums on "editorial"? […] Could not an editor of ideas produce the text for a normal popular national without spending more than (say) three times as much as the* Birmingham Post*?"*

Our model would claim that, indeed, a popular national would be able to; but that *it does not want to*. In fact one could argue that increasing the paper's quality enables the national paper to scare away low type readers who are not willing to pay for the artificially increased quality. Quite possibly, many of the high type readers would actually prefer reducing editorial expenditures as well, since the marginal value they contribute to reading enjoyment is arguably low (as exemplified by the above quote).

3.7 Appendix

3.7.1 Proofs

Definition 1 $\overline{v}_H := \sqrt{\frac{\left(\bar{U}_L - \bar{U}_H\right)\varphi}{\delta_H}}$

Definition 2 $\overline{v}'_H := \sqrt{\frac{2\varphi\left(\delta_H - \delta_L\right)}{\delta_L \delta_H^2} c}$

Definition 3 $\underline{v}_H := \sqrt{\frac{2\varphi\left(\delta_H - \delta_L\right)\left(\beta_H - \beta_L\right)^2}{\delta_L\left(1 - \delta_H \beta_L\right)^2} c}$

Definition 4 $\underline{v}'_H := \sqrt{\frac{\left(\bar{U}_L - \bar{U}_H\right)\varphi}{\frac{1-\gamma}{\gamma}\delta_L + \delta_H}}$

Definition 5 $\overline{\gamma} := \frac{\delta_L\left(\beta_H - \beta_L\right)}{1 - \delta_H \beta_H + \delta_L\left(\beta_H - \beta_L\right)}$

Proof of Proposition 3.1.

To simplify the reference, let us split conditions (5) and (6) into their single parts. We refer to the constraint $\alpha_H \geq 0$ by (5h), while we refer to $\alpha_L \geq 0$ by (5l). Likewise we refer to $p_H \geq 0$ by (6h) and to $p_L \geq 0$ by (6l).

First conjecture that (3), (4), (6l) and (8) are binding, whereas (5h), (5l), (6h) and (7) are slack. Let μ_i be the multiplier for constraint (i). This gives us the Lagrangean

$$
\begin{aligned}
L = {} & \gamma\left(\alpha_H\delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right) + (1-\gamma)\left(\alpha_L\delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right) - F \\
& + \mu_3\left[\bar{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right] \\
& + \mu_4\left[\bar{U}_L - \alpha_L - \beta_L p_L\right] \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right].
\end{aligned}
$$

Using $\gamma \le \bar{\gamma}$, $v_H \le \underline{v}_H$ and the assumptions from Section 3.2 we find that all multipliers are larger than zero and get the equilibrium values proposed in the proposition for the case where $v_H \in \left[0, \underline{v}_H\right]$. Substituting the solutions back in the constraints and rearranging shows that none of the constraints is violated.[90]

Next conjecture that (3), (6h), (6l) and (8) are binding, whereas (4), (5h), (5l) and (7) are slack. The Lagrangean then becomes

$$
\begin{aligned}
L = {} & \gamma\left(\alpha_H\delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right) + (1-\gamma)\left(\alpha_L\delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right) - F \\
& + \mu_3\left[\bar{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right] \\
& + \mu_4\left[\bar{U}_L - \alpha_L - \beta_L p_L\right] \\
& + \mu_{6h} p_H \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right].
\end{aligned}
$$

Using $\gamma \le \bar{\gamma}$, $\underline{v}_H \le v_H < \bar{v}_H$ and the assumptions from Section 3.2 we again find the multipliers to be larger than zero and get the equilibrium values proposed in the proposition for the case $v_H \in \left[\underline{v}_H, \bar{v}_H\right]$. As before, substitution of these values into the constraints and rearranging confirms that all constraints are fulfilled by the solution.

[90] More detailed calculations of this and later maximization problems are available from the authors upon request.

Finally, using $\gamma \leq \overline{\gamma}$, $v_H \geq \overline{v}_H$ and the assumptions from Section 3.2, simple substitution of the first best values into the constraints and rearranging confirms that the first best can be achieved for $v_H \geq \overline{v}_H$. *Q.E.D.*

Proof of Proposition 3.2.

First conjecture that (3), (6h), (6l) and (8) are binding, whereas (4), (5h), (5l), and (7) are slack. This gives us the Lagrangean

$$
\begin{aligned}
L = {} & \gamma\left(\alpha_H\delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right) + (1-\gamma)\left(\alpha_L\delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right) - F \\
& + \mu_3\left[\overline{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right] \\
& + \mu_{6h} p_H \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right].
\end{aligned}
$$

Using $\gamma > \overline{\gamma}$, $v_H < \underline{v}'_H$ and the assumptions from Section 3.2 we find that all multipliers are larger than zero and get the equilibrium values proposed in the proposition for the case where $v_H \in \left[0, \underline{v}'_H\right]$. Substituting the solutions back in the constraints and rearranging shows that none of the constraints is violated.

Next conjecture that (3), (4), (6h), (6l) and (8) are binding, whereas (5h), (5l) and (7) are slack. The Lagrangean then becomes

$$
\begin{aligned}
L = {} & \gamma\left(\alpha_H\delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right) + (1-\gamma)\left(\alpha_L\delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right) - F \\
& + \mu_3\left[\overline{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right] \\
& + \mu_4\left[\overline{U}_L - \alpha_L - \beta_L p_L\right] \\
& + \mu_{6h} p_H \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right].
\end{aligned}
$$

Using $\gamma > \overline{\gamma}$, $\underline{v}'_H \leq v_H < \overline{v}_H$ and the assumptions from Section 3.2 we again find the multipliers to be larger than zero and get the equilibrium values proposed in the proposition for the case $v_H \in \left[\underline{v}'_H, \overline{v}_H\right]$. As before, substitution of these values into the constraints and rearranging confirms that all constraints are fulfilled by the solution.

Finally, using $\gamma > \overline{\gamma}$, $v_H \geq \overline{v}_H$ and the assumptions from Section 3.2, simple substitution of the first best values into the constraints and rearranging confirms that the first best can be achieved for $v_H \geq \overline{v}_H$. *Q.E.D.*

Proof of Proposition 3.3.

First note that in the case $v_H \geq \overline{v}_H$ we are in first best. Hence, rationing can only be profitable if $v_H < \overline{v}_H$. Let us assume this to be the case. Denote by C_i^{FB} (C_i^{SB}) the first best (second best) contract offered to type i according to program (P2); and denote a no-trade situation by N. As for low types $C_L^{FB} = C_L^{SB}$, rationing high types can never improve the monopolist's profit. The most profitable strategy that possibly rations low types is offering C_H^{FB} only.

As the low type's incentive constraint is binding if $v_H < \overline{v}_H$, we must have $C_H^{FB} \text{ f}_L\, C_L^{FB}$. Furthermore, $C_L^{FB} :_L C_L^{SB}$ as $C_L^{FB} = C_L^{SB}$. Finally, since the low type's participation constraint is fulfilled, we must have $C_L^{SB}\, \underline{\text{f}}_L\, N$. Hence, by transitivity of L's preferences, $C_H^{FB} \text{ f}_L\, N$. This means that the most profitable candidate for rationing actually does not involve any rationing if offered alone. Therefore, there exists no rationing contract that generates a higher profit for the monopolist than the solution to program (P2). *Q.E.D.*

Proof of Lemma 3.1.

Suppose there exists a pooling equilibrium in which only the bundle $C_P = (p_P, \alpha_P, q_P)$ is offered by the media firms. As both types consume the bundle, the advertising rate that C_P generates is $\delta_P = \gamma\delta_H + (1-\gamma)\delta_L$. Since firms engage in Bertrand competition, we must have that C_P entails zero profits for media firms.

We will first prove the lemma for the case $\alpha_P > 0$. Consider entry of a firm that offers bundle $C_A = (p_P + \varepsilon_1, \alpha_P - \varepsilon_1/\delta_P - \varepsilon_2, q_P)$ with ε_1 and ε_2 small.[91] We will show that there exist $\varepsilon_1 > 0$ and $\varepsilon_2 > 0$ such that all high types strictly prefer C_A, all low types strictly prefer C_P and the entering firm makes a strictly positive profit. Evidently, this is a contradiction to C_P being a pooling equilibrium contract.

From (1) and after simple rearranging we find that $C_A \succ_H C_P$ is equivalent to $\varepsilon_2/\varepsilon_1 < \beta_L - 1/\delta_P$. Similarly, $C_P \succ_L C_A$ is equivalent to $\varepsilon_2/\varepsilon_1 > \beta_H - 1/\delta_P$. There must exist small ε_1 and ε_2 such that both inequalities are fulfilled as $\beta_L > \beta_H$. Let $\overline{\varepsilon}$ be a value of $\varepsilon_2/\varepsilon_1$ such that both conditions hold.

As firms make zero profits with C_P alone, C_A makes positive profits whenever C_A generates higher profits than C_P. From (2) and after some rearranging we find that this is the case whenever $\alpha_P > \varepsilon_1/\delta_P + \varepsilon_2\delta_H/(\delta_H - \delta_P)$. Substituting $\varepsilon_2 = \overline{\varepsilon} \cdot \varepsilon_1$ into this inequality yields $\alpha_P > [1/\delta_P + \overline{\varepsilon}\delta_H/(\delta_H - \delta_P)]\varepsilon_1$. Clearly, this inequality holds for small enough ε_1, which completes the proof for $\alpha_P > 0$.

In the case $\alpha_P = 0$ an analogous proof can be used, where this time quality and price are varied in the destabilizing contract (instead of advertising and price). *Q.E.D.*

---

[91] This guarantees that the non-negativity constraint for advertising is not violated.

Proof of Proposition 3.4.

First conjecture that (6l), (8) and (9) are binding, whereas (5h), (5l), (6h) and (7) are slack. This gives us the Lagrangean

$$
\begin{aligned}
L = {} & \gamma\left(\bar{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right) + (1-\gamma)\left(\bar{U}_L - \alpha_L - \beta_L p_L\right) \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right] \\
& + \mu_{9h}\left[\alpha_H \delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right] \\
& + \mu_{9l}\left[\alpha_L \delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right].
\end{aligned}
$$

Using $v_H < \underline{v}_H$ and the assumptions from Section 3.2 we find that all multipliers are larger than zero and get the equilibrium values proposed in the proposition for the case where $v_H \in \left[0, \underline{v}_H\right)$. Substituting the solutions back in the constraints and rearranging shows that none of the constraints is violated.

Next conjecture that (6h), (6l), (8) and (9) are binding, whereas (5h), (5l) and (7) are slack. The Lagrangean then becomes

$$
\begin{aligned}
L = {} & \gamma\left(\bar{U}_H - \alpha_H - \beta_H p_H + v_H q_H\right) + (1-\gamma)\left(\bar{U}_L - \alpha_L - \beta_L p_L\right) \\
& + \mu_{6h} p_H \\
& + \mu_{6l} p_L \\
& + \mu_8\left[\alpha_H - \alpha_L + \beta_L\left(p_H - p_L\right)\right] \\
& + \mu_{9h}\left[\alpha_H \delta_H + p_H - c - \tfrac{1}{2}\varphi q_H^2\right] \\
& + \mu_{9l}\left[\alpha_L \delta_L + p_L - c - \tfrac{1}{2}\varphi q_L^2\right].
\end{aligned}
$$

Using $\underline{v}_H \le v_H < \vec{v}'_H$ and the assumptions from Section 3.2 we again find the multipliers to be larger than zero and get the equilibrium values proposed in the proposition for the case $v_H \in \left[\underline{v}_H, \vec{v}'_H\right)$. As before, substitution of these values into the constraints and rearranging confirms that all constraints are fulfilled by the solution.

Finally, using $v_H \geq \vec{v}'_H$ and the assumptions from Section 3.2, simple substitution of the first best values into the constraints and rearranging confirms that the first best can be achieved for $v_H \geq \vec{v}'_H$. *Q.E.D.*

Proof of Proposition 3.5

A pure strategy equilibrium exists if and only if there does not exist a pooling contract $C_P = \left(p_P, \alpha_P, q_P\right)$ that the high types prefer to their separating contract $C_H^{SB} = \left(p_H^{SB}, \alpha_H^{SB}, q_H^{SB}\right)$ and that generates non-negative profits for a media company offering it. Denote by C_P^* the pooling contract that is the most preferable for high types among the contracts that generate non-negative profits for firms if the advertising rate is $\delta_P = \gamma\delta_H + \left(1-\gamma\right)\delta_L$. This contract can be found just as the first best contract for high types, but replacing δ_H with δ_P. First assume that $\beta_H \delta_L > 1$. This guarantees that advertising is the efficient way of financing the pooling media product. Then the best pooling contract corresponds to the solution to program (P3), with δ_H replaced by δ_P. We will proceed in several steps.

Step 1: $\hat{\gamma}\left(0\right) \in \left(0,1\right)$

For $\gamma = 1$, we must have $C_P^* \succ_H C_H^{SB}$ as $C_P^* = C_H^{FB}$ in that case. And we know $C_H^{FB} \succ_H C_H^{SB}$ as C_H^{SB} is distorted away from first best at $v_H = 0$. For $\gamma = 0$ we must have $C_H^{SB} \succ_H C_P^*$ as $C_P^* = C_L^{SB}$ in that case. And we know that $C_H^{SB} \succ_H C_L^{SB}$ from the fact that (7) is slack in program (P4). Clearly, the utility that C_P^* generates for high types is continuously increasing in γ, as an increase in γ increases δ_P in a continuous way. Hence, there exists a unique $\hat{\gamma}\left(0\right) \in \left(0,1\right)$ at which $C_P^* \sim_H C_H^{SB}$.

Step 2: $\hat{\gamma}(v_H)=1$ for all $v_H \geq \overline{v}'_H$

This follows immediately from Proposition 3.4, as the first best must constitute a pure strategy Nash equilibrium for every $v_H \geq \overline{v}'_H$.

Step 3: $\partial V_H\left(C_H^{SB}\right)\big/\partial v_H > \partial V_H\left(C_P^{*}\right)\big/\partial v_H \geq 0$ and $\partial V_H\left(C_P^{*}\right)\big/\partial \gamma > 0$ for all $v_H < \overline{v}'_H$

Substituting the equilibrium values in (1) for high types and taking derivatives we find

$$\frac{\partial V_H\left(C_P^{*}(\gamma, v_H)\right)}{\partial v_H} = \frac{\delta_P}{\varphi} v_H \geq 0 \text{ for all } v_H < \overline{v}'_H,$$

$$\frac{\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)}{\partial v_H} = \begin{cases} \dfrac{1-\delta_H \beta_L}{\varphi\left(\beta_H - \beta_L\right)} v_H & \text{for } v_H \in \left[0, \underline{v}_H\right) \\ \sqrt{\dfrac{2\left(\delta_H - \delta_L\right)}{\varphi \delta_L}}\, c & \text{for } v_H \in \left[\underline{v}_H, \overline{v}'_H\right) \end{cases} \geq 0 \text{ for all } v_H < \overline{v}'_H$$

$$\text{and } \frac{\partial V_H\left(C_P^{*}(\gamma, v_H)\right)}{\partial \gamma} = \frac{\delta_H - \delta_L}{\delta_P} c + \frac{\delta_H - \delta_L}{\delta_P} v_H^2 > 0 \text{ for all } v_H < \overline{v}'_H.$$

Simple comparisons show that $\partial V_H\left(C_H^{SB}\right)\big/\partial v_H \leq \partial V_H\left(C_P^{*}\right)\big/\partial v_H$ would imply that either $v_H \geq \overline{v}'_H$ or $0 > 1 - \beta_H \delta_P \geq \beta_L\left(\delta_H - \delta_P\right) > 0$, both of which is a contradiction.

Step 4: $d\hat{\gamma}(v_H)\big/d\,v_H > 0$ for all $v_H \leq \overline{v}'_H$

$\hat{\gamma}(v_H)$ is implicitly defined by the equation $V_H\left(C_H^{SB}(\gamma, v_H)\right) - V_H\left(C_P^{*}(\gamma, v_H)\right) = 0$, whose left-hand-side is a function $F(\gamma, v_H)$. From the implicit function theorem we have $d\hat{\gamma}(v_H)\big/d\,v_H = -\left(\partial F/\partial v_H\right)\big/\left(\partial F/\partial \gamma\right)$.

Therefore,

$$\frac{d\hat{\gamma}(v_H)}{dv_H} = -\frac{\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)/\partial v_H - \partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial v_H}{\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)/\partial \gamma - \partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial \gamma}$$
$$= \frac{\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)/\partial v_H - \partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial v_H}{\partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial \gamma} > 0,$$

where we use $\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)/\partial \gamma = 0$ from Proposition 3.4 and $\partial V_H\left(C_H^{SB}(\gamma, v_H)\right)/\partial v_H - \partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial v_H > 0$ and $\partial V_H\left(C_P^*(\gamma, v_H)\right)/\partial \gamma > 0$ from Step 3.

Step 5: $\hat{\gamma} \to 1$ as $v_H \to \vec{v}'_H$

As $v_H \to \vec{v}'_H$ we have $C_H^{SB} \to C_H^{FB}$ from Proposition 3.4. Also we know $C_H^{FB}\ \mathrm{f}_H\ C_P^*$ for $\gamma < 1$. Hence for every $\gamma < 1$ there exists an $\varepsilon > 0$ such that $C_H^{SB}\left(\gamma, \vec{v}'_H - \varepsilon\right)\ \mathrm{f}_H\ C_P^*\left(\gamma, \vec{v}'_H - \varepsilon\right)$, which proves the statement.

Taken together, Steps 1, 2, 4 and 5 prove the proposition for the case $\beta_H \delta_L > 1$. If this condition is not met, the high types will prefer financing of the pooling media product by price rather than advertising whenever $\beta_H \delta_P \le 1$. In this case, it may thus be that the equilibrium values in C_P^* change if γ gets too low. Simple adaptation of the above steps for the new equilibrium values then completes the proof. *Q.E.D.*

3.7.2 Analysis of Alternative Monopoly Cases

In this Appendix we analyze the monopoly media case in the situation where one type has both a higher willingness to pay and a higher willingness to accept advertising. Let us first consider the subcase where $\bar{U}_H \geq \bar{U}_L$ and $\bar{U}_H / \beta_H \geq \bar{U}_L / \beta_L$, that is where the high types have a higher willingness to pay in both dimensions. In this case, the high types are unambiguously the more attractive customers for the monopolist. This renders the optimal behavior of the monopolist similar to price discriminating behavior in standard goods markets (Mussa and Rosen, 1978). We forgo presenting the formal solution to this case; instead we will present the results graphically.[92] Figure A.3.4 shows the results.

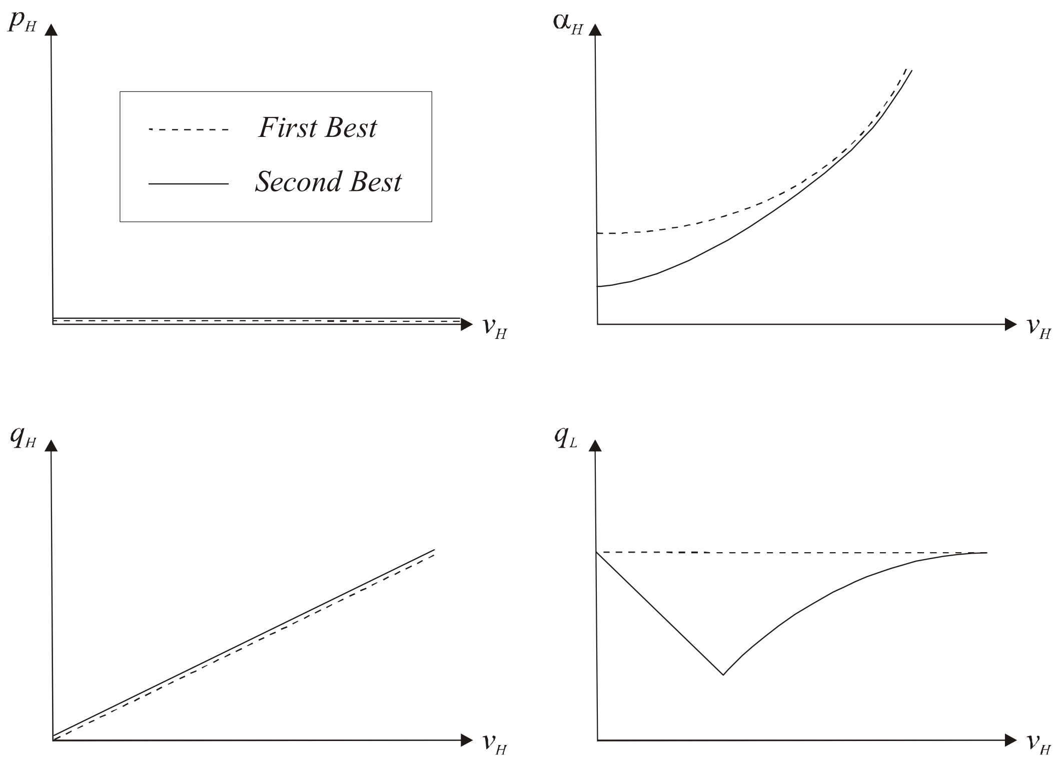

Figure A.3.4: The Alternative Monopoly Case

[92] A complete algebraic solution for this case is available from the authors upon request.

The first notable feature of this case is that high types have to be impeded from choosing the low type contract. This implies that they receive their first best quality throughout (no distortion at the top). In addition, they have to endure less advertising than in first best (that is, they receive an information rent). Low types quality is distorted downwards throughout, in order to deter high types. Note that this quality distortion is not due to the adverse selection of advertising, but due to price discrimination, quite contrary to the case that is analyzed in the main text. As can be seen from Figure A.3.4, in the present case it is never possible to obtain the first best. However, for $v_H \to \infty$ the optimal price discriminating contract converges to the first best contract. Note that it may be profitable for the monopolist to ration low types. Rationing will occur whenever γ is high, $\bar{U}_H$ is high and v_H is low.

Next turn to the case where low types have a higher willingness to pay in both dimensions, that is $\bar{U}_L \geq \bar{U}_H$ and $\bar{U}_L / \beta_L \geq \bar{U}_H / \beta_H$. This is the case that has been analyzed by Srinagesh and Bradburd (1989) for standard goods. This time, however, the results in the media market do not match the results in goods markets at all. Quite to the contrary, the analysis in this case corresponds to the analysis in the main text in all but one subcases. The only difference occurs when $\gamma \leq \bar{\gamma}$ and $v_H \in \left[0, \underline{v}_H\right)$. Even in this subcase, a difference to the main text only occurs within an interval $\left[0, \underline{v}_H''\right)$, where $\underline{v}_H'' < \underline{v}_H$. In this subinterval there will be pooling of types. Whether the pooling involves positive price and zero advertising or the other way around depends on the parameters. Since this difference is so minor we forgo a more detailed analysis.

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CURRICULUM VITAE

14. March 1975	born in Munich, Germany.
July 1994	Abitur, Gymnasium Dingolfing.
December 1998	Diplom Volkswirtschaftslehre, Ludwig-Maximilians-University, Munich.
Januar 1999 - March 2004	Ph.D. program in Economics, Wissenschaftlicher Mitarbeiter, Seminar for Economic Theory, Department of Economics, Ludwig-Maximilians-University, Munich.
September 2000 - Februar 2001	Marie Curie Fellowship, University Copenhagen, Denmark.
Juli 2004	Ph.D. in Economics (Dr. oec. publ.), Ludwig-Maximilians-University, Munich.