The Effects of Preference Characteristics and Overconfidence on Economic Incentives

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Florian Englmaier

Referent: Prof. Ray Rees
Korreferent: Prof. Dr. Klaus M. Schmidt
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Chapter 1

Introduction

In the last 30 years probably the two most influential innovations in microeconomics were the theory of incentives and the rise of behavioral economics. The theory of incentives deals with the issue that the real world suffers from informational problems which have to be overcome to establish efficiency. On the other hand, behavioral economics is concerned with the observation that people in the real world systematically deviate from the behavior we would expect from fully rational economic actors as the standard textbook models describe them.

In the beginning of behavioral economics there was a severe conflict between what could be called mainstream economists and researchers in behavioral economics. The proponents of the mainstream argued that real people are probably not rational actors, but in a competitive market they behave as if they were, as they would be driven out of the market otherwise. In addition it was argued that deviations from rational behavior were just idiosyncratic and thus would offset each other in large markets. Addressing this point, behavioral economists gathered evidence that people's deviations from predicted behavior are present at the market level and that they are not idiosyncratic but systematic. Labor and financial markets were analyzed in depth and these two fields were the first where it became acceptable to relax standard assumptions in modelling.

Only very few years ago has this discussion somewhat died out and it is more commonly accepted to also consider behavioral "anomalies" to explain economic outcomes. However, there is only little work done along these lines. In this thesis I combine the two strands, incentive theory and behavioral economics, in order to gain new insights in the interplay between preference characteristics, belief biases, and institutions.

The second chapter of this dissertation is based on the paper INCENTIVE CONTRACTS UNDER INEQUITY AVERSION[1]. This chapter analyzes a standard Moral Hazard problem following Holmström (1979) but amends this basic model by assuming that the agent is inequity averse. The concept of inequity aversion, stating that agents suffer from being better or worse off than others in their reference group, was introduced by Fehr and Schmidt (1999) to capture a wide array of experimentally and empirically observed non–selfish behavior and was probably the first operationalizable behavioral model of non-standard preferences. The results we obtain from introducing non–selfishness into the Moral Hazard problem differ from conventional contract theory and are more in line with empirical findings than these standard results. The key findings are that inequity aversion alters the structure of optimal contracts systematically. Inequity aversion gives scope for an additional incentive instrument as the agent can be rewarded for good performance not only by higher monetary rewards but also by less inequity. In addition, there is a strong tendency towards linear sharing rules as agents have an incentive to "insure" not only against variations in wealth but also the perceived fairness of an allocation. Moreover, enriching the model and allowing for more than one agent, inequity aversion delivers a simple rationale for the widespread use of team based incentive schemes, even in environments where standard theory would not predict them. This is again due to the fact that agents want to be insured against too volatile levels of equity. Finally, we find along the same line of reasoning that the Sufficient Statistics result is violated. Dependent on the environment, optimal contracts may be either overdetermined or incomplete. This depends on how the agent evaluates the fairness of an allocation.

The third chapter, MORAL HAZARD AND INEQUITY AVERSION: A SURVEY, summarizes the growing literature in the emerging field of behavioral contract theory that incorporates social preferences into the analysis of optimal contracts in situations of Moral Hazard. It contrasts these papers with the model and the results from the previous chapter. In order to ease this comparison the chapter contains a sketch of the previous

[1]This paper is joint work with Achim Wambach.

chapter's model. Studying these recent contributions emphasizes that taking social preferences into account when analyzing optimal contracts generates important new insights and can help us gain a better understanding of real world contracts and organizational structures.

The fourth chapter, A brief Survey on Strategic Delegation, outlines the literature on strategic delegation. It leads over to the other two main papers of this thesis that deal with the question to what extent players engaged in non–cooperative interactions can improve their strategic situation by having agents playing the game on their behalf. This brief survey summarizes where strategic delegation has been employed, what its effects are in the respective environments and what are the limitations of its application.

Chapter five is based on the paper A Model of Delegation in Contests[2]. In this paper we look at contests between two groups over a "rent". The situation is such that no contracts on the contested rent can be written and the group members may have differing valuations for this contested rent. In our model the Median Voter Theorem is applicable and we can show that generically the pivotal group member, with the median valuation for the rent, will not act himself but will want to send a group member that has preferences different to her own into the contest. The delegation can be either to more or less "radical" group members. The direction of delegation depends on the order of moves and the relative "aggressiveness" of the group medians. Delegation gives the pivotal group member a strategic tool to gain commitment power for the subsequent contest game. We show that generically very asymmetric equilibria arise, even if the median group members value the rent (almost) equally. Delegation leads to a social improvement in terms of resources spent in the contest. The intuition for the result is that the possibility to delegate amplifies, possibly minuscule initial differences.

While chapter 5 is concerned with delegation in contests in a rather abstract setting I will consider delegation in a specific context in what follows. The last paper deals with the question whether firms can gain a strategic advantage by hiring overconfident managers. Overconfidence is a phenomenon prominent in the psychological literature but so far only scarcely dealt with in economics. To introduce the concept I present in

[2] This paper is joint work with Stefan Brandauer.

chapter six A brief Survey on Overconfidence. I outline the psychological evidence for this phenomenon and give a taxonomy for an array of phenomena that come under the common label of overconfidence. It is pointed out that the psychological studies were early on concerned with overconfidence amongst professionals and executives, even in top rank management positions. Furthermore I show how the existence of overconfidence can be rationalized with economic reasoning, in which contexts the concept has been employed, and what are its effects in these situations.

Chapter seven, A Strategic Rationale for Overconfident Managers, adds strategic concerns to the list of economic modelling issues set out in the previous chapter. We analyze whether it might be desirable for a firm to hire an overconfident manager for strategic reasons. We analyze a tournament type version of Bertrand competition and a linear demand Cournot model. In each case there is an R&D stage where firms can invest in cost reduction before product market competition takes place. It is this R&D stage where overconfidence kicks in. Though under some qualifications, we find that under both specifications firms want to delegate to overconfident managers. The fact that both under price and quantity competition delegation works in the same direction is distinct to the standard literature on strategic delegation where optimal delegation in those two cases works in opposite directions. The models in this chapter not only help explain the empirical evidence that executives are prone to overconfidence but also deliver testable implications.

Finally, the Concluding Remarks in chapter eight contain some brief personal reflections.

Chapter 2

Contracts under Inequity Aversion

2.1 Introduction

> *"A given level of pay may be viewed as good or bad, acceptable or unacceptable, depending on the compensation of others in the reference group, and as such may result in different behavior. [...] This is a constraint on the use of any sort of incentive pay."*
>
> Milgrom and Roberts (1992, p. 419)

Although Milgrom and Roberts (1992) straightforwardly state that social preferences matter in the design of incentive schemes this issue has received little attention – though the question how to provide appropriate incentives was analyzed in much detail since Holmström's [1979] seminal paper on Moral Hazard [1].

We introduce social preferences[2], captured by inequity aversion following Fehr and Schmidt (1999), into a Holmström (1979) setting where a principal hires an agent who,

[1] Exemptions are Kandel and Lazear (1993) on peer pressure or the literature on status concerns in Public Finance. Examples for the latter are Lommerud (1989) or Konrad and Lommerud (1993).

[2] Throughout the paper we will use terms like fairness, reciprocity, social preferences, and inequity aversion somewhat interchangeably. What we mean is reciprocal patterns in behavior captured by inequity aversion. See Kolm (2003) for a detailed discussion and classification of different concepts of reciprocity.

by his choice of effort, determines the probability distribution of profits. Analyzing this problem with an agent that suffers from being worse off or better off than the principal gives us a better understanding of real world contracting. Section 8 contains a number of empirical findings that can be explained by our simple model.

We find that the optimal contract has to trade off three factors: insurance – incentives – fairness. The agent's concern for fairness leads to a tendency towards linear sharing rules. Furthermore the fairness concern delivers a new incentive instrument, as the agent can be rewarded for good performance not only by paying more, but also by paying more equitably. Moreover we find that Holmström's Sufficient Statistics result[3] is violated as optimal contracts may be either overdetermined or incomplete. Finally, turning to the multi–agents case, the fairness motive gives a rationale for the widespread use of team incentives even if the performed tasks are independent.

Only recently – backed by experimental research[4] – theoretical frameworks have been developed to model other–regarding preferences. Among the most prominent examples are Rabin (1993), Dufwenberg and Kirchsteiger (1998), Falk and Fischbacher (2000), Fehr and Schmidt (1999), and Bolton and Ockenfels (2000)[5]. The first three models – Rabin (1993), Dufwenberg and Kirchsteiger (forthcoming) and Falk and Fischbacher (2000) – try to actually model reciprocal behavior. Here the intentions of an agent play a role in evaluating the results of his actions. Whereas these models are certainly closer to a realistic modelling of human behavior they are analytically hardly tractable[6]. In contrast, Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) are only concerned with the effects of actions on final allocations. In these latter two models agents' utility increases in own profit but decreases if they are better or worse off than others. While in Fehr and Schmidt (1999) agents compare own payoffs to everybody else's payoff, in Bolton and

[3]The Sufficient Statistics result states that optimal contract should condition on all informative signal with respect to effort choice and not on uninformative signals.

[4]See Gächter and Fehr (2001), Fehr and Falk (2002) and Fehr and Schmidt (2003) for comprehensive surveys of these experimental studies.

[5]These topics have been discussed by sociologists for a long time. See for example Gouldner (1960), Goranson and Berkowitz (1966) or Berkowitz (1968). In the seventies also economists like Selten (1978) were interested in them.

[6]See however the recent paper by Cox and Friedman (2003) who try to build a "tractable model of reciprocity".

Ockenfels (2002) they compare themselves only to the average in the reference group. For the most part of our paper the two models would coincide in their prediction as there are only two players. We use the model by Fehr and Schmidt (1999) to conduct our analysis. While this model neglects intentions and solely focusses on final allocations it fares well in explaining observed experimental results while being still quite simple and tractable[7].

As noted earlier we are not the first to deal with the role of fairness in labor relations. In Akerlof (1982) and Akerlof and Yellen (1988) the labor relation is characterized as a partial gift exchange. A generous wage offer by a firm is interpreted as a gift which is met by the agent with a high effort choice. It is argued that in order to make use of this mechanism wages are kept high and this can account for observed involuntary unemployment. Bewley (1999) offers an extensive survey of numerous interviews with managers and argues that fairness concerns and the fear of harming "working morale'" might explain "Why wages don't fall during a recession".

A number of other researchers rely on controlled laboratory experiments to analyze the effects of social preferences in labor markets. Fehr, Kirchsteiger, and Riedl (1993) replicate the world of Akerlof (1982) and Akerlof and Yellen (1988) in a laboratory and confirm their prediction that even in very competitive environments markets may not clear as wages are kept high to trigger a reciprocal high effort choice. Fehr, Gächter, and Kirchsteiger (1997) argue in an incomplete contracts environment that reciprocity may serve as a contract enforcement device. They show that agents exert (on average) more effort if they face a more generous wage offer. Fehr and Falk (1999) finally combine these two findings and show that principals seem to be aware of the possible contract enforcement power of reciprocity in an incomplete contracts environment. Here wage levels remain high despite the fact that there is unemployment and there are workers willing to work for lower wages. In complete contracts environments however principals tend to squeeze down wage levels on the market clearing level. See Gächter and Fehr (2001) for a comprehensive survey of experiments on fairness in the labor market.

Standard economic theory predicts a much more complex and - from a practical point of view - generally undetermined structure to be the optimal solution to the principal

[7]Cf. Fehr and Schmidt (2003) where they show how their model performs in explaining experimental data from numerous experiments.

agent problem[8]. However, most real world contracts have a very simple linear structure. There have been only few attempts to explain this feature in standard contracting models. Holmström and Milgrom (1987) consider a setting where the agent controls the drift rate of a Brownian motion. They show that the optimal contract is - for a rather specific setting - linear in overall outcome. However, the Holmström and Milgrom result depends very delicately on the assumptions they make on the stochastic process and on the form of the utility function[9]. Innes (1990) assumes instead that the agent is risk neutral but wealth constrained. Then the optimal contract makes the agent the residual claimant if the outcome is such that it exceeds a threshold. In those regions the contract takes a linear form. This implies that the optimal contract has a slope of one, something which we rarely observe. Finally, Bhattacharyya and Lafontaine [1995] find a linear sharing rule to be the optimal sharecropping contract in a setting with bilateral moral hazard. But again the results depend on their specific assumption that error terms are additive and normally distributed.

The intuition why inequity aversion in our model helps to explain linearity is straightforward. An inequity averse agent cares for everybody getting a "fair share" of surplus. Now if an additional unit of surplus is to be distributed it should be distributed according to these fair shares. This holds for every additional unit of surplus. When every marginal unit is distributed according to fixed shares this is the very definition of a linear sharing rule.

Next to the topic of linearity another main focus of contract theory has been completeness of contracts. So while violations of Holmström's Sufficient Statistics result with respect to contractual incompleteness are widely accepted and a huge literature following Grossman, Hart and Moore deals with its implications, only recently attention has been paid to the fact that real world contracts may be overdetermined[10]. Again our model offers an explanation for either observation. Contracts may be overdetermined as inequity aversion implies an intrinsic interest in the distribution of firms' profits. If profit consists

[8]See e.g. Holmström (1979) or Mirrlees (1999).

[9]See Hellwig and Schmidt (2002) for a detailed discussion and a discrete time approximation of the Holmström and Milgrom (1987) continuous time model.

[10]See for example Bertrand and Mulainathan (2001) who find that CEO pay varies as much with non informative signals as with informative ones.

not only of parts influenced by agents' effort choices, agents might still want to participate in variations of overall profit. On the other hand this intrinsic interest in a firm's profit might render it infeasible to contract on better performance measures than profit as this might lead to too inequitable distributions. Thus contracts may be incomplete in equilibrium.

Finally our analysis offers an explanation for the prominence of team incentives. If workers care about each others payoffs it may be optimal to condition workers' pay on their co–workers' performance. This type of team incentives can be interpreted as a kind of insurance not only against income shocks but also against the disutility from being worse or better off than the co–workers.

Recently a couple of papers have dealt with the matter of incorporating social preferences into contract theory. Fehr, Klein and Schmidt (2004) analyze - experimentally and theoretically - the interaction of fair and selfish agents that are offered contracts by a principal. They find that incomplete bonus contracts perform better than more complete contracts. However, they severely restrict the set of contracts available to the principal.

Rob and Zemsky (2002), Huck, Kübler and Weibull (2003), and Neilson and Stowe (2003) look at optimal incentive intensity when agents exhibit some form of social preferences but restrict the class of contracts to linear incentive schemes. While Neilson and Stowe (2003) focus on the single agent case Rob and Zemsky (2002) and Huck, Kübler and Weibull (2003) look at problems with multiple agents.

So do Rey Biel (2002), Itoh (forthcoming), Dur and Glazer (2003) and Bartling and von Siemens (2004a,b). These papers restrict the agents effort choice to a binary decision while we allow for a continuous choice. Demougin and Fluet (2003) and Grund and Sliwka (2003) look at tournaments amongst inequity averse agents. Finally there is Demougin, Fluet and Helm (2004) who look at a binary choice multi task model[11].

As pointed out above, most of these models are less general than ours as they restrict themselves either to deterministic production technologies, binary effort decisions or in that they focus their analysis not on inequity aversion but envy, i.e. the worker cares only about being worse off and not about being better off. The latter effect however is

[11]For a comprehensive treatment of this literature see Englmaier (forthcoming).

confirmed by empirical and experimental data.

The remainder of the chapter is structured as follows. In section 2 we explain the basic model. Section 3 discusses the key assumptions. In section 4 we derive the optimal contracts for the situation where effort is contractible while in section 5 we focus on the Moral Hazard problem with non–contractible effort choice. In section 6 we do comparative statics with respect to the degree of inequity aversion and the profit level. Section 7 contains two extensions. First we allow for additional signals and shed light on the question of contractual completeness and then we study the multi–agent case. Section 8 compares our main findings with several stylized empirical facts. Section 9 concludes the chapter and the Appendix contains the proofs.

2.2 The Basic Model

This section sets out the basic model. In the section thereafter we will discuss several points that might be considered as critical.

We model the interaction between a risk neutral, profit maximizing principal and a utility maximizing agent who is inequity averse towards his principal. In the extensions section we deal with the case of multiple agents, exhibiting inequity aversion towards each other and towards the principal.

The principal hires the agent to work for him. The profit x realized at the end of the period is continuously distributed in an interval $[\underline{x}, \overline{x}]$ with density $f(x|e)$ which is determined by the effort e exerted by the agent. As the principal is neither risk averse nor inequity averse he wants to maximize his expected net profit

$$EU_P = \int_{\underline{x}}^{\overline{x}} f(x|e)[(x - w(x)]dx$$

where $w(x)$ is the wage paid to the agent.

The agent's utility function is additively separable and has three parts: First, he derives utility from wealth, $u(w(x))$, which is strictly increasing in the wage payment. Second, he suffers from effort $c(e)$ where only $c'(e) > 0$ has to hold. Finally the convex function $G(\cdot)$ captures his concern for equitable allocations. To decide whether an allocation is fair or unfair the agent compares her payoff $w(x)$ and the principal's net payoff $[x - w(x)]$[12]. Therefore the agent's utility is given by

$$\begin{aligned} EU_A &= u(w(x)) - c(e) - \alpha G[[x - w(x)] - w(x)] \\ \text{with} &\; G'(\cdot) > 0 \text{ if } [x - w(x)] > w(x) \text{ , } G'(\cdot) < 0 \text{ if } [x - w(x)] < w(x) \\ & G''(\cdot) > 0 \\ & G(0) = 0 \text{ , } G'(0) = 0 \end{aligned}$$

α is the weight the agent puts on achieving equitable outcomes. One could think of this weight embedded in $G(\cdot)$, but to ease comparative statics we write it explicitly.

Figure 2.1 shows one possible graph of $G(\cdot)$. A quadratic function, $(\cdot)^2$, would be an example for a function fulfilling our assumptions. However, the function has by no means to be symmetric around 0, i.e. the equitable allocation. Thus we allow for the agent suffering much more from disadvantageous inequity than from advantageous inequity. Note that assuming convexity of $G(\cdot)$ implies an aversion towards lotteries over different levels of inequity.

We assume that the agent can ensure himself a utility level $\overline{U}$ in the outside market implying that the principal has to obey the agent's participation or individual rationality constraint $EU_A > \overline{U}$.

We assume that the Monotone Likelihood Ratio Property[13] applies, i.e.

$$\frac{\partial\left(\frac{f_e(x|e)}{f(x|e)}\right)}{\partial x} > 0.$$

This ensures that the higher the realization of profit the more likely it is that high effort was exerted.

[12]Our results qualitatively also hold for a richer model where the agent compares her net payoff $[w(x) - c(e)]$ to the principal's net payoff $[x - w(x)]$. See the Appendix for a brief exposition of this case.

[13]Cf. Milgrom [1981].

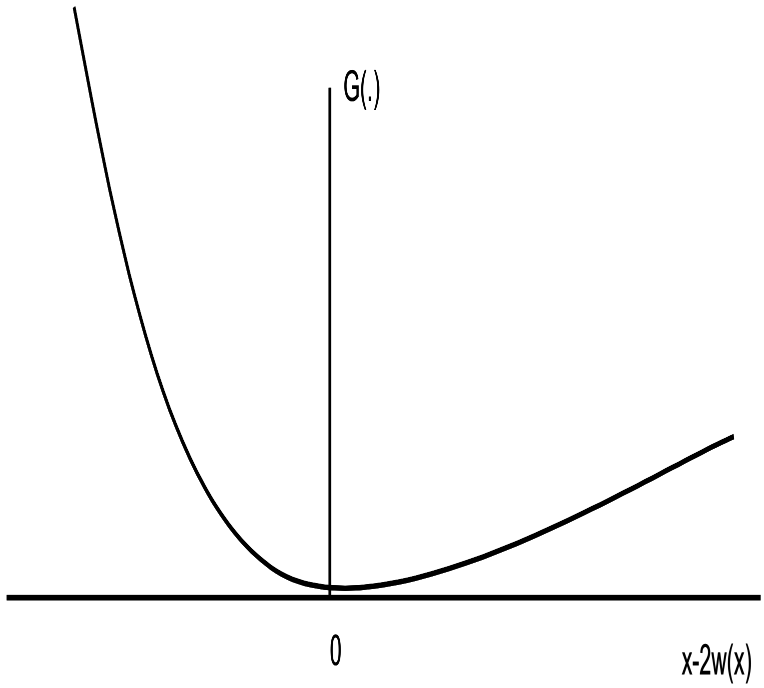

Figure 2.1: Example for $G(\cdot)$

2.3 Discussion

This section addresses several aspects of the model that might be considered critical. We start with our assumption that the principal has no concern for equity, but is selfish. We believe self selection of profit maximizing types into being entrepreneurs is a strong argument for this modelling choice. However, we can allow for the principal to be inequity averse, too. See the appendix for a brief outline of such a model. Assuming inequity aversion on the principal's side only strengthens our results as now both parties have a preference for equitable distributions and are pushing for an equal sharing rule.

Our assumption of $G(\cdot)$ being convex differs slightly from the original exposition of Fehr and Schmidt (1999)[14]. While utility in their model is also additively separable in income, effort and inequitable outcomes they describe the disutility caused by inequitable outcomes in a piecewise linear way. Our formulation is analytically more convenient to handle as we deal with continuously differentiable functions. However, the basic driv-

[14]They chose a piecewise linear model of the form $U_i(x_i) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\}$.

ing force of our model is present in their model, too. The agent is risk averse towards lotteries over levels of inequity. Whilst our convex formulation makes the agent also locally averse towards such lotteries their piecewise linear formulation implies only global aversion towards such lotteries.

Choosing the standard of comparison as comparing payoffs and equality to be the reference point for an allocation to be considered as fair is an assumption that can be also relaxed. The qualitative nature of our results remains entirely unchanged if we choose a formulation where the agent considers a fixed share $\frac{1}{k}$ of payoffs as fair or where the agent desires a fixed share of the net rent, i.e. payoffs net of agent's effort costs and any costs borne by the principal[15].

In contrast to standard contract theory models the assumption of an exogenously given outside option is not without loss of generality. Using it here basically implies that the agent no longer compares to the principal once he is not employed by him. Thus the reference group is restricted to the firm. This is however empirically backed by Bewley (2002).

One can ask whether focussing on the agent comparing himself to the principal and not to the other agents[16] is the appropriate thing to look at. We do not question the fact that those intra worker comparisons are very important. However, we firmly believe that workers indeed compare themselves to their superiors and, as Ed Lazear[17] puts it "...it is not obvious that workers should care more about harming other workers than they do about harming capital owners" when they contemplate shirking. An example for the importance of such vertical comparisons are the massive quarrels at *American Airlines* in 2003 that took place after the company had imposed massive wage cuts on the workers to avoid bankruptcy and it became known that the executives had not participated in these salary cuts. The unrest was explicitly pointed at this fact and *American Airlines* CEO Donald Carty had to resign after it became public that executives had secured their pension plans and claims from these cuts. Furthermore one has to note that all

[15]However cf. Young (1994) and Selten (1978) for detailed discussions of the non–trivial task to capture equity in economic models.

[16]However, we deal with this case in the Extensions section.

[17]cf. Lazear (1995), p.49

the important papers on the role of fairness from Akerlof (1982), over Rabin (1993), and the numerous papers by Ernst Fehr and his collaborators were framed in a setting where agents reciprocated towards their bosses.

Finally one could ask whether the relevant principals are really firm owners (as in our model) or the managers. Our model allows for this interpretation also, as long as this manager has discretion over the worker's pay and the manager's wealth depends on the agent's actions, e.g. via a stock option plan.

2.4 Contractible Effort

We start our analysis with the case where the principal can contract on effort, i.e. there is no Moral Hazard problem present. In this situation the principal wants to maximize his expected profit net of wage payments and has to obey only the agent's participation constraint (PC). Thus the problem becomes

$$\begin{aligned} \max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x - w(x)]\,dx \\ s.t. \quad (PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G[x - 2w(x)]]\,dx - c(e) \geq \overline{U}. \end{aligned}$$

Note that $[x - 2w(x)]$ as the argument of $G(\cdot)$ is derived by simplifying the initial comparison $[(x - w(x)) - w(x)]$. To isolate effects we first assume the agent to be risk neutral with respect to variations in income, i.e. $u\,(w(x)) = w(x)$.

In standard contracting models the contract structure in this setting is entirely undetermined. The principal is just interested in extracting all the rent from the relationship and as there is no risk aversion as a source of deadweight loss he can do so with any contract. However, introducing inequity aversion changes the picture.

Proposition 1 *If effort is contractible and the agent is risk neutral in wealth the unique optimal contract is linear with slope* $\frac{1}{2}$.

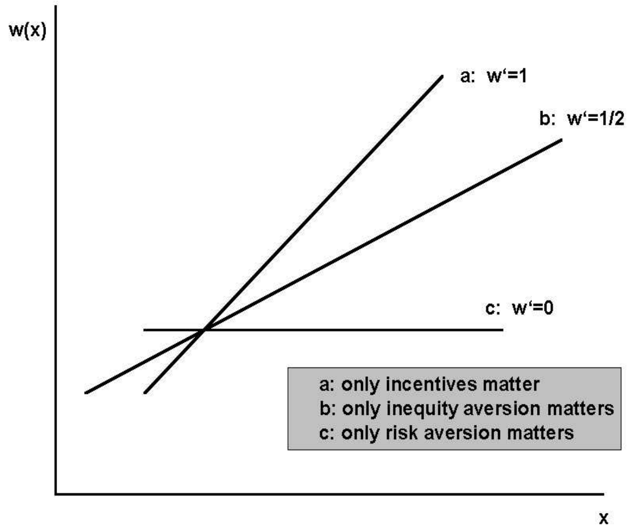

Figure 2.2: Forces at Work

The intuition for this result is that inequity aversion is the only source of welfare loss in the problem. Similar to risk aversion the agent dislikes here variations in inequity. Thus the deadweight loss can be minimized by offering a constant level of inequity over all realizations of x, i.e. a linear contract with slope $\frac{1}{2}$. However, generically there will be a welfare loss in equilibrium as the principal extracts the rent with a lump sum payment, thus inflicting some inequity on the agent.

Corollary 2 *Even with contractible effort and a risk neutral agent the welfare will not be maximized due to a welfare loss through the inequitable allocation caused by the lump sum component of the wage scheme.*

Proposition 1 gives us the prerequisites to fully describe all the forces at work in our model. Figure 2.2 shows these three forces. As in standard models the agent's insurance motive calls for a flat wage whilst the principal's wish to provide incentives calls for a wage scheme that makes the agent residual claimant. Finally, inequity aversion calls for an equal sharing rule.

With this at hand we can enrich our model by introducing risk aversion for the agent. In standard models of contract theory the solution is simply offering the agent a flat wage.

As there is no need to provide incentives the principal just has to ensure that the agent is fully insured.

Including now inequity aversion alters the situation. Looking at Figure 2.2 we see that as there is not yet a need to provide incentives the optimal contract's structure will be determined in the interplay of risk aversion (calling for a flat wage) and inequity aversion (calling for an equal sharing rule).

Proposition 3 *If effort is contractible and the agent is risk averse the optimal contract is strictly increasing with a slope of at most* 1/2.

This shows that we should always observe some profit sharing, even if it is not necessary for incentive reasons or when profits are not a good performance measure. Section 8 contains several observations backing this conjecture.

2.5 Non–Contractible Effort

Now we turn to the analysis of the classical Moral Hazard problem as we drop the assumption that effort can be contracted upon. When designing the contract the principal now has to keep in mind that the agent will act opportunistically and try to avoid effort costs by shirking. Thus the optimal contract has to be self enforcing, i.e. the agent has to find it in his own best interest to act as desired by the principal.

This incentive constraint (IC) the principal has to obey in addition to the above introduced participation constraint has the form

$$\text{(IC)} \quad e \in \arg\max_{\widetilde{e}} \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|\widetilde{e}) \left[u\left(w(x)\right) - \alpha G[x - 2w(x)] \right] dx - c(\widetilde{e})$$

and captures the fact that the agent will maximize his utility by choosing effort optimally given the offered compensation scheme.

In order to solve the problem we rely – as standard in the literature – on the First Order Approach and replace the above maximization problem in the principal's problem by its first order condition

$$(IC') \quad 0 = \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x)) - \alpha G\left[x - 2w(x)\right]]dx - c'(e).$$

First we look again at the case of a risk neutral agent. The standard contracting model (with a non–inequity averse agent) delivers a simple way to efficiently implement the first best effort level: The principal simply "sells the firm to the agent", i.e. offers a wage scheme with slope one, making the agent residual claimant of all accruing profits. As the agent is risk neutral he does not suffer from taking over the whole risk and as he is residual claimant his incentives are socially efficient. The solution in the case with a risk neutral but inequity averse agent looks different.

Proposition 4 *If effort is not contractible and the agent is risk neutral the optimal contract is strictly increasing with a slope between* $1/2$ *and* 1.

In the standard model there is nothing that would speak against making the agent residual claimant. But now as the agent is inequity averse we note that making him residual claimant implies generically very unequal allocations and thus the degree of inequity being very volatile. Therefore the need to give high incentives and the desire to insure the agent against fluctuations in inequity work against each other and have to be balanced off in the optimal contract.

As noted above in the standard model it is optimal to implement the full information effort level also under Moral Hazard. Under inequity aversion this is not possible as we have just one instrument, the slope of the wage scheme, to balance the need to incentivice and the desire to insure against varying degrees of inequity.

Proposition 5 *If effort is not contractible the full information effort level is not implemented though the agent is risk neutral*

This hints again at the fact that inequity aversion is a friction similar to risk aversion that acts as a source of welfare loss in the model. If the principal gave higher powered incentives that would lead to too inequitable allocations for which the agent would have to be compensated up front. Thus incentives are distorted downwards. However, it is not clear whether effort under inequity aversion will be lower than in the standard case as in some cases the agent will want to work harder as he also suffers if the principal is worse off than he is.

Now we approach the fully fledged problem and allow for risk aversion in the agent's preferences. Already in the standard model, where only the motive to insure the agent against fluctuations in wealth and the need to provide sufficient incentives are present, there is no clear cut prediction for the shape of the optimal incentive scheme, next to it being strictly increasing. This is due to the Monotone Likelihood Ratio Property which tells us that a higher profit level is informative with respect to the agent's effort choice. If we now turn to the analysis of our model where we additionally have to take into account the agent's concern for equity the situation gets even more complicated. Thus we cannot make a very sharp prediction either.

Proposition 6 *If effort is not contractible and the agent is risk averse the optimal contract is strictly increasing.*

Now one instrument has to balance off three countervailing forces and the shape of the scheme is determined by their interplay. We know that the scheme is increasing for two reasons: As in the standard model higher profit levels are informative signals and are therefore used to reward the agent. But additionally the agent cares for an increasing wage scheme for reasons of fair sharing.

Exploiting this latter reasons allows us to state that if the agent's concern for fairness is strong enough we get an increasing wage scheme no matter whether high profit levels are informative or not.

Proposition 7 *For any given signal quality there exits a value for α, the agent's concern for equity, such that the Monotone Likelihood Ratio Property is not needed to ensure the optimal contract being strictly increasing in x.*

2.6 Comparative Static Properties

To be able to be more precise with respect to the contractual structure we analyze the comparative static properties of our results. First we analyze what happens if the agent's concern for equity, captured by α, increases.

Proposition 8 *If α, the agent's concern for equity increases the optimal contract converges to $w(x) = 1/2x$, i.e. the equal split.*

If α increases, at some point this concern for equity becomes the dominant driving force for the structure of the contract and overrules all other motives. To the agent it is more important to ensure equity than to avoid risk and to the principal it is just too expensive to provide incentives over the equal split - as this would imply inequitable allocations at least sometimes. To compensate the agent for this risk then becomes prohibitively costly.

Looking at the comparative statics with respect to x shows another interesting property.

Proposition 9 *As the realized profit level increases the optimal contract specifies a more equitable distribution of overall profit*[18].

Thus inequity aversion is not only another friction but also delivers an additional incentive instrument. The effect is most pronounced under risk neutrality and under risk aversion if the agent is already generously compensated in monetary terms. In this case the additional utility from decreased inequity is more important than additional monetary compensation and makes reduced inequity a possibly valuable source of incentives.

This concludes the analysis of the basic model and we turn to the analysis of some extensions.

[18] The paper by Rey Biel (2002) uses a related effect.

2.7 Extensions

2.7.1 Overdetermined Contracts

As pointed out above, inequity aversion is one reason why the agent is inherently interested in how the profits are divided - not only via the channel of its informative use in incentive provision. To prove this consider the following setup: The firms' profit Π can be separated into two parts x and y, i.e. $\Pi = x + y$. While the distribution of x depends on the effort e exerted by the agent, y is purely randomly distributed. In the appendix it is shown that contrary to the well known sufficient statistics result, the optimal contract when the agent exhibits inequity aversion conditions on y, although this variable contains no information concerning the effort choice.

Proposition 10 *With inequity averse agents the sufficient statistics result no longer applies. Optimal contracts may be overdetermined, i.e. contain non relevant information with respect to effort choice.*

The intuition is along the lines of Proposition 1. Profit serves not only as a signal whether or not the agent exerted enough effort, but is also important for the agent's utility as he has a concern for equitable distributions. As the agent compares his payoff to the firm's profit, y is taken into account when equitability is judged. Therefore it has to be taken into account when the contract is written. If this is not done one ends up with too much inequity for which the agent has to be compensated upfront.

2.7.2 Incomplete Contracts

In economic theory much more attention has been paid to incomplete contracts than to overdetermined contracts. Interestingly our model can also account for incompleteness. Suppose we have the following situation. The principal has now not only access to profit x but also to another more direct performance measure m. The signal m contains additional information on the agent's effort choice and should be therefore – following Holmström's

[1979] Sufficient Statistics Result – included in the optimal contract. In our set up this is not necessarily the case.

Corollary 11 *If α, the agent's concern for equity, converges to ∞ the optimal contract is uniquely defined by $w(x) = \frac{1}{2}x$ and additional informative signals are disregarded. Thus the optimal contract is incomplete.*

Note that this holds even for the extreme case where the signal x is dominated in the sense of Second Order Stochastic Dominance by signal m. The idea behind this result is again that the improved incentives cannot compensate for the fact that the agent now has to be compensated for less equitable allocations. Therefore it might be better to forego the chance to use superior performance measures and instead stick to profit in which the agent is intrinsically interested[19].

2.7.3 Team Incentives

Another natural extension is to analyze what happens if there is not only one agent but many as inequity aversion should be also important when agents interact with peers. Suppose there is one principal and two agents. The agents' tasks are technologically independent. Each agent has to choose an effort level e_i to influence a distribution function $f_i(x_i|e_i)$ where x_i is the profit generated from agent i's project. Only the x_i are contractible. The agents compare each others' gross payoff and the principal's payoff. The principal offers a contract $w_i\left(x_1, x_2\right)$ that can in principle depend on both performance measures.

[19]Note that if net–of–effort payoffs are compared this result no longer holds as now agents have not only an intrinsic interest in profit but also in effort (via effort costs). Thus the contract will always condition on all available sufficient statistics with respect to effort choice.

Agent 1's utility function takes the form

$$\begin{aligned}
EU_1^A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x|e_1)f_2(x|e_2)u_1\left(w_1\left(\cdot\right)\right) - \alpha_P G\left[\left[\left(x_1+x_2\right)-\left(w_2\left(\cdot\right)+w_1\left(\cdot\right)\right)\right]-w_1\left(\cdot\right)\right] \\
&\quad -\alpha_A H\left[w_2\left(\cdot\right)-w_1\left(\cdot\right)\right]dx_1dx_2 - c(e) \\
&= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x|e_1)f_2(x|e_2)u_1\left(w_1\left(\cdot\right)\right) - \alpha_P G\left[x_1+x_2-w_2\left(\cdot\right)-2w_1\left(\cdot\right)\right] \\
&\quad -\alpha_A H\left[w_2\left(\cdot\right)-w_1\left(\cdot\right)\right]dx_1dx_2 - c(e).
\end{aligned}$$

α_P measures how much weight he puts on the comparison towards the principal. The agent now suffers if his payoff $w_1\left(\cdot\right)$ differs from the principal's gross payoff $\left(x_1+x_2\right)$ net of total wage payments $\left(w_2\left(\cdot\right)+w_1\left(\cdot\right)\right)$. The disutility is – as in the basic model – captured by a convex function $G\left(\cdot\right)$. The agent also suffers if his payoff $w_1\left(\cdot\right)$ differs from his co–worker's payoff $w_2\left(\cdot\right)$. His concern for equity towards the other agent is weighted by α_P and measured by the convex function $H\left(\cdot\right)$.

As before the agent is risk averse against variations in equity towards his co–worker. The optimal contract takes care of this.

Proposition 12 *If agents are inequity averse there is a rationale for team incentives even if tasks are technologically independent and there is a sufficient statistic for every agent.*

Standard theory would suggest that if there is no technological link between agents' tasks and therefore no scope for relative performance evaluation to filter out common shocks, conditioning pay on other agents' output only adds noise. Following the Sufficient Statistics result the principal should therefore not condition upon such uninformative signals. But inequity averse agents have an intrinsic interest in other agents' performance. Conditioning pay on others' performance ensures that there is not too much inequity among the workers. This reduces the compensation agents demand for the risk of facing inequitable allocations and hence reduces the principal's costs. It is again the tradeoff between optimal incentive provision and ensuring equity that drives this result. Focussing on the extreme case where inequity aversion is the sole driving force we get a very simple contractual structure.

Corollary 13 *If agents' concern for equity among them becomes very large* ($\alpha_A \to \infty$) *the optimal contract is a simple team contract basing each agent's pay solely on overall profit.*

Related to this issue is an observation by Bartling and von Siemens (2004b). They argue that keeping salaries secret can never be optimal as it would limit the possibilities to insure the agent against variations in income as compared to his co–workers.

2.8 Empirical Evidence

Our first central finding is, that the distribution of profits within a firm actually matters when agents are inequity averse. Rotemberg (2003) has several examples that clearly show that agents are very much interested in their companies' profits and the distribution of the produced rents. Lord and Hohenfeld (1979) report a study of major league baseball players who became "free agents"[20] in one season where club owners had made use of an option to cut wages by 20%. After this wage cut these players' – beforehand better–than–average – performance declined significantly, only to go up again after they had signed with new clubs. While standard theory would predict that performance should go up if the agent is looking for a new job to signal his high ability to the market, models of reciprocity are in line with this behavior. In our framework the declining performance can be seen as a means of the players to lower owner's profits in order to equalize shares of profits after the 20% cut.

Greenberg (1993) reports a field experiment in several plants of a firm where theft after a cut in wages was measured. In those plants where wages were cut "with no good reason" theft went up significantly. This study controls for the argument that a theory of efficiency wages could explain this finding[21]. Taking into account social preferences allows us to interpret the increase in theft as the employees stealing back what they view their fair share. In a similar vein we can interpret Bewley's (1999) finding that the productivity

[20] A professional athlete who is free to sign a contract to play for any team.

[21] By the wage cut the value of retaining the job declines and thus the worker is more willing to take the risk of getting caught stealing and loosing the job.

loss in a firm after a wage cut is stronger in boom times, i.e. when firms' profits are high, than in a downturn when firms run losses[22].

In a meta study Thaler (1989) reports systematic and persistent inter industry wage differentials, i.e. an equally qualified worker in the same job earns significantly more in a high profit industry. The papers by Blanchflower, Oswald and Sanfey (1996) and Hildreth and Oswald (1997) find the same and additionally the intertemporal effect that increased firm profits feed through to wage increases. Whilst these facts are contradicting standard labor market theories they are again consistent with fairness based theories of rent sharing.

Our second central result is the tendency towards linear and equal sharing rules implied by agents exhibiting inequity aversion. Taking a global perspective the most widespread incentive contracts are sharecropping contracts. As empirical studies by Bardhan and Rudra (1980), Bardhan (1984), Young (1996) and Young and Burke (2001) from India and Illinois find those are predominantly linear. Moreover 60% to 90% of these sharecropping contracts stipulate equal splitting rules. Allen (1985) states that "metayage", the French word for sharecropping, actually means "dividing in half". The same holds for the Italian term "mezzadria".

Now let us turn to the analysis of contractual completeness. While it is hardly questioned that real world contracts are predominantly incomplete there has been less focus on overdetermination of contracts. There are several sources showing the widespread use of employee stock and stock options also for lower tier workers. For example *CISCO Systems* has such schemes for every single employee and is a very successful company in terms of profit and in terms of retaining their workforce. At *Starbucks* even part time workers are entitled to such schemes. A 1987 US Government Accounting Office survey shows that 54% of non-unionized and 39% of unionized *Fortune 1,000* firms had firm wide profit sharing plans in place. Knez and Simester (2001) report the enormous success of *Continental Airlines* that introduced a firmwide profit sharing scheme. Their econometric study showed that the increases in productivity can be largely accounted for by this profit sharing plan. The study by Oyer and Schaefer (2003) shows in addition that the adoption of broad based employee stock and stock option plans is much more common

[22]Cf. Bewley (1999), p. 203 tables 12.4 and 12.5.

in smaller firms. If one is willing to accept that in smaller groups social comparisons are more important this points at a fairness based interpretation. These findings fit in our analysis as inequity averse workers are interested in profit sharing plans inherently - even if these stock and stock options are not good performance measures as a single lower tier worker's influence on the stock price is certainly negligible[23].

These findings, however, also hold for top tier employees. Bertrand and Mullainathan (2001) find that CEO income reacts equally strongly to "lucky" and to "general" profits, where lucky profits are those not controllable by the CEO. Furthermore they find that in firms with "anti–takeover–clauses" (that protect the CEO) not only the CEO earns more, but also all other employees. So whilst the finding on CEO income could also be interpreted a la Bebchuk and Fried (2003) as the CEO – who basically can freely set his own pay – just diverting money from the shareholders to herself, the latter finding is very much in line with a theory of an inequity averse workforce that demands to be taken care of fairly.

Finally our analysis of teams fits the study by Agell (2003) who finds that there are systematic differences in pay structure between large and small firms where small firms have less competitive schemes in place. Taking it again as given that in smaller groups social comparisons are more important this fits our results that with multiple agents compensation should be rather team then relative performance based.

2.9 Conclusion

Our analysis has shown that incorporating social preferences in the analysis of optimal incentives can improve our understanding of real world incentive schemes a lot. If agents exhibit an aversion towards inequitable distributions the optimal contract has to balance the agent's concern for insurance and fairness and the principal's desire to provide adequate incentives.

The agent's concern for equity adds a rationale for linear sharing rules and it adds an

[23]Moreover is stockholding in the own company bad from a portfolio composition perspective as this is highly correlated with risks to a employee's (firm specific) human capital.

additional incentive instrument: the agent can be rewarded for better performance not only by paying more, but also by paying more equitably. Due to the inherent interest in the distribution of profits, Holmström's Suffcient Statistics result is violated and optimal contracts may be either overdetermined or even incomplete. Along the same lines of reasoning we get a rationale for team incentives even if tasks are independent. Thus, introducing inequity aversion into the analysis of contracting problems offers a plausible explanation for an array of empirical phenomena at once.

However, our analysis is only a first step in the - as we believe - right direction and there remain many open questions to be tackled. If social preferences are important and matter for effort exertion and incentive provision it would naturally be of importance for firms to be able to alter them. And Milgrom and Roberts (1992) already point out that a large share of companies' Human Resource Management activities is targeted at shaping employees preferences. While this question is central to researchers in Organizational Behavior or Human Resource Management it has received only little attention by economists[24].

A related question is, how an interaction is perceived by the agent. What is the relevant time horizon, what are the limits of a relation? Psychologists would call this "bracketing". The right framing of the work interaction is surely another important task for managers within a firm.

Another interesting question is whether there is sorting with respect to the "fairness type" in the labor market. Casciaro (2001) reports that people can detect whether others have social feelings towards them and O'Reilly and Pfeffer (1995) and Oliva and Gittell (2002) report about *Southwest Airlines* that apparently uses this and hired only after checking for social type. In Southwest's hiring process these social factors were more important than ability or past performance. So it remains to be determined for what jobs or tasks socially motivated workers are especially desirable or detrimental.

Finally it is important to understand, what determines the reference group for social comparison processes. As relative income comparisons have the above described effects on incentives and effort it is important to control to whom agents compare such that ill-led

[24]Rotemberg (1994) is one prominent exception, although his focus is slightly different.

comparisons do not lead to detrimental outcomes.

2.10 Appendix

2.10.1 Proofs

Proof of Proposition 1

The principal's problem is given by

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\left[x - w(x)\right] dx \\
s.t.(PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\left[u\left(w(x)\right) - \alpha G[x - 2w(x)]\right] dx - c(e) \geq \overline{U}
\end{aligned}$$

and the Lagrangian takes the form

$$\begin{aligned}
L &= \int_{\underline{x}}^{\overline{x}} f(x|e)\left[x - w(x)\right] dx \\
&\quad -\lambda\left[\overline{U} - \int_{\underline{x}}^{\overline{x}} f(x|e)\left[u\left(w(x)\right) - \alpha G[x - 2w(x)]\right] dx + c(e)\right]
\end{aligned}$$

The First Order Condition is then given by

$$\frac{\partial L}{\partial w(x)} = -f(x|e) + \lambda f(x|e) u_x\left(w(x)\right) + \lambda f(x|e) 2\alpha G'\left[x - 2w(x)\right] = 0.$$

Dividing by $f(x|e)$ and rearranging yields

$$\frac{\lambda u'\left(w(x)\right) - 1}{\lambda 2\alpha} = G'\left[x - 2w(x)\right].$$

Note that for risk neutral agents $u'(w(x))$ is a constant: $u'(w(x)) = u$

$$
\begin{aligned}
\frac{\lambda u - 1}{\lambda 2\alpha} &= G'[x - 2w(x)] \\
\frac{\lambda u - 1}{\lambda 2\alpha} &= const. \\
&\Longrightarrow \\
G_x[x - 2w(x)] &= const. \\
&\Leftrightarrow \\
x - 2w(x) &= const. \text{(due to convexity of } G[x - 2w(x)]\text{)} \\
&\Leftrightarrow \\
w(x) &= \frac{const.}{2} + \frac{x}{2}
\end{aligned}
$$

PROOF OF PROPOSITION 3

The principal's problem, the Lagrangian and the first order condition look like above and can be rewritten as

$$-1 + \lambda\left[u'(w(x)) + 2\alpha G'[x - 2w(x)]\right] = 0.$$

Totally differentiating this expression yields

$$
\begin{aligned}
0 &= w'(x)u''(w(x)) + 2\alpha G''(\cdot)(1 - 2w'(x)) \\
w'(x) &= \frac{[2\alpha G''(\cdot)] - \left[\frac{1}{2}u''(w(x)) - \frac{1}{2}u''(w(x))\right]}{(4\alpha G''(\cdot) - u''(w(x)))} \\
w'(x) &= \frac{2\alpha G''(\cdot) - \frac{1}{2}u''(w(x))}{4\alpha G''(\cdot) - u''(w(x))} \\
&\quad + \frac{\frac{1}{2}u''(w(x))}{4\alpha G''(\cdot) - u''(w(x))} \\
w'(x) &= \frac{1}{2} + \frac{u''(w(x))}{(8\alpha G''(\cdot) - 2u''(w(x)))}.
\end{aligned}
$$

Note that

$$\frac{u''(w(x))}{(8\alpha G''(\cdot) - 2u''(w(x)))} < 0$$

as

$$u''(w(x)) < 0.$$

Thus

$$w'(x) < \frac{1}{2}$$

holds.

Proof of Proposition 4

Now the principal has to take care of the agent's incentive constraint. Thus his problem is given by

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x-w(x)]\,dx \\
\text{s.t.(PC)} \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G[x-2w(x)]]\,dx - c(e) \geq \overline{U} \\
\text{(IC)} \quad e &\in \arg\max_{\widetilde{e}} \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|\widetilde{e})\,[u\,(w(x)) - \alpha G[x-2w(x)]]\,dx - c(\widetilde{e}) \\
\text{(IC}') \quad 0 &= \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x)) - \alpha G\,[x-2w(x)]]dx - c'(e)
\end{aligned}$$

where the Lagrangian takes the form

$$\begin{aligned}
L = & \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x-w(x)]\,dx \\
& -\lambda\left[\overline{U} - \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G[x-2w(x)]]\,dx + c(e)\right] \\
& -\mu\left[0 - \int_{\underline{x}}^{\overline{x}} f_e(x \mid e)[u(w(x)) - \alpha G\,[x-2w(x)]]dx + c'(e)\right].
\end{aligned}$$

The resulting first order condition can be divided by $f(x|e)$ and rewritten to

$$\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]-1=0.$$

Totally differentiating with respect to x yields

$$\begin{aligned}0 &= \left[u''\left(w(x)\right)w'(x)+2\alpha G''\left[x-2w(x)\right]\left(1-2w'(x)\right)\right]\\ &\quad+\mu\frac{\left(\frac{f_e(x|e)}{f(x|e)}\right)'}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right].\end{aligned}$$

Note that due to risk neutrality $u''\left(w(x)\right)=0$ and $u'\left(w(x)\right)$ is a constant. Thus we get

$$w'(x)=\frac{1}{2}+\frac{\mu\left(\frac{f_e(x|e)}{f(x|e)}\right)'\frac{\left[u'(w(x))+2\alpha G'[x-2w(x)]\right]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}}{4\alpha G''\left[x-2w(x)\right]}$$

where all terms but

$$\frac{\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}$$

are obviously positive. To ensure that

$$\frac{\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}$$

is positive, too, check again the first order condition:

$$\begin{aligned}\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]-1 &= 0\\ &\Leftrightarrow\\ \left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right] &= \frac{1}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}.\end{aligned}$$

This is only possible if the both terms $\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]$ and $\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]$ have the same sign. Thus all terms from above are strictly positive and $w'(x)>\frac{1}{2}$ holds.

Proof of Proposition 5

Note that here - in contrast to standard principal agent models - the optimal First Best contract is unique. The Lagrangian of the First Best Problem has the form

$$L = E[U_P(x - w(x))|e] - \lambda[\overline{U}_A - E[U_A|e]]$$

The derivative of the Lagrangian with respect to effort yields

$$\frac{\partial L}{\partial e} = \frac{\partial E[U_P(x - w(x))|e]}{\partial e} + \lambda \frac{\partial E[U_A|e]}{\partial e} = 0$$

The second expression is the derivative of the agent's incentive constraint and therefore has to be zero in optimum in the Second Best case. If we plug in the First Best wage scheme, which according to Proposition 1 has the form $w^*(x) = \gamma + 1/2x$, the term $\frac{\partial E[U_P(x-w(x))|e]}{\partial e}$ changes to $1/2\frac{\partial E[x|e]}{\partial e}$, which has to be zero in order to guarantee the First Best solution if the Incentive Constraint holds in the Second Best. But, as we assumed $c(e) > 0$, it can not be an equilibrium if $\frac{\partial E[x|e]}{\partial e}|_{e=e^{FB}}$ is equal to zero, as we could reduce the effort, and hence $c(e)$ without reducing the expected value of x. Therefore $\frac{\partial E[U_A|e]}{\partial e} \neq 0$ must hold, which means that the First Best effort level is not implementable in the Second Best.

Proof of Proposition 6

The principal's problem, the Lagrangian and the first order condition look like in the proof of Proposition 3. The latter can be written as

$$\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] \left[u'\left(w(x)\right) + 2\alpha G'\left[x - 2w(x)\right]\right] - 1 = 0.$$

Totally differentiating this expression with respect to x yields

$$\begin{aligned} 0 \;=\; & \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] \left[u''\left(w(x)\right) w'(x) + 2\alpha G''\left[x - 2w(x)\right]\left(1 - 2w'(x)\right)\right] \\ & + \mu \left(\frac{f_e(x|e)}{f(x|e)}\right)' \left[u'\left(w(x)\right) + 2\alpha G'\left[x - 2w(x)\right]\right]. \end{aligned}$$

which can be rearranged to

$$
\begin{aligned}
w'(x) \quad = \quad & \frac{2\alpha G''\left[x-2w(x)\right]}{\left[4\alpha G''\left[x-2w(x)\right]-u''\left(w(x)\right)\right]} \\
& + \frac{\mu\left(\frac{f_e(x|e)}{f(x|e)}\right)'\left[u'\left(w(x)\right)+2\alpha G'\left[x-2w(x)\right]\right]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]\left[4\alpha G''\left[x-2w(x)\right]-u''\left(w(x)\right)\right]}.
\end{aligned}
$$

As all terms are strictly positive (see the proof of Proposition 3 which shows that the last term has to be positive) it holds that $w'(x) > 0$.

Proof of Proposition 7

Taking the limit for $\alpha \to \infty$ in the proof of Proposition 7 implies the proposition as the slope of $\frac{1}{2}$ is independent of the signal quality.

Proof of Proposition 8

We will check that for all the treated combinations of risk neutrality, risk aversion, effort contractibility and effort non–contractibility. Consider all the first order conditions:

Contractible effort and risk neutral agent

$$
G'\left[x-2w(x)\right] = \frac{1}{2\alpha}\left[\frac{\lambda u-1}{\lambda}\right]
$$

Contractible effort and risk averse agent

$$
G'\left[x-2w(x)\right] = \frac{1}{2\alpha}\left[\frac{1}{\lambda}-u'\left(w(x)\right)\right]
$$

Non–contractible effort and risk neutral agent

$$
G'\left[x-2w(x)\right] = \frac{1}{2\alpha}\left[\frac{1}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}-u'\left(w(x)\right)\right]
$$

NON–CONTRACTIBLE EFFORT AND RISK AVERSE AGENT

$$G'\left[x - 2w(x)\right] = \frac{1}{2\alpha}\left[\frac{1}{\left[\lambda + \mu\frac{f_e(x|e)}{f(x|e)}\right]} - u'\left(w(x)\right)\right]$$

For all these cases for $\alpha \to \infty$ the limit of $G'\left[x - 2w(x)\right]$ is 0, i.e.

$$\underset{\alpha\to\infty}{lim} G'\left[x - 2w(x)\right] = 0.$$

This implies a linear contract of the form $w(x) = \frac{1}{2}x$.

PROOF OF PROPOSITION 9

Remember that the first order condition can be written as

$$G'\left[x - 2w(x)\right] = \frac{1}{2\alpha}\left[\frac{1}{\left[\lambda + \mu\frac{f_e(x|e)}{f(x|e)}\right]} - u'\left(w(x)\right)\right]$$

If x increases $\frac{f_e(x|e)}{f(x|e)}$ goes up (as we assumed Monotone Likelihood Ratio Property) and the whole latter term goes down. Thus the absolute value of $G'(\cdot)$ decreases, in term implying a lower degree of inequity.

PROOF OF PROPOSITION 10

Suppose the firms' profit Π can be separated into two parts x and y, i.e. $\Pi = x + y$. While the distribution $f(x \mid e)$ of x depends on the effort e exerted by the agent, y is purely randomly distributed and its density is given by $g(y)$. To show that the sufficient statistics result does not apply when the agent exhibits inequity aversion consider the principal's optimization problem

$$\begin{aligned}
\max EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)xdx + \int_{\underline{y}}^{\overline{y}} g(y)ydy - \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} w(x,y)f(x|e)g(y)dxdy \\
\text{s.t.(PC) } \overline{U} &\leq \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} \{u\left(w(x,y)\right) - \alpha G[x+y-2w(x,y)]\} f(x|e)g(y)dxdy - c(e) \\
\text{s.t.(IC) } e &\in \arg\max_{\widetilde{e}} \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} \{u[w(x,y)] - \alpha G[x+y-2w(x,y)]\} f(x|\widetilde{e})g(y)dxdy - c(\widetilde{e}) \\
(\text{IC}') \; 0 &= \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} f_e(x|e)g(y)[u[w(x,y) - \alpha G[x+y-2w(x,y)]]dxdy - c_e(e)
\end{aligned}$$

where $g(y)$ is the density function for y, the random part of the profit.

The Lagrangian is given by

$$\begin{aligned}
L &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)xdx + \int_{\underline{y}}^{\overline{y}} g(y)ydy - \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} w(x,y)f(x \mid e)g(y)dxdy \\
&\quad -\lambda \left[\overline{U} - \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} \{u[w(x,y)] - \alpha G[x+y-2w(x,y)]\} f(x \mid e)g(y)dxdy + c(e) \right] \\
&\quad -\mu \left[0 - \int_{\underline{x}}^{\overline{x}} \int_{\underline{y}}^{\overline{y}} f_e(x \mid e)g(y)[u[w(x,y) - \alpha G[x+y-2w(x,y)]]dxdy + c_e(e) \right].
\end{aligned}$$

The first order condition for the principal's optimization problem has the following form

$$-1 + \lambda \left[u'[w(x,y)] + 2\alpha G'(\cdot)\right] + \mu \frac{f_e(x|e)}{f(x|e)} \left[u'[w(x,y)] + 2\alpha G'[\cdot]\right] = 0.$$

An application of the implicit function theorem yields

$$\frac{\partial w}{\partial y} = \frac{\alpha G''[\cdot]}{4\alpha G''[\cdot] - u''[w(x,y)]} \neq 0 \qquad \forall\ \alpha \neq 0.$$

As w depends on y, which does not contain any information about the agent's effort choice the sufficient statistics result does not apply. Not surprisingly, for $\alpha = 0$, i.e. a purely selfish agent, the sufficient statistics result applies again, as there $w_y(y) = 0$ holds.

Proof of Corollary 11

The proof follows immediately from the proof of Proposition 7. For $\alpha \to \infty$ the optimal contract is uniquely determined by $w(x) = \frac{1}{2}x$, no matter whether effort is contractible or not. Thus effort is disregarded.

Proof of Proposition 12

For the case with two agents the utility of agent 1 is given by

$$\begin{aligned} EU_1^A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1(w_1(\cdot)) - \alpha_P G[[x_1+x_2-w_2(\cdot)-w_1(\cdot)] - w_1(\cdot)] \\ &\quad -\alpha_A H[w_2(\cdot)-w_1(\cdot)]]dx_1dx_2 - c(e) \\ &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1(w_1(\cdot)) - \alpha_P G[x_1+x_2-w_2(\cdot)-2w_1(\cdot)] \\ &\quad -\alpha_A H[w_2(\cdot)-w_1(\cdot)]]dx_1dx_2 - c(e) \end{aligned}$$

where $w_1(\cdot) = w_1(x_1,x_2)$ and $w_1(\cdot) = w_2(x_1,x_2)$.

Thus the principal's problem takes the form

$$\begin{aligned} \max_{e,w(x)} \quad EU_P &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[x_1+x_2-w_2(\cdot)-w_1(\cdot)]dx_1dx_2 \\ \text{s.t.(PC)} \quad EU_A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1(w_1(\cdot)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c(e_1) \geq \overline{U} \\ \text{(IC)} \quad e &\in \arg\max_e \quad EU_A = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_i(x_i|e_i)f_j(x_j|e_j)[u_i(w_i(\cdot)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c(e_i) \\ i,j &\in \{1,2\}, i \neq j \\ \text{(IC}') \quad 0 &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{i_{e_i}}(x_i|e_i)f_j(x_j|e_j)[u_i(w_i(x_i,x_j)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c'(e_i) \end{aligned}$$

and the Lagrangian becomes

$$\begin{aligned}
L &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_1(x_1|e_2)\left[x_1+x_2-w_2\left(x_1,x_2\right)-w_1\left(x_1,x_2\right)\right]dx_1dx_2 \\
&\quad -\lambda\left[\overline{U}-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1\left(w_1\left(x_1,x_2\right)\right)-\alpha_P G\left[\cdot\right]-\alpha_A H\left(\cdot\right)]dx_1dx_2+c(e_1)\right] \\
&\quad -\mu\left[0-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{i_{e_i}}(x_i|e_i)f_j(x_j|e_j)[u_1\left(w_1\left(x_1,x_2\right)\right)-\alpha_P G\left(\cdot\right)-\alpha_A H\left(\cdot\right)]dx_1dx_2+c'(e_1)\right].
\end{aligned}$$

The first order condition can be written as

$$\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]\left[u_1'\left(w_1\left(x_1,x_2\right)\right)+2\alpha_P G'\left(\cdot\right)+\alpha_A H'\left(\cdot\right)\right]-1=0.$$

Differentiating this expression with respect to x_2 yields

$$\left[u_1''\left(w_1\left(\cdot\right)\right)w_{1x_2}\left(\cdot\right)+2\alpha_P G''\left[\cdot\right]\left(1-w_{2x_2}\left(\cdot\right)-2w_{1x_2}\left(\cdot\right)\right)+\alpha_A H''\left(\cdot\right)\left(w_{2x_2}\left(\cdot\right)-w_{1x_2}\left(\cdot\right)\right)\right]=0$$

which we can solve for $\frac{\partial w_1(\cdot)}{\partial x_2}$:

$$\frac{\partial w_1\left(\cdot\right)}{\partial x_2}=\frac{w_{2x_2}\left(\cdot\right)\left[2\alpha_P G''\left(\cdot\right)-\alpha_A H''\left(\cdot\right)\right]-2\alpha_P G''\left(\cdot\right)}{u_1''\left(w_1\left(\cdot\right)\right)-4\alpha_P G''\left(\cdot\right)-\alpha_A H''\left(\cdot\right)}.$$

This is generically non zero. Thus we know

$$\frac{\partial w_1\left(\cdot\right)}{\partial x_2}\neq 0$$

as implied by the Proposition. The same logic applies for the N agent case.

Proof of Corollary 13

From above we know

$$w_{1x_2}\left(\cdot\right)=\frac{w_{2x_2}\left(\cdot\right)\left[2\alpha_P G''\left(\cdot\right)-\alpha_A H''\left(\cdot\right)\right]-2\alpha_P G''\left(\cdot\right)}{u_1''\left(w_1\left(\cdot\right)\right)-4\alpha_P G''\left(\cdot\right)-\alpha_A H''\left(\cdot\right)}$$

where w_{ix_j} denotes the derivative of $w_i(\cdot)$ with respect to x_j.

Applying L'Hospital's Rule

$$\lim_{\alpha_A \to \infty} \frac{f(x)}{g(x)} = \lim_{\alpha_A \to \infty} \frac{f'(x)}{g'(x)}$$

we get

$$\lim_{\alpha_A \to \infty} w_{1x_2}(\cdot) = w_{2x_2}(\cdot)$$

and analoguously we get

$$\lim_{\alpha_A \to \infty} w_{1x_1}(\cdot) = w_{2x_1}(\cdot).$$

This however implies that $w_{1x_1}(\cdot) = w_{1x_2}(\cdot) = w_{1x}(\cdot)$.

2.10.2 The Problem for an inequity averse principal

The principal's problem is only slightly changed due to his changed objective function, now including a part capturing his suffering from inequitable allocations, $-\beta H[2w(x)-x]$. For this part the same assumptions as on $G(\cdot)$ apply.

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\left[\left[(x - w(x)\right] - \beta H[2w(x) - x]\right] dx \\
s.t.(PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\left[u\left(w(x)\right) - \alpha G[x - 2w(x)]\right] dx - c(e) \geq \overline{U} \\
(IC)\ e &\in \arg\max_{e} \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x \mid e)\left[u\left(w(x)\right) - \alpha G[x - 2w(x)]\right] dx - c(e) \\
(IC') \quad 0 &= \int_{\underline{x}}^{\overline{x}} f_e(x \mid e)[u(w(x)) - \alpha G\left[x - 2w(x)\right]] dx - c'(e)
\end{aligned}$$

The resulting first order condition of this problem can be written as

$$-1 - 2\beta H'[2w(x) - x] + \left(\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]\right)(u'[w(x,y)] + 2\alpha G'[x - 2w(x)]) = 0.$$

Differentiating this first order condition yields after rearranging

$$\frac{\partial w}{\partial x} = \frac{2\beta H''(\cdot) + 2\alpha G''[\cdot]\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] + \mu \left(\frac{f_e(x,y|e)}{f(x,y|e)}\right)'(u'[w(x,y)] + 2\alpha G'[x - 2w(x)])}{4\beta H''[\cdot] + 4\alpha G''(\cdot)\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] - \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] u''[w(x,y)]}.$$

We see that α and β, i.e. agent and principal fairness attitudes work in the same direction.

2.10.3 The Problem with inequity aversion defined over net rents

The preferences of the agent are given by

$$\begin{aligned} EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\{u(w(x)) - \alpha G[[x - w(x)] - \left[w(x) - u^{-1}(c(e))\right]]\}dx - c(e) \\ &\Leftrightarrow \\ EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\{u(w(x)) - \alpha G[x - 2w(x) + u^{-1}(c(e))]\}dx - c(e) \end{aligned}$$

The change here is now that the agent no longer compares gross payments $[[x - w(x)] - w(x)]$ but corrects for his effort costs measured in monetary units

$[[x-w(x)]-[w(x)-u^{-1}(c(e))]]$. Thus the principal's problem takes the form

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)[(x-w(x)]dx \\
s.t.(PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x|e)\{u(w(x))-\alpha G[x-2w(x)+u^{-1}(c(e))]\}dx - c(e) \geq \overline{U} \\
(IC)\ e &\in \arg\max_e \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|e)\left[u(w(x))-\alpha G[x-2w(x)+u^{-1}(c(e))]\right]dx - c(e) \\
(IC') \quad 0 &= \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x))-\alpha G(x-2w(x)+u^{-1}(c(e)))]dx \\
&\quad - \int_{\underline{x}}^{\overline{x}} f(x|e)\alpha G'[x-2w(x)+u^{-1}(c(e))]u^{-1\prime}(c(e))\, c'(e)dx - c'(e)
\end{aligned}$$

The resulting first order condition is

$$-1+\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right][u'[w(x)]+2\alpha G'(\cdot)]-\mu 2\alpha G''[\cdot]u^{-1\prime}(c(e))\, c'(e)=0$$

which we can solve for

$$G'[\cdot]=\frac{1}{2\alpha}\left[\frac{1+\mu 2\alpha G''[\cdot]u^{-1\prime}(c(e))\, c'(e)}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}-u'[w(x)]\right]$$

and

$$w'(x)=\frac{1}{2}+\frac{\frac{1}{2}u''(w(x))+\mu\frac{\left(\frac{f_e(x,y|e)}{f(x,y|e)}\right)'[u'[w(x)]+2\alpha G'[\cdot]]}{\left[\lambda+\mu\frac{f_e(x,y|e)}{f(x,y|e)}\right]}}{4\alpha G''(\cdot)-u''[w(x)]}+\frac{4\alpha G'''[\cdot]u^{-1\prime}(c(e))\, c'(e)}{[4\alpha G''[\cdot]-u''[w(x)]]\left[\lambda+\mu\frac{f_e(x,y|e)}{f(x,y|e)}\right]}.$$

Compare this to the solution of the standard problem

$$w'(x)=\frac{1}{2}+\frac{\frac{1}{2}u''(w(x))+\mu\frac{\left(\frac{f_e(x|e)}{f(x|e)}\right)'[u'(w(x))+2\alpha G'(\cdot)]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}}{4\alpha G''(\cdot)-u''(w(x))}$$

and note that the basic structure is very similar to the original problem as it differs only by one additively separable term.

Chapter 3

Moral Hazard and Inequity Aversion: A Survey

3.1 Introduction

This paper provides a non-technical survey of recent contributions to the emerging field of behavioral contract theory that try to incorporate social preferences into the analysis of optimal contracts in situations of Moral Hazard. The presence of these social preferences is confirmed by numerous studies. Taking them into account when analyzing optimal contracts generates important new insights, and might help us gain a better understanding of real world contracts and organizational structures.

A central question that economists have been facing for a long time is how to give workers the right incentives to motivate them to perform as desired by the principal. Over the years, the Moral Hazard problem has become one of the most intensely analyzed. As a result, many insights have been gained and the problem also seems to be one of the best understood in economics.

Having said this, the theory has an important shortcoming. Real world contracts seldom look like those predicted by theory. Often contracts are linear and simpler, incentives are sometimes more high powered or the wage schedule more compressed than expected. And some features, such as the widespread use of employee stock option plans, seem somewhat bewildering.

One reason for this shortcoming may be that economic theorists have based their models on the assumption that the agent is a solely self interested homo economicus. Although this is often a good working assumption, in the specific context of labor relations it misses out on some important aspects like social ties, team spirit or work morale, which appear fundamental to researchers and practitioners in the field of human resources. With some notable exceptions, this gap between economic theory and research in human resources is only now beginning to close.

Kandel and Lazear (1992) in an early theoretical paper, try to incorporate social relations into a formal model. They model "peer pressure" where co-workers inflict social sanctions on agents who fall short of some norm. As an additional instrument to provide incentives, peer pressure is efficiency enhancing. This can have implications for a firm's policy. Kandel and Lazear highlight the importance of profit sharing plans as well as "spirit building activities" as means of enhancing the power of peer pressure.

Similarly, Rotemberg (1994) examines whether it may be optimal to develop altruistic preferences in a working relation. In his model, agents can choose whether to be altruistic towards their co-workers. Although intuitively that never seems to be an optimal thing to do, in fact it may be beneficial, since altruism gives commitment power. In a team production setting with strategic complementarities, they can now commit to exert a high level of effort as it is now in their best interest to do so. Hence in such settings the efficient outcome can be realized if agents can choose to become altruistic beforehand. It may thus be good for firms to give their workers the chance to develop altruistic feelings towards each other, such as by socializing a lot.

All these papers use a somewhat ad hoc specification of not solely self-centered preferences. But recently experimental and field evidence has helped to amend the standard utility function and move it to a sounder footing, and to develop extensive form models of social preferences. Further below we will discuss several of these amendments. However, Fehr and Schmidt's (1999) model serves as a reference point in most of the papers presented in this survey.

The present paper is modest in scope and will only address the theoretical contributions to the moral hazard problem. It will not address experimental work on incentive provision[1]. Neither will it address other informational problems such as Adverse Selection.

The rest of the paper is structured as follows. In section two the paper spells out why social preferences can add valuable insights to the analysis of incentive provision and how to model these social preferences. Section three analyzes the standard one–agent–one–principal problem, as studied by Holmström (1979). The exposition here follows Englmaier and Wambach (2002). Section four then turns to a special case of multi-agent settings, tournaments, while section five deals with team production problems. The concluding section six outlines some promising topics for future research.

3.2 Social Preferences - Evidence and Modelling Approaches

Akerlof (1982) was probably the first to point to the importance of social preferences for labor market outcomes in a theoretical model. He characterized labor relations as a form of gift exchange. In a situation where we cannot contract effort, the employer offers the employee a generous wage, hoping that the employee will reciprocate this "gift" with more than minimum effort. In a subsequent paper, Akerlof and Yellen (1988) argue that the resulting market clearing wages may account for equilibrium unemployment.

These arguments are experimentally backed by two papers: Fehr, Kirchsteiger, and Riedl (1993) and Fehr, Gächter, and Kirchsteiger (1997). In experiments, these authors replicate labour markets and confirm the results of Akerlof (1982) and Akerlof and Yellen (1988). In their data they show that there is a positive relation between wage offers by firms and work effort responses by workers. And firms seem to understand the possibility of triggering effort by this means, since they make deliberate and extensive use of it. As a result, even in competitive double auction environments, the wage level remains above the market clearing level, resulting in involuntary unemployment[2].

[1] Cf. e.g. Gächter and Fehr (2001) on that.

[2] In the sense that for the current wage level jobless workers would have been willing to work.

There is a great deal more experimental evidence on the importance of social preferences for incentive provision. See the references in Fehr and Falk (2002), Fehr and Schmidt (2003), and Gächter and Fehr (2001) for an overview. Important additional evidence is also provided by Bewley (1999) who undertook an extensive survey. He asked a large number of managers their opinions on wage cuts and other pay policies. These interviews clearly highlight that managers fear a breakdown of working morale if they make use of an adverse labor market situation in an "unfair" manner and cut wages.

Given this evidence, it is no surprise that there have been several attempts to amend standard theory with social preferences. Rabin (1993) tries to incorporate fairness into game theory. In his model of a static simultaneous move game, individual utility depends on a belief about the other's intentions. If you believe that your opponent wants to do something in your favor, your utility increases by returning this favor. If, however, you believe that your opponent will hurt you, the optimal response is to retaliate. One can easily see that there are generally multiple equilibria sustained by self-fulfilling prophecies. A good one, where each believes that the opponent has good intentions and where these expectations are met in equilibrium, and a bad one where each player believes the other to be evil-minded and this belief again is met in equilibrium. Dufwenberg and Kirchsteiger (forthcoming) extend Rabin's paper to sequential games and Falk and Fischbacher (2000) is another attempt at a general model. The equilibrium predictions of these models crucially depend on a player's belief about the other player's intentions. This is tricky to deal with and inherently hard to test empirically or experimentally. Therefore models have been developed that try to capture social preferences while only placing observable variables such as monetary outcomes, as conditions.

Generally, in these models there is a separable term added to standard utility which captures relative income comparisons. Agents suffer a utility loss if they do not get their "fair" share of total output, that is, if the allocation is "inequitable". For most experimental settings inequity can be replaced by inequality. The two most prominent models are those by Bolton and Ockenfels (2000) and Fehr and Schmidt (1999).

While in the Bolton and Ockenfels (2000) model agents compare their own payoff to the average payoff of all other agents, in Fehr and Schmidt (1999) the relative income comparison is a weighted sum of comparisons between each agent separately. Note that with only two agents those two models coincide. Although both models are close to one another in spirit, somehow the Fehr and Schmidt (1999) model has proved to be a bit more flexible and most of the models discussed in this survey use it, or a variant of it, as a reference point. A more detailed exposition of this model thus seems appropriate.

Fehr and Schmidt assume a utility function of the following form

$$U_i(x_i) = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\}.$$

I.e., utility is additively separable in income and disutility from inequitable outcomes.

The first addend x_i is standard and depicts utility from monetary payoff. The second addend, $\alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\}$, creates disutility whenever the agent's payoff falls short of another player's payoff whilst the third addend, $\beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\}$, reduces utility when the reverse holds true, i.e. when the agent is better off than an opponent.

The parameters α_i and β_i denote the weight that the agent puts on those social comparisons. The following restrictions are placed on these parameters: $\alpha_i \geq \beta_i$ and $\beta_i \in [0, 1[$. This implies that agents suffer more from being worse off than others than from being better off. And the assumption that $\beta_i \in [0, 1[$ rules out both "status seeking" and situations where agents would forego own material payoff in order to reduce favorable inequity.

This functional form depicts "self centered inequity-aversion", that is, agents are not really interested in the allocation of wealth in the population, they are only interested in their relative standing in this wealth distribution. Although the aversion towards disadvantageous inequity is more pronounced than aversion towards advantageous distributions, Fehr and Schmidt need both parts of the inequity aversion to explain observed behavior. Moreover, they allow for heterogeneity in the population and inequity aversion still has relevance even if a substantial part of the population is purely self-interested.

While intention based models clearly provide a more realistic depiction of reality, they are highly complicated to deal with[3]. Even very simple and abstract experimental games are hard to solve and the more interesting problems basically become intractable. Thus the purely outcome based models serve as short cuts for modelling reciprocal preferences. While they are still analytically tractable they capture many aspects of reality and do a remarkably good job in explaining experimental evidence.

3.3 The Moral Hazard Problem

As already highlighted in the introduction, the moral hazard problem is one of the central problems of labor market analysis. Englmaier and Wambach (2002) were the first to introduce inequity aversion into agency theory and by amending Holmström's (1979) seminal paper. In this model one principal and one agent interact. The agent's (unobservable) choice of effort influences the distribution of profits. Englmaier and Wambach make one important change in Holmström's model: the agent's preferences exhibit inequity aversion as he compares himself to the principal. As we will contrast the literature to this paper more emphasis will be placed on its exposition in what follows.

The agent's utility is given by

$$U_A \quad = u[w(x)] - c(e) - \alpha G\{[x - w(x)] - w(x)\}$$

Utility consists of three parts. $u[w(x)]$, the utility derived from monetary income, and $c(e)$, the disutility from effort, are standard. For those two parts the standard assumptions apply, i.e. utility is increasing in income – however agents may be risk averse or risk neutral – and effort costs increase in effort. New is the last part, $\alpha G\{[x - w(x)] - w(x)\}$. This captures the disutility from inequitable outcomes where α is the weight the agent puts on achieving equitable outcomes.

The convex cost function $G(\cdot)$ displays the disutility from inequity. It is assumed to be equal to zero at $x - w(x) = w(x)$, i.e. for equitable outcomes where the agent's wage payment $w(x)$ equals the principal's net profit $[x - w(x)]$, and also to be flat at this

[3] However see the recent paper by Cox and Friedman (2003) who try to build a "tractable model of reciprocity".

point. But marginal disutility increases the further away from equity the outcome is. A quadratic function would do that job. However, $G(\cdot)$ is not required to be symmetric around zero. I.e. agents may – quite realistically – suffer a lot more from being worse off than from being better off than the principal. The convexity implies an aversion against lotteries over different levels of inequity.

It is assumed that the principal is of a standard type, that is, he is just interested in his expected payoff and not in relative comparisons. Again, all the results would go through qualitatively but the exposition would be more cumbersome.

Thus the principal's problem takes the following form

$$\max_{w(x)} \quad EU_P = \int_{\underline{x}}^{\bar{x}} f(x \mid e)[x - w(x)]dx$$

$$\text{(PC)} \quad EU_A = \int_{\underline{x}}^{\bar{x}} f(x \mid e)\{u_A[w(x)] - \alpha G[x - 2w(x)]\}dx - c(e) \geq \overline{U}$$

$$\text{(IC)} \quad e \in \arg\max_{e} \; EU_A = \int_{\underline{x}}^{\bar{x}} f(x \mid e)\{u_A[w(x)] - \alpha G[(x - 2w(x)]\}dx - c(e).$$

To solve this problem the authors rely on the First Order Approach and it is assumed that the Monotone Likelihood Ratio Property holds, that is, a higher profit can serve as a signal for a higher effort choice.

Now I will present the results of this model in some depth, offer a brief intuition for each of them, and compare them at each step with the standard result. Where effort is contractible and the agent is risk neutral, the optimal contract is uniquely determined by $w' = 1/2$, that is, the first derivative of the wage scheme specifies an equal sharing rule. This is in contrast to the standard case where there is no clear-cut prediction for the contract structure. The principal extracts the rent with a flat payment, as agents dislike fluctuations over different levels of inequity.

If we keep effort contractible but add risk aversion to the agent's preferences, the standard case prescribes a flat wage. With inequity aversion this no longer holds and the contract can only be shown to be increasing, as it now has to balance off insurance against fluctuations in income and fluctuations in inequity. One can show that the slope of the incentive scheme, w', is bound between 0 and 1/2.

Let us now turn to the case of interest, where effort is no longer contractible, that is the moral hazard problem. Start with considering a risk neutral agent. Here w' is between 1/2 and 1 to balance off the desire to insure against inequity and to provide strong incentives. Then adding risk aversion to the moral hazard problem leaves us - as in the standard case - with the statement that w' is strictly increasing with profit.

The comparative statics of the latter most general case, add further insights. If α, that is the agent's concern for equity, increases, the optimal contract converges to $w = (1/2)x$, that is to the equal split. In that sense, inequity aversion adds a tendency towards linear contracts. Furthermore inequity aversion is used as an additional incentive instrument. If profit x increases, the agent is not only rewarded with a higher wage payment, but also with a lower level of inequity. Thus both ways of creating utility (or reducing disutility) are used[4].

The last set of results alludes to Holmström's influential sufficient statistics result. Holmström proved that optimal contracts have to be conditional on all available informative signals (with respect to effort choice) but not on noninformative ones. The authors show that in their set-up contracts may be incomplete or overdetermined. In a situation where there is a better measure of performance than profit, that is a sufficient statistic for the effort choice, contracts should still be conditional on profit as the agent is inherently interested in profit as far as its distribution is concerned. In this sense contracts are overdetermined. If the concern for equity continues to increase this concern for the distribution of the payoff becomes increasingly dominant. Thus the optimal contract puts less and less weight on the sufficient statistic and in the limiting case, for extremely high values of α, disregards it altogether and is thus optimally left incomplete.

[4]Mayer and Pfeiffer (2003) analyze a version of the Englmaier and Wambach model. They restrict contracts to be linear, utility exhibits constant absolute risk aversion and the agent chooses the mean of a normal distribution. They can solve this model and confirm the findings by Englmaier and Wambach (2002).

The authors relate their theoretical results to some stylized facts, such as sharecropping contracts predominantly specifying an equal split between landlord and tenant[5], the persistence of interindustry wage differentials where more profitable firms pay higher wages to workers of the same profession[6], and the widespread use of stock option plans at all levels of a firm's hierarchy[7]. Englmaier and Wambach (2002) offer some additional results on the multi-agent case. These will be covered in Section 5 of this chapter.

Itoh (forthcoming) analyzes a model where the agent is risk neutral but wealth constrained. Furthermore the effort choice of the agent is not continuous but binary. His qualitative results on the structure of contracts are similar to those of Englmaier and Wambach (2002) but in addition he can show that the principal's profit generally decreases if the agent's concern for equity increases. This result depends on the restriction that the principal always earns more than the agent. Hence whether the principal prefers to employ inequity averse or "standard" agents depends on the possible profit level. If the possible profit levels are rather high, such that the principal is better off than the agent, the principal has to pay high wages to the agent in order to counterbalance inequity.

Dur and Glazer (2003) analyze a model where a worker envies his boss, thus neglecting the "α-part" of Fehr and Schmidt's model. Although the workers' effort choice is continuous there are only two possible realizations of firm profits. Thus a bonus contract is optimal. Like Englmaier and Wambach, they find a violation of the sufficient statistics result. They can also show that envy increases incentive intensity but decreases the principal's profits. They discuss several interesting applications. They suggest that envy (or more accurately a lack of it) may be a reason for less pronounced incentives in governmental organizations. As there is no single rich principal (or several presumably rich stock holders) toward whom the workers may feel envious, since basically the general public owns the firm, the incentive intensifying effect, present in private firms, disappears. Continuing this argument they note that progressive taxation - reducing income disparities - may in fact be efficiency enhancing, as it dampens the adverse effects of envy. Another application they mention is in consumer goods markets. Consumers compare themselves to the "rich" producers of goods and are unwilling to leave too high profits to them. This

[5] Cf. e.g. Bardhan (1984) or Bardhan and Rudra (1980).

[6] Cf. e.g. Thaler (1989) in a meta study.

[7] Cf. e.g. Oyer and Schaefer (2003).

affects their willingness to pay and thus restricts the producers' pricing behavior.

3.4 Multiple Agents - Tournaments

If one now analyzes situations where there is more than one agent interacting with the principal, tournaments seem to be a natural starting setting for exploring the effects of social preferences. In a tournament, agents compete for a prize and only one of them can win. This automatically generates inequality. Tournaments are a widely studied means of providing incentives. Following the seminal contribution by Lazear and Rosen (1981), much work has been devoted to exploring the incentive properties of tournaments and to pin down situations where their use is actually optimal.

Although it is not really a tournament situation, Rey Biel's (2002) model is a good starting point to demonstrate the basic mechanism at work. He develops a deterministic model where two agents simultaneously have to make a binary effort choice. This choice is not plagued by moral hazard. The principal can contract the agent's choice. Rey Biel uses this simple framework to highlight how the principal can utilize the agents' inequity aversion by offering them very unequal payoffs off the desired equilibrium and thus reduce costs. The desired equilibrium is where both exert high effort. Offering agents unequal payoffs if this outcome is not reached, inflicts disutility on them, thereby making the desired outcome, where both get the same pay, relatively more attractive. One could interpret this as a special kind of tournament where both get the prize if performance exceeds a given threshold. In this framework Rey Biel find that the agents' social preferences increase the principal's profits. This comes as no surprise given that the principal gets an additional instrument to generate incentives. However, the analysis neglects the agents' participation constraint, which the author justifies by arguing that the agents would also face inequity in alternative occupations.

Turning to more standard tournament settings with stochastic production and just one agent winning the prize, renders disregarding the participation constraint less innocuous than one might think, because now the agent has to be compensated upfront for the inequity inflicted on him in order to create incentives. Taking the participation constraint into account thus changes the picture quite dramatically.

Grund and Sliwka (2002) do so. They analyze a simple tournament where two agents compete for a prize. The one with the higher output wins, where output is a function of effort plus an error term. They call the part of Fehr and Schmidt's model where agents suffer from being worse off "envy", and the part where agents suffer from being better off, "compassion". For a given prize structure they show that profits unambiguously increase with an increase in the agents' degree of envy and decrease with an increase in the agents' degree of compassion. As agents expect to feel envy if their opponent wins the tournament they have an incentive to work harder in order to avoid this. On the other hand, if they are compassionate they are not so happy about winning. The latter effect dampens the incentive to work hard.

However if the principal can also choose the prize structure and wants to do so optimally, he has to obey the participation constraint. As in Englmaier and Wambach (2002), Grund and Sliwka assume that the outside option is exogenously given. They find that inequity aversion lowers the principal's profits. The reason is that the agent has to be compensated upfront for the inequity that is going to be inflicted on him for incentive reasons, and this extra compensation outweighs the positive incentive effects. From that, Grund and Sliwka draw conclusions for a firm's optimal promotion policy. Interpreting a tournament as a competition for promotion, they compare vertical and lateral promotions. Whereas in vertical promotions the team leader is hired from within a team or group, in lateral promotions a team leader is always hired from another team. Now assuming that within a team social preferences are more pronounced, they conclude that lateral promotion schemes are preferable.

Demougin and Fluet (2003) also analyze a two person tournament but they differ in three respects from Grund and Sliwka. First, they consider the limited liability case. Thus there can even be ex-ante rents for the agent. Second, agents do not compare their gross payments but their rents, that is their received payments net of effort costs. And third, the principal can invest resources in order to make the tournament more informative.

If in the initial situation the participation constraint does not bind, envy lowers the principal's wage costs and thus increases profits. If, however, agents do not earn rents, envy and compassion both reduce profits. While the latter result is in line with Grund and Sliwka (2002) the first case is different. In the standard case, when providing only monetary incentives, the principal leaves some rent to the agent due to limited liability. The incentives provided via the threat of inequitable outcomes are not subject to the wealth constraint and thus, for a given wealth constraint the incentive intensity is stronger. Taking into account the principal's ability to increase the tournament's informational content and to focus on the envy part of inequity aversion, provides additional insights. If additional precision is "cheap" to attain, envy in fact increases profits. If however additional precision is "expensive", profits fall.

3.5 Multiple Agents - Teams

Examining more general mechanisms than tournaments, while taking care of social preferences, the analysis of team problems becomes a more elaborate task. A first guess might be that the effect is similar to that described by Rasmusen (1987) for risk aversion. We can improve upon the initial situation by offering random contracts off the desired equilibrium outcome level. These random contracts have to assign the whole outcome to one player. As a consequence agents not only face the risk of getting nothing when they shirk, but they are also likely to suffer from a large degree of inequality. Hence, as with risk aversion, this constitutes a form of commitment to "burn money" off the equilibrium, thus rendering a deviation less alluring. In a sense the effect is similar to the introduction of a budget breaking principal who will happily keep the money if the agents have fallen short of the equilibrium effort.

But social preferences do more than just reinforce the effects of risk aversion. Englmaier and Wambach (2004) extend their model discussed in section three for the case of many inequity averse agents. They find that whenever an output measure is available for each agent, the optimal contract has to be conditional on each agent's individual output measure, even if the tasks are technologically independent. The reason is that by doing so the agents are offered insurance against inequitable payoffs. In the limiting case where the agents' concern for fairness is the only important driving force, the optimal contract has a very simple structure as it is only conditional on overall output. In this way, they deliver a simple rationale for the widespread use of team based incentives.

While in standard team production problems the rationale for using team based incentives (or relative performance evaluation schemes) is that this will filter out common shocks from the performance measures, Englmaier and Wambach's result is driven by the fact that agents have an inherent interest in the other agents' outcome. Here team based incentives are used as an insurance mechanism against very unequal outcomes.

Itoh (forthcoming) gets results similar to those of Englmaier and Wambach (2002) but since his model is less general, he manages to pin down the contract structure a bit more. In Itoh's model the two risk neutral agents have a binary effort choice and the limited liability constraint holds. Where agents perform technologically independent projects, he basically finds two possible contracts: an extreme team contract where all agents always get the same payment and an extreme relative performance contract which is similar to a tournament. The extreme team contract is optimal if either agents are highly inequity averse or the project is very risky. Note that in this case the principal's payoff is independent of the degree of inequity aversion, as agents are always paid the same. In the opposite case the extreme relative performance contract is optimal. Here the principal generates inequity and makes use of it.

Allowing for correlated shocks to the two projects, standard theory would call for the relative performance contract. But due to a sufficient amount of inequity aversion, the extreme team contract may remain optimal in this case. In another specification analyzed by Itoh, agents do not compare their gross payments but their rents, net of effort costs. Under this assumption, he can show that the team contract is more likely to be optimal, meaning that it is optimal for a larger set of parameter constellations.

Bartling and von Siemens (2004a) analyze a situation with deterministic team production. They require contracts to be budget balancing and renegotiation proof. Starting from that they construct an equilibrium where the optimal contract is "equal at the top", that is it gives an equal share to every worker if all (or all but one) agents choose high effort and assign the whole output (deterministically) to just one agent otherwise. With this mechanism they find that inequity aversion is beneficial. However, this positive effect decreases with team size. They interpret this to be the reason why small work teams seem to perform better than larger ones. They then distinguish between worker owned firms, that is, firms with no principal claiming residual output for himself, and firms with a principal. They find that worker owned firms may be inefficiently small, as agents may not want to employ an additional worker even if it were efficient to do so. They anticipate that overall surplus will be shared evenly and they may be better off with their share in the smaller firm than in the (more efficient) larger firm. This effect is absent if there is a principal running the firm.

In a companion paper Bartling and von Siemens (2004b) analyze a team production setting with stochastic production for a restricted class of utility functions. There are two agents who have to make a binary effort choice. The agents' projects are technologically independent. Here agents are not inequity averse but only suffer from envy. Assuming inequity aversion instead may, however, invert their results. They show that envy unambiguously increases agency costs. In order to insure against the risk of suffering from envy, the principal has to give equitable flat wage contracts instead of incentive contracts and, as in Englmaier and Wambach (2002), team based contracts may become optimal. In order to avoid these effects of envy, the principal may prefer to employ only one agent although it would be efficient to employ the other too. The authors also ask whether salaries should be kept secret. Interestingly they find that keeping salaries secret is a bad idea as it takes away the chance to insure against relative income fluctuations by making one worker's pay conditional on the other workers' pay.

Masclet (2002) extends the standard team production game with an additional stage where inequity averse agents can punish their shirking colleagues. They will do so in order to re-establish equity. As in public goods games, described, for instance, by Fehr and Gächter (2000), the efficient cooperative outcome now becomes implementable. This is very close in spirit to Kandel and Lazear's (1992) model of peer pressure.

Huck and Rey Biel (2003), too, extend the standard team production framework. They analyze a two player situation with an exogenously given equal sharing rule. Both agents are again inequity averse. But here they explore what happens if agents can choose their effort sequentially. In their example they show that moving sequentially (with the less productive agent starting) can improve the situation because the agent that moves first can push the one that follows to a higher level of effort by choosing higher effort himself.

The agent who moves later does not want to fall short of the first one's contribution. Their result is driven by their assumption that agents do not compare gross payments but payments net of effort costs.

There are two more models that provide interesting insights on the interaction of incentives and social preferences. Although they are not based on inequity aversion I want to discuss them here.

In Rob and Zemsky's (2002) dynamic model, people are not inequity averse but they can build up social capital. Agents can decide whether to help each other or to produce on their own. Helping is efficient but not contractible. In the repeated game, agents are more willing to help if they have received help from the other agent before, that is, if social capital has been built up. A contractible performance measure is also available. Putting more weight on this contractible performance measure reduces the incentive to help, as producing more output oneself becomes relatively more lucrative. Choosing different dynamic incentive structures can give rise to "cultural" differences across firms.

In Huck, Kübler, and Weibull (2003) agents are concerned about adherence to a social norm which emerges endogenously. They restrict themselves to linear contracts and analyze the effects of such social norms in two settings. When only overall team output is observable, the social norm fosters positive externalities. If the others work more, an agent is also expected to work more in order to adhere to the social norm. This increases team output and everybody's pay. In this situation multiple equilibria exist. The authors ask whether dynamically adjusting the slope of the incentive scheme can help the principal to select the most profitable equilibrium. If individual output is observable, relative performance schemes are utilized. If an agent now exerts more effort this has a negative effect on the relative performance of the other agents. There are now negative externalities and the norm may compress effort. The overall effect of social norms is thus unclear.

3.6 Conclusion

This survey has shown how incorporating social preferences in economic models can enhance our understanding of relationships in the work place. Social preferences interact in non-trivial ways with incentives and alter the structure of optimal compensation schemes, sometimes drastically. But the research on these issues is still in its infancy.

So far the results are inconclusive with respect to the question: under what circumstances is a fair-minded workforce desirable? Related issues are the implications of social preferences for structuring work teams, the production process, the informational environment or even the boundaries of the firm. These topics deserve further investigation.

Yet another interesting question is the interplay between extrinsic and intrinsic motivation and whether the provision of high powered monetary incentives might crowd out intrinsic motivation. One could guess that these high powered incentives change the nature of interaction and thus affect the way social preferences come into play. For further discussion of these topics see, for example, Fehr and Rockenbach (2002) or Gneezy and Rustichini (2000).

As already alluded to by Rotemberg (1994) the commitment power provided by social preferences for principals or team leaders needs investigation. Research along these lines may shed light on the determinants of good leadership and trust.

Finally it should by now be clear that the definition of the reference group (peer group) and the definition of what actually is the job and the surplus generated from it is very important for the analysis. Those concepts, familiar to researchers in human resources, have so far received insufficient attention from economic theorists.

In conclusion, incorporating social preferences into models of agency can open the door to a fruitful dialogue between economic theorists and human resource researchers, and can prove to be a promising new avenue for research.

Chapter 4

A brief Survey on Strategic Delegation

4.1 Introduction

Delegation means that an agent is entitled by a principal to carry out an action on his own responsibility. In standard models of the firm, e.g. Demsetz (1983) or Fama and Jensen (1983), this delegation is somewhat technology driven as the agent is indispensable for carrying out a specific task since only he has the required ability or human capital. In models of asymmetric information, Moral Hazard or Adverse Selection, this very need to delegate an action and the resulting conflict of interest between principal and agent is a problem that one tries to solve by aligning preferences as well as possible.

However, there are more elaborate interpretations of delegation that make use of the difference in interests between agent and principal. Now defining delegation as giving up control over certain decisions allows richer interpretations in various environments.

4.2 Intra Firm Effects of Delegation

Let us start looking at delegation within the boundaries of a firm. Philippe Aghion has a series of papers with various co–authors on the issue of the principal giving up control for a purpose. In Aghion and Bolton (1992) it is argued that allocating control contingent on the realized state of the world, i.e. firm profit, can help explain the financial structure of a firm, as delegating control to the financier in bad states of the world mitigates the conflict of interest between the entrepreneur and the financier.

Aghion and Tirole (1997) take a different focus and look on real versus formal authority. In this model the principal gives up his formal authority and delegates real authority, i.e. the right to decide upon project implementation, to the agent who has to come up with the project himself. Knowing that he will have some discretion in implementing a project of his choice raises the agents incentives to exert effort to come up with a project in the first place. However there is an issue of how the principal can credibly commit not to overrule the agent's project choice (as he is still endowed with the formal authority to do so) when the agent's project is too much biased to cater to the agent's interests. They suggest "strategic overload" as a solution for this commitment problem. The principal takes over a span of control which is so wide that he cannot effectively gather the information necessary to overrule the agent's decision. Baker, Gibbons, and Murphy (1999) on the other hand solve the commitment problem in a repeated interaction model where the principal builds up a reputation for not interfering.

Finally, Aghion, Dewatripont, and Rey (2004) study transferable control. They argue that the transfer of control rights can be used to extract information about the type of the agent to whom control is transferred. If the principal gives him discretion a bad type will abuse this power and reveal himself as a bad type whereas a good type will prove trustworthy. Thus, delegating control early on in a worker's career helps screening types.

Related to the analysis in Aghion and Tirole (1997) on how to provide agents with appropriate incentives to generate ideas is Rotemberg and Saloner (2000) who study the potential use of visionary managers. They define such visionaries as being systematically biased towards projects from a certain field or product group. This increases their subordinates' incentives to come up with such projects as they can be more confident that those projects will be adopted.

4.3 Inter Firm Effects of Delegation

All the above papers aim at explaining the effects of delegation within a firm. However most firms are interacting on (imperfectly) competitive markets with other firms and thus it is interesting to look at the interaction between the form of delegation and the competition on the market. While Schmidt (1997) addresses the question how product market competition affects the optimal shape of managerial incentives we are here more interested in the reverse effect: How does the choice of managerial incentives affect the competition on the product market.

Already Schelling (1960, p. 142/3) noted: "The use of thugs and sadists for the collection of extortion or the guarding of prisoners, or the conspicuous delegation of authority to a military commander of known motivation, exemplifies a common means of making credible a response pattern that the original source of the decision might have been thought to shrink from or to find profitless, once the threat had failed."

What he describes here is that by delegating certain tasks to agents with preferences different from one's own, one can make threats credible that were not individually rational to carry out if oneself would act. Vickers (1985), Fershtman (1985), Fershtman and Judd (1987) and Sklivas (1987) incorporated this into an industrial organization framework where the firm owners can alter the manager's preferences by changing his incentive scheme.

Vickers (1985) analyzes a situation where two firms are engaged in Cournot competition and the firm owners can simultaneously decide upon the incentive contracts for their managers who have to decide upon the quantities offered by the firms. He can show that these contracts have elements of relative performance evaluation in them, thus inducing the agent to act more aggressively. Vickers (1985) highlights the implications of his findings for the theory of the firm and interprets the commonly observed separation of ownership and control and the prevalence of multi–division firms or the degree of vertical integration from a strategic delegation perspective.

The point that relative performance evaluation has not only informative aspects but also influences the way managers interact in product market competition was further elaborated by Fumas (1992) and Aggarwal and Samwick (1999). The latter paper tests empirically the prediction that relative performance elements make managers more aggressive and finds their prediction confirmed. In highly competitive industries – where committing to even more aggressive behavior would be harmful – they do not find relative performance elements in executive contracts whilst in industries with low levels of competition they are prevalent.

Another way to make managers more aggressive is conditioning their pay not only on own profits but also on sales. Fershtman (1985) provides an example that in Cournot duopoly firm profits increase if managerial incentive contracts condition not only on profits but also sales. Fershtman and Judd (1987) extend this analysis to differentiated Bertrand competition and show that the owners there also have an incentive to distort managerial incentives. But whilst under Cournot competition the optimal contract entails a positive premium on sales under differentiated Bertrand competition this premium on sales is negative. Along the same lines is the analysis by Sklivas (1987) who focuses on the separation of ownership and control and analyzes the desirability of delegation for firm owners. He shows that delegation is always a dominant strategy. But whilst under Bertrand competition profits go up when firms are able to delegate decisions to an appropriately incentivized manager in Cournot competition this ability to delegate strengthens competition and lowers firm profits[1].

[1]Huck, Müller and Normann (2004) experimentally test the predictions of Fershtman (1985), Sklivas (1987) and Vickers (1985) that firm owners give contracts on profit and sales to manager. In their experiment the owners can choose to give a contract on profits only or one that puts some weight on sales also. They find that contrary to the theoretical prediction the latter is not chosen. But their analysis shows also that this is rational given the fact that managers in the final stage do not play the standard subgame perfect equilibrium but act such that their behavior is best described by social preferences a la Fehr and Schmidt (1999). Whether this is a remedy of their experimental setting is at least debatable.

4.4 The Role of Observability

All the above papers start from the assumption that delegation is observable. And it is this very observability that makes delegation valuable as it allows to commit to aggressive behavior.

Now there are two possible issues with that. On the one hand it may be possible to write secret sidecontracts countervailing the initial delegation contract, i.e. the actual contract structure may not be credibly signalled to the market, on the other hand there may be renegotiation of the initial contract.

Katz (1991) focusses on the analysis of delegation with unobservable contracts but he does not allow for renegotiation of the initial contract. In his setting the principal cannot decide whether to hire an agent or not but can only decide upon the manager's incentive scheme. He finds that the set of Nash equilibria under delegation coincides with the set of Nash equilibria when the principal acts himself whenever the first best allocation is implementable. I.e. in a moral hazard problem with a risk neutral manager, where the optimal contract makes the manager residual claimant, delegation has no bite, as the principal cannot make credible to the market any other contract than the first best contract. Thus there is no added commitment power. When the first best allocation cannot be implemented by the agency contract then delegation has an effect. This is not surprising as, e.g. due to matters of risk sharing, the agent optimally acts differently from the principal.

Fershtman and Kalai (1997) elaborate on Katz (1991) and analyze the effects of delegation if there is restricted observability. Delegation still has an effect when in a repeated setting information can be transmitted to the market (if there is learning about delegation) or when with some probability the delegation contract is observed.

Kockesen and Ok (2004) pursue another avenue. They also assume that contracts are unobservable and that there is no renegotiation. In their basic setting they look at one sided delegation but the principal can choose whether to hire an agent or not. To hire an agent is costly and can be observed by the market. By using forward induction they construct "well–supported" equilibria with delegation. The intuition for their argument is that the principal would not spend money on hiring an agent if it were not for reasons of strategic delegation. They extend their model along two dimensions. First they look at two–sided delegation and find that in any pure strategy equilibrium at least one principal chooses to delegate. Furthermore they allow for renegotiation of the initial contract. If this renegotiation is costless it undoes the effect of strategic delegation: hence there will be only delegation in equilibrium if renegotiation is limited or costly.

Beaudry and Poitevin (1994) focus solely on the renegotiation issue. In their paper the principals simultaneously write delegation contracts with their managers and then simultaneously renegotiate these contracts. They analyze costless renegotiation in two settings. In the first setting renegotiation takes place before the actual actions or decisions for which the agent is hired are taken. In this situation renegotiation has no effect as the situation has not changed as compared to the initial contract. Thus delegation works here. In their second setting the renegotiation takes place while the decisions or actions are taken. Under this setting the ex post distortions are greatly reduced and can no longer be used for commitment purposes. The principal has an incentive to renegotiate to the efficient contract, which is anticipated and thus commitment via delegation loses its bite in the first place.

Summing up, one has to note that limited observability or similarly the possibility to renegotiate the initial contract can undo much of the effects of strategic delegation. However, there are quite strict disclosure requirements for managerial contracts in the US such that the observability of these contracts should be reasonably ensured, thus making strategic delegation an available option in a firm's policy space.

4.5 Strategic Elements of Financial Structure

So far the focus was on contracts as a means of strategically manipulating an agent's preferences. But already early on in the discussion of the possible role of strategic delegation the importance of a firm's financial structure for its management's incentives has been noted. In Brander and Lewis (1986) the firm owners can choose to issue debt. This debt introduces a probability that the firm goes bankrupt. In their model the preferences of the (risk neutral) manager and the owners are perfectly aligned. Thus the manager maximizes a convex objective function. Firms are engaged in Cournot competition and the possibility of bankruptcy (due to the issued debt) shifts the reaction functions outwards which leads to tougher competition. In Brander and Lewis (1986) the equilibrium is characterized by positive debt levels, higher quantities and lower profits. Thus firms are in some sense locked in a prisoner's dilemma. Though issuing debt makes them worse off in equilibrium it is unilaterally a dominant strategy. However their findings are not empirically backed[2] as higher debt levels tend to be associated with higher profits.

There are two papers that bring in line the basic idea by Brander and Lewis (1986) with the stylized facts. Showalter (1995) does so by assuming differentiated Bertrand competition and Nier (1998) gets it right by assuming that the manager is just interested in avoiding bankruptcy, i.e. he is extremely risk averse. In both papers the key effect is that managers' actions are no longer strategic substitutes but complements.

4.6 Strategic Delegation in Political Economy

The last section already dealt with a general framework and not an individual contract that is used to alter an agent's behavior. However we still needed contract enforceability to use these arrangements on the financial structure to generate incentives. But there are many situations where no binding contracts can be written. A prime example for such a situation can be found in Political Economy where the idea of strategically delegating power to an agent was exploited, too. The first and probably still most prominent example is Rogoff's (1985) model of central bank policy. The government wants to promise low inflation and afterwards stimulate the economy by surprise inflation. Rogoff now argues that delegating monetary policy authority to an independent conservative central banker can mitigate this time inconsistency problem. Walsh (1995) uses the same ideas and derives the optimal contract for a central banker. This contract makes pay contingent on observable performance indicators of the economy and distorts incentives in the direction of a conservative central banker. He analyzes the problem for a banker with the same preferences as the government and with an opportunistic banker who is only interested in

[2]Cf. e.g. Chevalier (1995).

monetary payments.

Another example of strategic delegation in Political Economy is Persson and Tabellini (1994) who deal with the problem of capital taxation with imperfectly mobile capital. Ex–ante the state wants to promise low taxes to attract capital, but once investments have been made the state wants to impose a high tax. The electorate now can partially commit to a low tax policy by electing a "rich" politician who has less interest in redistributive politics.

4.7 Conclusion

While in most models of strategic delegation in and between firms the delegation effect is created by a contractual structure (incentive contracts or financial contracts) the Political Economy applications resorted to personal traits of agents. There has been only little work done in this direction in IO or agency theory. The next two papers of this dissertation will focus on the role of preference characteristics (*A Model of Delegation in Contests*) or more specifically of bounded rationality (*A Strategic Rationale for having Overconfident Managers*) for issues of strategic delegation. This was also pointed at by Schelling (1960, pp. 142/3) whose above quote continued: "Just as it would be rational for a rational player to destroy his own rationality in certain game situations, either to deter a threat that might be made against him or to make credible a threat that he could not otherwise commit himself to, it may also be rational for a player to select irrational partners or agents."

Chapter 5

A Model of Delegation in Contests

5.1 Introduction

In the last twenty years contests received a lot of publicity not only in the economics literature, but also in political science and other related fields. Especially in the form of rent seeking contests they were extensively analyzed. Starting with Tullock's seminal paper (Tullock, 1980) a large strand of literature evolved[1].

Contests have been used to model a wide array of situations of conflicts, ranging from inter-state conflicts (see e.g. Hirshleifer (2001)) to promotion tournaments (see e.g. Lazear and Rosen (1981)). A common feature of these models is that no explicit contract can be written to allocate a disputed rent and that the resources spent in the contest are regarded as sunk.

In this paper we recognize that contests often take place between different groups. In the light of this we explicitly allow for the possibility that the members of these respective groups might have differing valuations for the contested rent. This seems quite natural: If

[1] See Nitzan(1994) for a detailed review of the rent seeking literature.

a group of producers tries to influence lawmakers to create favorable legislation[2], the value of this legislation is likely to be different for different group members. As an example one might consider the market for agricultural products where the value of specific legislation may vary greatly between large industrial farmers and smaller family run farms.

If we allow for this intra-group heterogeneity, there is a conflict of interest between different members of the group on how much resources to spend in the contest. The problem becomes even more severe if one takes into account the fact that typically not all the group members are actively participating in the contest, but typically groups assign delegates that act in the contest on behalf of the whole group.

This naturally gives rise to a delegation problem as we assume that the assigned representative will act according to her preferences once she is in office[3]. In our model the Median Voter Theorem can be applied, thus the delegate's assignment can be modelled as the median voter's choice problem over different delegates' types.

Our model allows us to analyze under what circumstances radical appointees come into power. The model predicts that in most situations of conflict "tough" types will negotiate with "weak" types and that it is rather unlikely that two opponents with the same degree of "radicalization" meet. Furthermore we can show that delegated rent seeking is generically less wasteful than conventional rent-seeking. Thus delegation is a desirable feature from a social planner's point of view.

The delegation problem has also a long tradition in the political economy literature. Agents often want to delegate certain actions to other agents that have preferences different to their own as the latter might be able to commit more credibly to carry out certain actions at a future point in time. A prominent example is Rogoff's (1985) model of monetary policy. In his model a central banker faces a time inconsistency problem as his incentives are altered once the private sector has formed its expectations over future inflation. It turns out that the optimal solution is to delegate the monetary authority to a conservative and independent central banker who will never use monetary policy as a macroeconomic stimulus. Similar incentives work in capital taxation. Persson and

[2]Cf. the work of Pelzman (1976).

[3]This gives our analysis the flavor of citizen candidate models a la Besley and Coate (1997) or Osborne and Slivinsky (1996).

Tabellini (1994) analyze a model where, before capital is accumulated, politicians have an incentive to promise low tax rates. Once the capital is accumulated politicians have clear incentives to tax the capital contrary to their past promises. Political economy equilibrium models show that median voters find it optimal to delegate the taxation authority to a politician who possesses more wealth than they do as the wealthier person can commit more credibly not to overtax the capital[4]. Whilst in these two examples delegation is used to overcome a time inconsistency problem our model focuses on the strategic value of delegation in situations of conflict.

Also in the context of contests strategic delegation has been analyzed. Dixit (1987) shows that agents have a local incentive to commit to exert higher effort in a contest. However he remains silent about how this commitment can work and points out that the specific channels of commitment should be analyzed in depth. We present one possible way to do this and offer a full analysis.

Baik and Shogren (1992) build on Dixit (1987) and endogenize the order of moves. They can show that the "underdog" always wants to move first whilst the "leader" is happy to wait for his time to come. However we come to a different conclusion: In our framework both types would want to be the first mover.

Allard (1988) and Leininger (1993) analyze asymmetric contests but do not allow for delegation. In addition they focus only on the effect of asymmetry on the rent dissipation in these contests.

Levy and Razin (2002) analyze a model of two conflicting states where the electorate's choice to either delegate or retain final decision rights leads to improved information transmission about a "country's preferences". Whilst they use this "indirect" effect of delegation to overcome problems of informational asymmetry our model is one of symmetric information and we focus on the more direct effects of delegation.

There is also a relation to the auction and the bargaining literature. Contests are closely related to all–pay–auctions[5]. But whilst all pay auctions are a special case of fully

[4]See Person and Tabellini (2000) for a comprehensive treatment of this literature.

[5]Baye et al. (1993) and Hilman and Riley (1989) are examples of applying all–pay–auctions to lobbying.

discriminating contests (i.e. the contestant spending the most certainly wins), we look at not-fully discriminating contests, i.e. the party spending more is not with certainty the winner. There is a small literature on delegation in bargaining that tries to analyze under which circumstances it might be optimal to let the bargaining be carried out by somebody that has costs to revise an initial proposal. Whereas these models assume exogenously given, vaguely defined costs of revising former positions, our model derives the aggressiveness of different negotiators endogenously from their valuations of the rent.

Finally, our paper relates to the game theoretic analysis of arms races. If one is willing to interpret the groups as nations, the resources as military expenditure and the rent as something that can be gained in foreign policy, our model can be seen as a model of arms races. We allow for this interpretation as we believe the model can explain in a simple way several features of arms races.

The remainder of this chapter is structured as follows. Section two introduces the basics of the model. We then derive personal preferences over delegate's types and show that the median voter theorem can be applied. In section four we look at a simple version of the model where only one group has to appoint a member that carries out the rent–seeking activities. This simplified version already gives us valuable insights into the mechanisms at work. In section five, we look at sequential delegation decisions, in section six the same is done for simultaneous delegation decisions. Section seven provides some possible extensions. Finally, we conclude in section eight.

5.2 Basic Model

To fix ideas consider two countries a and b that quarrel about a foreign policy issue[6]. Assume this issue can be captured by a rent R. These countries each have to appoint first a politician to act on their behalf. These politicians then have to decide how much of a given budget B_a to spend in the contest[7]. We solve for a subgame perfect Nash equilibrium by first solving the final stage contest game taking the acting politician's

[6]See Paul and Wilwhite (1990) for a similar interpretation.

[7]For simplicity we will, without loss of generality, set out the primitives of the model from the perspective of country a.

types as given. Then we use these results when deriving the optimal delegation decision of a country. There is no asymmetric information in the model.

The citizens of the two states may have differing valuations of this rent. The valuation of the rent to citizen i is $\alpha_a^i R$, i.e. α_a^i can be seen as the weight placed on the foreign policy issue. α^i is continuously distributed according to the distribution function $f_a(\alpha)$ within each group. The only restriction we put on the distribution functions is that they have to be bounded on $(0, \overline{\alpha}_a]$, i.e. there exists a most radical type $\overline{\alpha}_a$.

An integral part of the model is the contest success function (CSF) $g(m_a; m_b)$ that determines the probability of winning the contest for a contestant dependent on the resources spent by him, m_a , and the opponent, m_b . To avoid technical difficulties assume $g(0; 0) = 1/2$.

To model the contest we use a Tullock style contest success function $\frac{m_a}{m_a+m_b}$. Our results would hold for all "constant returns to scale" contest success functions, i.e. functions of the form $\frac{\theta m_a}{\theta m_a + \pi m_b}$ that are homogenous of degree 0. See the Appendix 10.1 for an exposition with a general constant returns to scale contest success function.

Skaperdas (1996) shows at least that the general structure $\frac{h_a(m_a)}{\sum h_j(mj))}$, with $h_j(m_j)$ being an increasing function, is the only structure that fulfills several desirable axioms: the contest success function satisfies the conditions on a probability distribution, the success probability is increasing in the own expenses, an anonymity property applies and independence of irrelevant actions, i.e. actions of non-participants, holds[8].

To ease the exposition we focus on Tullock's initially proposed function $\frac{m_a}{m_a+m_b}$. As we stick to risk neutrality throughout one can interpret this not only as the winning probability but also as being the share the group secures for itself.

An individual citizen i's utility function in country a is given by

$$u^i = \alpha_a^i R \frac{m_a}{m_a + m_b} + (B_a - m_a)$$

[8]For contest success functions of the more general form $\frac{m_a^k}{m_a^k + m_b^k}$ we have the problem that we do not get closed form solutions for $k \neq 1$. However numerical examples give us some hope that our main results should remain qualitatively unchanged with increasing returns to scale ($k > 1$) or decreasing returns to scale ($k < 1$) contest success functions.

This states that utility is increasing in the (expected) rent and decreasing in the resources spent by the country in the contest. This cost $-m_a$ can be considered as the foregone public good which is produced with a simple linear production function from the exogenously given budget B_a not spent in the contest[9].

In our extensions section later on we will introduce heterogeneity in the cost of provision of the public good and analyze the effects.

We proceed from here by first deriving the equilibrium of the contest stage dependent on the politician's types. Then we use our results to derive in the next section the citizens' preferences over politician's types.

In the contest stage the two agents i (for county a) and j (for county b) in charge maximize their utility by deciding upon m_a and m_b.

$$\begin{aligned} \underset{m_a}{max}\ u^i &= \alpha_a^i R \frac{m_a}{m_a+m_b} + (B_a - m_a) \\ \underset{m_b}{max}\ u^j &= \alpha_b^j R \frac{m_b}{m_a+m_b} + (B_b - m_b) \end{aligned}$$

From the two first order conditions of this problem we can solve for the reaction functions

$$m_a = \sqrt{m_b R \alpha_a^i} - m_b \quad \text{and} \quad m_b = \sqrt{m_a R \alpha_b^j} - m_a$$

and the equilibrium values of m_a^* and m_b^* which are uniquely determined by

$$m_a^* = R\frac{\left(\alpha_a^i\right)^2 \alpha_b^j}{\left(\alpha_a^i + \alpha_b^j\right)^2} \quad \text{and} \quad m_b^* = R\frac{\alpha_a^i \left(\alpha_b^j\right)^2}{\left(\alpha_a^i + \alpha_b^j\right)^2}.$$

They depend only on the politicians' types and on the size of the rent under consideration[10].

It is interesting and facilitates the intuition of our results later on to note already here how these equilibrium values for m_a^* and m_b^* behave in the limits with respect to the acting

[9] Alternatively think of the contest expenditure financed by an equal per-capita-tax. However our model works as long as the share in financing can not be made dependent on the valuation.

[10] Note that for $\alpha_a^i = \alpha_b^j = 1$, i.e. the situation analyzed by Tullock (1980) the values not surprisingly boil down to his solution, namely $m_a^* = m_b^* = \frac{R}{4}$.

politicians' types. Interestingly the equilibrium contests spending does not go to infinity if the politician's valuation of the rent goes to infinity, but is bounded.

Lemma 1 *If the politician's valuation of the rent goes to infinity the equilibrium contest spending stays bounded with*

$$\lim_{\alpha_a^i \to \infty} m_a^* = R\alpha_b^j \quad \textit{and} \quad \lim_{\alpha_b^i \to \infty} m_b^* = R\alpha_a^i.$$

5.3 Individual Preferences over Types

This section uses our results from above on the contest stage game to derive individual citizens' preferences over politicians' types. From above we know the equilibrium values of m_a^* and m_b^* are uniquely determined by

$$m_a^* = R\frac{\left(\alpha_a^i\right)^2 \alpha_b^j}{\left(\alpha_a^i + \alpha_b^j\right)^2} \quad \text{and} \quad m_b^* = R\frac{\alpha_a^i \left(\alpha_b^j\right)^2}{\left(\alpha_a^i + \alpha_b^j\right)^2}.$$

Now we are interested in the question what kind of politician a citizen i would like to send into the contest, taking country b's politician choice as given. Would he want to act himself or would he want to have a politician with a lower or higher valuation α_a^P than his own to act on his behalf?

Thus the problem of state a citizen i is given by

$$\underset{\alpha_a^P}{max} \quad u^i = \alpha_a^i R\frac{m_a\left(\alpha_a^P, \alpha_b^P\right)}{m_a\left(\alpha_a^P, \alpha_b^P\right) + m_b\left(\alpha_a^P, \alpha_b^P\right)} - m_a\left(\alpha_a^P, \alpha_b^P\right).$$

Using our results from above the problem becomes

$$\underset{\alpha_a^P}{max} \quad \alpha_a^i R\frac{\left(\alpha_a^P\right)^2 \alpha_b^P}{\left(\alpha_a^P\right)^2 \alpha_b^P + \alpha_a^P\left(\alpha_b^P\right)^2} - R\frac{\left(\alpha_a^P\right)^2 \alpha_b^P}{\left(\alpha_a^P + \alpha_b^P\right)^2}$$

and we can solve for the reaction function

$$\alpha_a^{P*} = \frac{\alpha_b^P \alpha_a^i}{2\alpha_b^P - \alpha_a^i}.$$

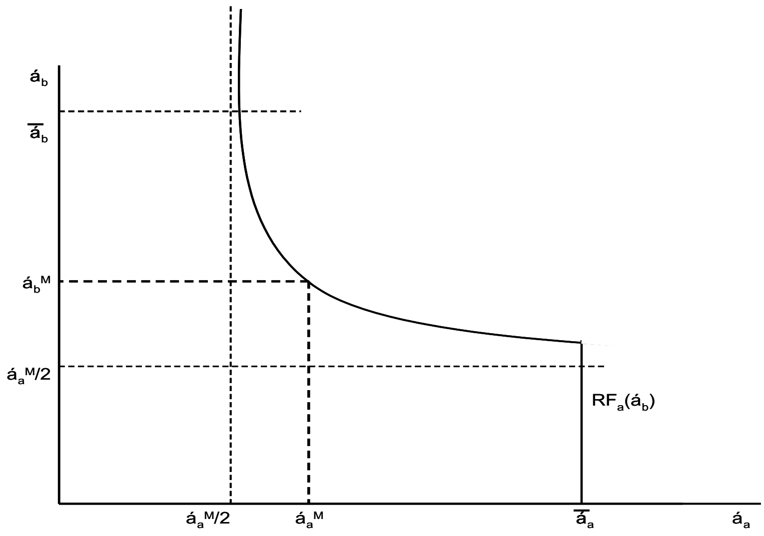

Figure 5.1: Reaction Function

Looking at the comparative statics we find that the optimal action increases in the citizen's type $\frac{\partial \alpha_a^{P*}}{\partial \alpha_a^i} = 2\left(\frac{\alpha_b^P}{2\alpha_b^P - \alpha_a^i}\right)^2 > 0$ and decreases in the type of the other country's politician, $\frac{\partial \alpha_a^{P*}}{\partial \alpha_b^P} = -\left(\frac{\alpha_a^i}{2\alpha_b^P - \alpha_a^i}\right)^2 < 0$.

Note that in the case where country b's politician has exactly the same valuation as the country a citizen under consideration, $\alpha_b^P = \alpha_a^i$, this country a citizen prefers to act himself, $\alpha_a^{P*} = \alpha_a^i$.

If we now draw the reaction function (see Figure 5.1) we have to be careful. Due to some properties of the contest success function the country a citizen would like to delegate to a politician with a negative valuation for cases where he is confronted with a country b politician with a very low valuation ($\alpha_b^P < \frac{\alpha_a^M \overline{\alpha_a}}{\left(2\overline{\alpha_a} - \alpha_a^M\right)}$). As we restricted the type space to positive valuation types we can show that in all those cases the utility of citizen i is strictly increasing in α_a^P (see Appendix 10.2) and thus he wants to delegate to the most radical type $\overline{\alpha}_a$. This leads to the vertical piece in the reaction function. Thus the reaction function is characterized by $\alpha_a^{P*} = \frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M}$ if $\frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M} < \overline{\alpha_a}$ and by $\alpha_a^{P*} = \overline{\alpha_a}$ otherwise.

In order to analyze the delegation problem we proceed now by showing that in our context the Median Voter Theorem (MVT) is applicable.

Following Black (1948) we know that in any one dimensional policy problem the median voter's most preferred policy choice will win any pairwise vote over any other policy candidate if the agents exhibit single peaked preferences over the policy choices[11].

First note that we deal with a one dimensional policy problem, as the question at hand is in the end what amount m_a to spend in the contest. As we have shown above the decision how much to spend corresponds one to one to the decision which delegate to have in the contest. Now for the Median Voter Theorem to be applicable we have to show single peakedness.

There is a one-to-one mapping from the spending decision to the type decision as any pair (m_a, m_b) can be generated by choosing a pair of politicians $\left(\alpha_a^P, \alpha_b^P\right)$ and the functions for m_a and m_b respectively are strictly increasing in the politician's type. Thus we focus only on the decision over types. Above we derived the reaction function in the delegate's type space for an arbitrary group member. Now we show that the utility has a unique peak on this reaction function for any group member for any given delegate type of the other group.

The optimal value of α_a^P for an arbitrary type α_a^i is given by $\alpha_a^P = \frac{\alpha_a^i \alpha_b^P}{2\alpha_b^P - \alpha_a^i}$. The derivative is given by

$$\frac{\partial u}{\partial \alpha_a^P} = \frac{R\alpha_b^P}{(\alpha_a^P + \alpha_b^p)^3}\left(\alpha_a^i \alpha_a^P + \alpha_a^i \alpha_b^P - 2\alpha_a^P \alpha_b^P\right).$$

Thus we know that

$$sgn(\frac{\partial u}{\partial \alpha_a^P}) = sgn(\alpha_a^i \alpha_a^P + \alpha_a^i \alpha_b^P - 2\alpha_a^P \alpha_b^P).$$

Now plugging in $k\frac{\alpha_a^i \alpha_a^P}{2\alpha_a^P - \alpha_a^i}$ and checking for $k < 1$ (left of the reaction function) and $k > 1$ (right of the reaction function) gives

$$sgn(\frac{\partial u}{\partial \alpha_a^P}) = +1 \quad \text{for} \quad k < 1$$

[11] See Mueller (2003) for a more recent exposition of the Median Voter Theorem.

and

$$sgn(\frac{\partial u}{\partial \alpha_a^P}) = -1 \quad \text{for} \quad k > 1.$$

Thus, as needed for single peakedness, utility is strictly increasing in α_a^P to the left of the optimal choice and strictly decreasing in α_a^P to the right of the optimal choice. As argued above for the vertical part of the reaction functions where the optimal choice of α_a^P is restricted by $\overline{\alpha}_a$ utility is strictly increasing until $\overline{\alpha}_a$. Single peakedness is therefore automatically ensured and the Median Voter Theorem is applicable.

Lemma 2 *Given the one dimensional policy problem with single peaked preferences we can analyze the delegation problem as the median voter's optimization problem.*

5.4 One sided delegation

A natural starting point for the analysis of the delegation decision is the situation where only one country delegates. Without loss of generality we restrict our analysis to the case where country a has this option. An interpretation of this situation would be that the population in country b has homogenous valuation of the rent or that in country b institutional features hinder delegation.

In the case of one sided delegation we only have to closely inspect the above derived reaction function of country a's median voter α_a^M. As shown above his valuation determines country a's delegation decision. To ease exposition we assume without loss of generality that in country b the median type acts in the contest.

Proposition 3 *In the case of onesided delegation the optimal delegation decision depends solely on the type of the median and on the type of the other country's acting politician. The best response is given by* $\alpha_a^{P^*} = \frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M}$ *if* $\frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M} < \overline{\alpha_a}$ *and by* $\alpha_a^{P^*} = \overline{\alpha_a}$ *otherwise.*

A closer inspection of this reaction function tells us more about when country a wants to delegate to more radical or less radical politicians.

Proposition 4 *If $\alpha_a^M < \alpha_b^M$ the median group member prefers to send a group member that values the rent less than him into the contest (delegation to a less aggressive type).*

If $\alpha_a^M > \alpha_b^M$ the median group member prefers to send a group member that values the rent more than him into the contest (delegation to a more aggressive type).

If $\alpha_a^M = \alpha_b^M$ the median group member prefers to act himself in the contest, i.e. $\alpha_a^{P^*} = \alpha_a^M$.

Here we already see the basic logic of delegation at work. Delegation leads to an amplification of initial differences which makes the actual contest more asymmetric. We will use the insights from this simple case in the analysis of what follows.

5.5 Sequential Delegation

Now we allow both countries to decide which citizen to send into the contest (two sided delegation). Again we first look at an analytically simpler situation in which country a has to appoint its politician before country b does. In what follows we refer to this case as sequential delegation.

We solve the problem by backwards induction and first have a look at country b 's problem where the median citizen has to decide upon delegation.

$$\underset{\alpha_b^P}{max}\ u^M = \alpha_b^M R \frac{m_b^*}{m_a^* + m_b^*} + (B_b - m_b^*)\,.$$

Using our results for m_a^* and m_b^* and deriving the the first order condition we get the by now familiar expression for the optimal choice of α_b^P:

$$\alpha_b^{P^*} = \frac{\alpha_a^P \alpha_b^M}{2\alpha_a^P - \alpha_b^M}.$$

Lemma 5 *The best response function for α_b^M is given by $\alpha_b^{P^*} = \frac{\alpha_a^P \alpha_b^M}{2\alpha_a^P - \alpha_b^M}$ if $\frac{\alpha_b^M \alpha_a^M}{2\alpha_a^M - \alpha_b^M} < \overline{\alpha_a}$ and by $\alpha_b^{P^*} = \overline{\alpha_b}$ otherwise.*

Anticipating the behavior of the country b median and the behavior of the politicians the country a median faces the following optimization problem:

$$\max_{\alpha_a^P} \quad u^M = \alpha_a^M R \frac{m_a^*}{m_a^* + m_b^*} - m_a^*$$

Using the equilibrium values of m_a^* , m_b^* and $\alpha_b^{P^*}$, this becomes:

$$\max_{\alpha_a^P} \quad R\left[\frac{\alpha_a^M}{2} - \alpha_b^M \left(\alpha_b^M + 2\alpha_a^M\right) \frac{1}{4\alpha_a^P}\right].$$

As can be seen easily, utility strictly increases in α_a^P. Thus it is optimal to choose $\alpha_a^{P^*} = \overline{\alpha_a}$. This means that it is optimal for the group a median to delegate the negotiations to the most aggressive group member, irrespective of his relative aggressiveness as compared to country b's median.

Plugging this into α_b^M 's best response function we get $\alpha_b^{P^*} = \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}$.

Proposition 6 *In the sequential move game the first mover chooses to delegate as radically as possible* $\left(\alpha_a^{P^*} = \overline{\alpha_a}\right)$ *whereas the second mover accommodates* $\left(\alpha_b^{P^*} = \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}\right)$ *. For* $\overline{\alpha_a} \to \infty$ *we find that* α_b^* *converges to* $\frac{\alpha_b^M}{2}$ *. This result is independent of whether the first or the second moving median is more radical.*

This result deserves some consideration for several reasons. First of all, it tells us that the result from the delegation case will differ from the one of standard rent seeking games. While standard rent seeking games predict also asymmetric equilibria for symmetric players in a sequential situation, the model of delegated rent seeking predicts extremely asymmetric equilibria in its sequential version and thus makes the standard result more pronounced. This result parallels the analysis of Cournot and Stackelberg models in Industrial Organization.

Secondly, the model gives us a clear prediction of the way in which the asymmetry works: The group that is able to appoint a negotiator first has a first mover advantage as the appointment of a negotiator presents a fait accompli to the second group. Namely, the first country will use its first moving advantage in order to delegate the rent seeking to its most radical member, thereby making fighting for the rent more costly for the other group. Consequently, in equilibrium the share of the rent (and the utility for the median type) the first moving country can get will be significantly greater than the other country's share (see Appendix 10.3). This holds as long as $\bar{\alpha}$ is sufficiently large, namely $\bar{\alpha} > 2\alpha_b^M$. I.e., as long as delegation is a powerful instrument it ensures an advantage. The result is particularly striking for groups that are absolutely identical.

Note that our result that both countries prefer to have the first moving advantage contradicts Baik and Shogren's (1992) result that the underdog (in our case the country with the less aggressive median) wants to move first whilst the top dog happily waits for its turn.

5.6 Simultaneous Delegation - Asymmetry

We now look at the situation where the medians delegate simultaneously. Using the above derived equilibrium values of the final stage game we can solve for the best reply functions of the median types in the type space.

The problem of the median voter in countries a and b respectively is to choose a politician that will maximize their utility given his behavior in the final stage game

$$\begin{aligned} \underset{\alpha_a^P}{max}\ u^M &= \alpha_a^M R \frac{m_a}{m_a + m_b} + (B_a - m_a) \\ \underset{\alpha_b^P}{max}\ u^M &= \alpha_b^M R \frac{m_b}{m_a + m_b} + (B_b - m_b). \end{aligned}$$

We can use the equilibrium values for m_a^* and m_b^* and derive the first order conditions and get again the best reply functions in the politician's type space:

$\alpha_a^{P*} = \frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M}$ if $\frac{\alpha_b^M \alpha_a^M}{2\alpha_b^M - \alpha_a^M} < \overline{\alpha_a}$ and $\alpha_a^{P*} = \overline{\alpha_a}$ otherwise for country a.

$\alpha_b^{P*} = \frac{\alpha_b^M \alpha_a^M}{2\alpha_a^M - \alpha_b^M}$ if $\frac{\alpha_a^M \alpha_b^M}{2\alpha_a^M - \alpha_b^M} < \overline{\alpha_b}$ and $\alpha_b^{P*} = \overline{\alpha_b}$ otherwise for country b.

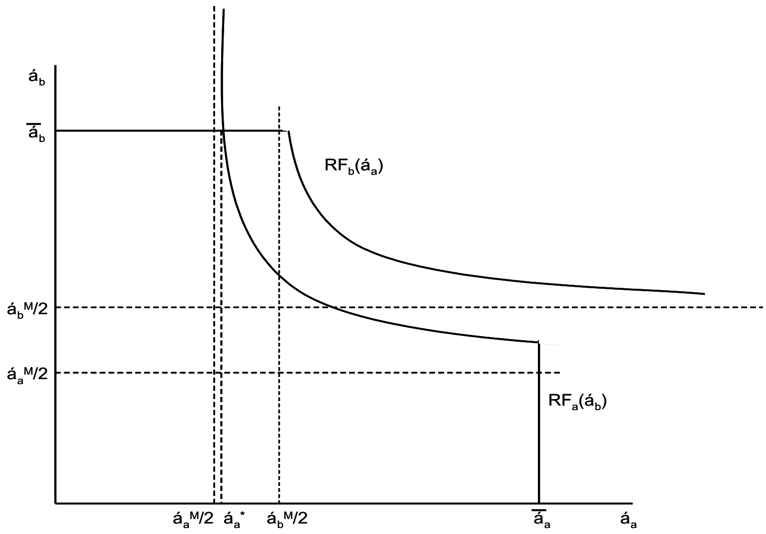

Figure 5.2: Simultaneous Delegation - Asymmetry

These functions have an interesting property. They are symmetric around the bisecting line. And, if one neglects for a moment the restriction that $\alpha_{a/b}^{P*} < \overline{\alpha_{a/b}}$, we can see that for $\alpha_a^M = \alpha_b^M$, i.e. perfectly symmetrical countries, they coincide for positive values of $\alpha_{a/b}^{P*}$. If however $\alpha_a^M \neq \alpha_b^M$ they do not intersect at all, i.e. there does not exist an equilibrium in pure strategies. We will treat those two cases separately.

We start with the generic case where countries' medians differ in their valuation, i.e. $\alpha_a^M \neq \alpha_b^M$. Without loss of generality we focus on the case where $\alpha_a^M < \alpha_b^M$. In this case we can use our above derived results and find that the unique intersection of the best response functions is given by the point where α_b^M delegates to his most radical option, $\alpha_b^{P^*} = \overline{\alpha_b}$, and α_a^M accommodates by choosing $\alpha_a^{P^*} = \frac{\overline{\alpha_b}\alpha_a^M}{(2\overline{\alpha_b} - \alpha_a^M)}$. It is interesting that we get this result of extreme polarization independent of the difference in the median types, i.e. initially only marginal differences are drastically amplified and lead to very asymmetric equilibria.

Proposition 7 *If countries are asymmetric, i.e.* $\alpha_a^M < \alpha_b^M$ *(w.l.o.g.), there is a unique equilibrium characterized by* α_b^M *delegating to* $\alpha_b^{P^*} = \overline{\alpha_b}$ *, i.e. as radically as possible, and* α_a^M *accommodating and delegating to* $\alpha_a^{P^*} = \frac{\overline{\alpha_b}\alpha_a^M}{(2\overline{\alpha_b} - \alpha_a^M)}$ *. This polarization is independent of the degree of the countries' asymmetry.*

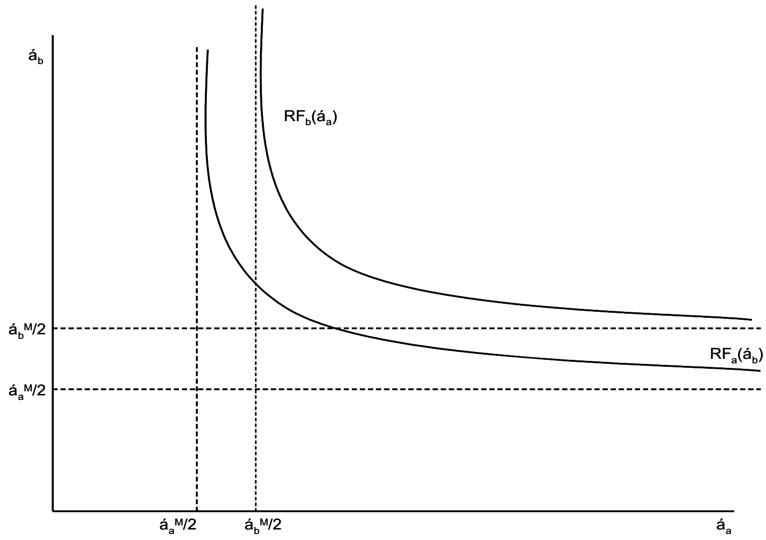

Figure 5.3: Asymmetry - No Equilibrium

Note that even if country b can delegate very extremely, i.e. $\overline{\alpha_b} \to \infty$, we get country a still delegating not to the lowest type.

Lemma 8 *For $\overline{\alpha_b} \to \infty$ we find that α_a^{P*} converges to $\alpha_a^M/2$.*

Note that non-delegated rent seeking predicts asymmetric equilibria as well, if the rent seekers valuation of the rent is different. It is easy to show however that even in this case the asymmetry will be more pronounced in the case of delegated rent seeking.

Note however, that this equilibrium was sort of forced by the fact that we restricted the support to $\alpha_b^{P*} \leq \overline{\alpha_b}$. If we allow for unbounded support this equilibrium ceases to exist and we do not find a pure strategy equilibrium[12] (see Figure 5.3).

Lemma 9 *If the support of α is not bounded by $\overline{\alpha}$ there exist no pure strategy equilibria.*

[12]We tried to show existence of a mixed strategy equilibrium, but none of the standard existence proofs has bite in our model (see e.g. Reny (1999) or Mas-Colell, Whinston, and Green (1995)). The intuition seems to be against the existence of a mixed strategy equilibrium. Because no matter how far we push $\overline{\alpha}$ out the extremely asymmetric nature of the pure strategy equilibrium persists. But the very moment we really go to the limit of $\overline{\alpha} \to \infty$ the nature of the (mixed strategy) equilibrium would change non-continuously.

However, as the existence of an infinitely radical citizen seems to be not the empirically most relevant case we neglect this particularity in the remainder of the analysis and assume that there exists a maximum type $\overline{\alpha}$.

5.6.1 Aggregate Waste under Delegation and No Delegation

Now we are going to analyze whether there is an effect of delegation on social welfare. We compare whether aggregate waste differs in a situation where delegation is possible as compared to a situation where the median type himself acts. Recall that aggregate waste in the latter case can be written as $m_a^* + m_b^* = R\frac{\alpha_a^M \alpha_b^M}{\alpha_a^M + \alpha_b^M}$. In the case of delegation we have seen above that equilibrium waste always is given by $m_a^* + m_b^* = R\frac{\alpha_a^M}{2}$ [13].

Now we compare these by subtracting the two expressions and checking the sign.

$$\begin{aligned} sgn[R\frac{\alpha_b^M \alpha_a^M}{\alpha_b^M + \alpha_a^M} - R\frac{\alpha_a^M}{2}] &= sgn[\frac{2\alpha_b^M \alpha_a^M - \alpha_b^M \left(\alpha_b^M + \alpha_a^M\right)}{\left(\alpha_b^M + \alpha_a^M\right) 2}] \\ &= sgn[\alpha_b^M \alpha_a^M - \alpha_b^M \alpha_b^M] \\ &= sgn[\alpha_a^M - \alpha_b^M] \\ &> 0 \end{aligned}$$

This leads us to the following proposition.

Proposition 10 *The possibility of delegation leads to social improvement due to a reduction in aggregate waste in the case of asymmetric countries.*

Again this result is due to the (by delegation extremely pronounced) asymmetry of the equilibrium. A standard result in contest theory is that more asymmetric equilibria imply less waste as the "race is decided before the start". We term this allocation a second best allocation given that it is not possible to eliminate rent seeking contests as a

[13] We get that by noting that $\alpha_a^M < \alpha_b^M$. Thus we know $\alpha_b^{P^*} = \overline{\alpha_b}$, and $\alpha_a^{P^*} = \frac{\overline{\alpha_b}\alpha_a^M}{(2\overline{\alpha_b} - \alpha_a^M)}$ which leads to $m_a^* + m_b^* = R\frac{\alpha_a^M}{2}$.

whole. This may imply interesting policy implications for designing optimal contests as a social planner interested in reducing the amount of resources spent in rent seeking who is not able to eliminate the rent or to suppress the competition[14] still can try to design the structure of the contest such that groups are able/forced to delegate.

5.7 Simultaneous Delegation - Symmetry

In the non generic case where $\alpha_a^M = \alpha_b^M = \alpha^M$ countries are perfectly symmetric in terms of the technological prerequisites and the preferences of the median citizen. In this case there exists a continuum of equilibria as the reaction function coincide (as noted above) (See Figure 5.4).

Proposition 11 *For $\alpha_a^M = \alpha_b^M$ a continuum of equilibria exists in the simultaneous delegation game.*

There is no a priori reason why one of these equilibria should have more appeal than the others but we can compare these equilibria with respect to some variables of interest.

5.7.1 Utility Ranking

First we compare these equilibria with respect to the utility country a's median receives in them. From that we can see which equilibrium this agent would choose if he had the power to determine which equilibrium should be played.

As a first step we write m_a^* and m_b^* as functions of α_a^P :

$$m_a^* = R\frac{\left(2\alpha_a^P\alpha^M - \left(\alpha^M\right)^2\right)}{4\alpha_a^P} \text{ and } m_b^* = R\frac{\left(\alpha^M\right)^2}{4\alpha_a^P}$$

[14]It might indeed be difficult, if not impossible to eliminate rents in an economy. The same is true for the suppression of rent seeking activities which can take numerous different visible and invisible forms. Mueller(1989) points out, that "rents are omnipresent. They exist whenever the information and mobility asymmetries impede the flow of resources. They exist in private good markets, factor markets, asset markets and political markets. Where rents exist, rent seeking can be expected to exist."

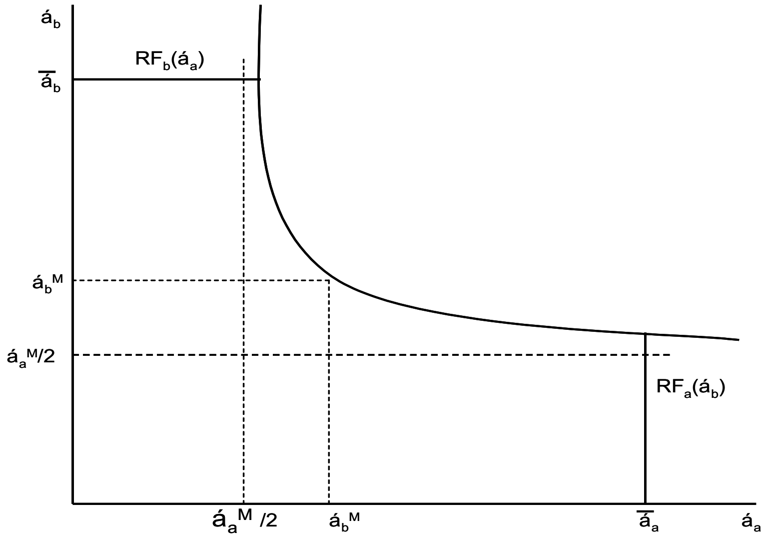

Figure 5.4: Symmetry - Continuum of Equilibria

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Using this expressions and using that $\alpha_a^M = \alpha_b^M = \alpha^M$ we can write the utility of country 1's median voter as $u_a^M = \frac{1}{2}R\alpha^M - \frac{R\left(\alpha^M\right)^2}{4\alpha_a^P}$. We can easily see, that this expression strictly increases in α_a^P and reaches a maximum at $\alpha_a^P = \overline{\alpha_a}$.

Lemma 12 *Country a median prefers most the equilibrium where he delegates to his most radical option* $\overline{\alpha_a}$ *.*

This result parallels the analysis of our sequential case where it was most desirable to be the first mover and delegate as extreme as possible. Thus it seems hardly surprising that in this case this type of equilibrium is preferred, too.

5.7.2 Waste Ranking

Another matter of interest is the social planner's perspective. Thus we compare the equilibria with respect to the aggregate waste, i.e. the sum of the resources invested in the contest. To do so we again express m_a^* and m_b^* as functions of α_a^P and use the fact that $\alpha_a^M = \alpha_b^M = \alpha^M$. Thus we get for the aggregate waste $m_a^* + m_b^* = R\frac{\alpha^M}{2}$ which is constant. Thus we can state the following Lemma.

Lemma 13 *The aggregate waste is constant for all equilibria.*

As there is no initial difference to be amplified delegation apparently looses its bite in the symmetric case.

5.8 Extensions

5.8.1 Countries with Differing Budgets

This first extension is merely an observation. If we look at the median citizens' problems

$$\begin{aligned} u_a^M &= \alpha_a^M R \frac{m_a}{m_a + m_b} + (B_a - m_a) \\ u_b^M &= \alpha_b^M R \frac{m_b}{m_a + m_b} + (B_b - m_b) \end{aligned}$$

we see that we can allow for the budgets to differ. However due to the structure of the problem these budgets do not show up in the first order conditions. As the values of m_a^* and m_b^* are defined as absolute values they are independent of the available budget.

If we are now willing to accept the share of GDP spent on military as an empirical measure of country radicalization our model generates the commonly observed result that smaller/poorer countries spend a larger share of their budget on their military. This is admittedly due to the primitives of our model as we do not control for (dis-)economies of scale in the provision of the public good. However it is reassuring that the simple model delivers this empirically backed stylized fact.

Lemma 14 *Richer countries tend to be less radicalized.*

5.8.2 Heterogeneity with Respect to the Cost of Public Good Provision

Again looking at the median citizens' problems we can also allow for differing efficiency k_a and k_b in providing the public good. A higher value for $k_{a/b}$ expresses here a higher opportunity cost of resources spent in the contest as more of the public good consumption is foregone.

$$\begin{aligned} u_a^M &= \alpha_a^M R \frac{m_a}{m_a + m_b} + k_a (B_a - m_a) \\ u_b^M &= \alpha_b^M R \frac{m_b}{m_a + m_b} + k_b (B_b - m_b) \end{aligned}$$

The analysis is basically the same as above and leads to equilibrium expenses in the contest given by

$$m_a^* = R \frac{\left(\frac{\alpha_a^P}{k_a}\right)^2 \left(\frac{\alpha_b^P}{k_b}\right)}{\left(\left(\frac{\alpha_a^P}{k_a}\right) + \left(\frac{\alpha_b^P}{k_b}\right)\right)^2} \text{ and } m_b^* = R \frac{\left(\frac{\alpha_a^P}{k_a}\right) \left(\frac{\alpha_b^P}{k_b}\right)^2}{\left(\left(\frac{\alpha_a^P}{k_a}\right) + \left(\frac{\alpha_b^P}{k_b}\right)\right)^2}.$$

Using that we can solve for the best responses in the politician type space, again similar to above:

$$\alpha_a^{P*} = \frac{k_a \alpha_b^P \alpha_a^M}{2\alpha_b^P k_a - \alpha_a^M k_b} \text{ and } \alpha_b^{P*} = \frac{k_b \alpha_a^P \alpha_b^M}{2\alpha_a^P k_b - \alpha_b^M k_a}.$$

Now performing comparative statics with respect to the efficiency of public goods provision, $k_{a/b}$, leads us to conclude that an increase in the efficiency of public good provision, e.g. better developed infrastructure, leads to less radical delegation, i.e. an inward shift of the best response function, and thus has the same effect as a lower valuation of the median citizen.

$\frac{\partial\left(\alpha_a^P\right)}{\partial k_a} = -\alpha_a^M \alpha_b^P \frac{k_b \alpha_a^M}{\left(k_b \alpha_a^M - 2k_a \alpha_b^P\right)^2} < 0$ (analogous for country b)

Proposition 15 *Better developed countries tend to delegate less radically.*

5.8.3 Costly Concessions

In the literature on delegated bargaining[15] the actual bargaining can be delegated to agents who have differing costs of taking back an initial demand. The higher this cost,

[15] See Muthoo (1999) for a comprehensive survey.

the more credible the initial commitment is. I.e. by delegating to an agent with high costs of conceding one can ensure a high share of the pie.

In our context Mo (1995) analyzed the question how much decision authority to give to a delegate. In the US for some international issues domestic institutions retain a veto right to overrule presidential decisions. One could include this feature in our model and would again get some sort of a theory of domestic institutions. However in our basic model one would expect that one wants always an as strong as possible commitment in the delegation decision.

5.8.4 Bundling of Issues

We have only looked on one dimensional issues. In reality one can observe that quite commonly several issues are bundled and rent seeking takes place in several dimensions at once. Now an normative analysis could be applied what kinds of issues should be bundled or kept separately respectively. Should the social planner put together issues where both parties have similarly high valuations, or should she try to create an already asymmetric initial situation to start with by bundling differently valued issues?

5.8.5 Endogenous Specialization

Another question related to the analysis of multidimensional issues is the question what kind of delegate groups will send into a contest if the delegate has to contest simultaneously for several issues. In a model with two separate issues 1 and 2 we expect that delegation will lead to "endogenous specialization", meaning that one country will elect an politician very keen on issue 1 and moderate on issue 2 whilst the other country will elect just the other way around, in that way coordinating on their respective claims. The exact analysis of this problem may be very interesting in a field next to public choice, namely Industrial Organization.

Consider a situation where two firms compete in two different product markets. By hiring a manager who is clearly in favor of one of the markets (thus more inclined to spend money on R&D or advertising in this market) the two firms can avoid intense competition on both markets and both secure themselves their market with barely challenged monopoly rents. If the same logic as in our model applies we hope to get also a unique equilibrium in which initial differences are amplified[16].

The decision what CEO to hire is generally considered to be an important signal for markets. Recent examples are the Deutsche Bank who set clear sign of their orientation to investment banking when making Josef Ackermann their new CEO in 2002 or Ford who hired the former BMW manager Wolfgang Reizle for their "Premium Group" in 1999.

5.9 Conclusion

This chapter presented a simple model of delegation in contests. We have shown that the equilibria that tend to arise seem to be characterized by a high degree of asymmetry. This can be due to two factors. In the sequential game, the asymmetry was simply due to the first mover advantage in the delegation game. Using this advantage, the first moving group could secure itself a higher share of the expected rent. Even in the simultaneous game asymmetry is likely to arise although for different reasons. Here we found that a median group member that is only slightly more radical than her opponent in the other group will decide to give the rent seeking power to its most radical and aggressive member. The other group's median accommodates by delegating to a rather moderate politician. Thus initial asymmetries are amplified by delegation. Further we showed that delegated rent seeking implies by its asymmetry that less resources will be spend in the contest than under non-delegation.

If one is willing to go some way in interpreting our model one could interpret the US electing the hawkish Ronald Reagan in 1981 being followed by dovish Mikhail Gorbachev coming into power in the USSR in 1985 as being consistent with the predictions of our sequential model.

Finally we would like to stress that the main implications of our model are testable. Our

[16] An example of a somewhat related reasoning for intra-firm conflicts can be found in Rotemberg and Saloner (1995).

model identifies not only the circumstances under which the median group member will be decisive, but although to whom he wants to delegate the decision and what resource spending in the rent seeking contest this implies. Finally, our model predicts extremely asymmetric spending of both groups in the rent seeking contest. Taking that into account it should be possible to test the model of delegated rent seeking against conventional models of rent seeking.

Looking at the issues pointed out in the last section it appears to be that the reasoning applied in this chapter can be fruitfully enriched and applied to other issues. As well in the field of public choice as in other fields such as Industrial Organization. We believe that this avenue is an interesting one and worthwhile to pursue.

5.10 Appendix

5.10.1 Derivation of Reaction Function for General Constant Returns to Scale Contest Success Function

Utility of country a citizen

$u_a = \alpha_a^i R \frac{\theta m_a}{\theta m_a + \pi m_b} + (B_a - m_a)$

Utility of country b citizen

$u_b = \alpha_b^i R \frac{\pi m_b}{\theta m_a + \pi m_b} + (B_b - m_b)$

From the FOCs we can derive the reaction functions in the contest stage

$$m_a^* = \frac{\sqrt{R\alpha_a^i \pi m_b}}{\sqrt{\theta}} - \frac{m_b \pi}{\theta} \text{ and } m_b^* = \frac{\sqrt{m_a R \beta \theta}}{\sqrt{\pi}} - \frac{m_a \theta}{\pi}$$

and derive the equilibrium spending

$$m_a^* = R\frac{\alpha_b^i \left(\alpha_a^i\right)^2 \theta\pi}{\left(\alpha_b^i \pi + \alpha_a^i \theta\right)^2} \text{ and } m_b^* = R\frac{\left(\alpha_b^i\right)^2 \alpha_a^i \theta\pi}{\left(\alpha_b^i \pi + \alpha_a^i \theta\right)^2}.$$

The problem of the median citizens in countries a and b is given by

$$\begin{aligned} \underset{\alpha_a^P}{max} u_a &= \alpha_a^M R \frac{\theta m_a}{\theta m_a + \pi m_b} + (B_a - m_a) \\ \underset{\alpha_b^P}{max} u_b &= \alpha_b^M R \frac{\pi m_b}{\theta m_a + \pi m_b} + (B_b - m_b) \end{aligned}$$

or using the equilibrium values for m_a^* and m_b^* as

$$\begin{aligned} &\underset{\alpha_a^P}{max} R \frac{\alpha_a^M \left(\alpha_a^P\right)^2 \theta^2 + \alpha_a^M \alpha_a^P \alpha_b^P \theta\pi - \alpha_b^P \left(\alpha_a^P\right)^2 \theta\pi}{\left(\alpha_b^P \pi + \alpha_a^P \theta\right)^2} \\ &\underset{\alpha_b^P}{max} R \frac{\alpha_b^M \pi \alpha_b^P \alpha_a^P \theta + \alpha_b^M (\beta)^2 \pi^2 - \left(\alpha_b^P\right)^2 \alpha_a^P \theta\pi}{\left(\alpha_b^P \pi + \alpha_a^P \theta\right)^2}. \end{aligned}$$

Again we can derive the reaction functions in the politicians type space

$$\begin{aligned}\alpha_a^{P*} &= \frac{\pi\alpha_a^M\alpha_b^P}{2\pi\alpha_b^P-\theta\alpha_a^M}\\ \alpha_b^{P*} &= \frac{\theta\alpha_b^M\alpha_a^P}{(2\theta\alpha_a^P-\pi\alpha_b^M)}\end{aligned}$$

which are qualitatively equivalent to our formulation. Thus the results hold for this more general formulation, too.

5.10.2 Derivation of the Reaction Function

Here we proof the optimality of delegating to $\overline{\alpha_a}$ if $\alpha_b^P < \frac{\alpha_a^i\overline{\alpha_a}}{(2\overline{\alpha_a}-\alpha_a^i)}$.

For $\alpha_b^P \in \left[\frac{\alpha_a^i}{2}, \frac{\alpha_a^i\overline{\alpha_a}}{(2\overline{\alpha_a}-\alpha_a^i)}\right]$ the optimality is shown by checking that left of the reaction function, i.e. for $\alpha_a^P < \frac{\alpha_a^i\alpha_a^P}{2\alpha_a^P-\alpha_a^i}$ utility is strictly increasing in α_a^P.

The derivative $\frac{\partial u}{\partial\alpha_a^P}$ is given by

$$\frac{\partial u}{\partial\alpha_a^P} = \frac{R\alpha_b^P}{(\alpha_a^P+\alpha_b^p)^3}\left(\alpha_a^i\alpha_a^P+\alpha_a^i\alpha_b^P-2\alpha_a^P\alpha_b^P\right).$$

Thus we know that

$$sgn(\frac{\partial u}{\partial\alpha_a^P}) = sgn(\alpha_a^i\alpha_a^P+\alpha_a^i\alpha_b^P-2\alpha_a^P\alpha_b^P).$$

Left of the reaction function it holds that $\alpha_a^P = k\frac{\alpha_a^i\alpha_a^P}{2\alpha_a^P-\alpha_a^i}$ for $k<1$.

Plugging this in gives $sgn(\frac{\partial u}{\partial\alpha_a^P}) = +1$ for $k<1$.

For $\beta \in (0, \frac{\alpha_a^i}{2}]$ we repeat the exercise:

$$\frac{\partial u}{\partial\alpha_a^P} = \frac{R\alpha_b^P}{(\alpha_a^P+\alpha_b^p)^3}\left(\alpha_a^i\alpha_a^P+\alpha_a^i\alpha_b^P-2\alpha_a^P\alpha_b^P\right).$$

Thus again we know that

$$sgn(\frac{\partial u}{\partial \alpha_a^P}) = sgn(\alpha_a^i \alpha_a^P + \alpha_a^i \alpha_b^P - 2\alpha_a^P \alpha_b^P).$$

Now we check for $\alpha_b^P < \frac{\alpha_a^i}{2}$, i.e. $\alpha_b^P = k\frac{\alpha_a^i}{2}$ for $k < 1$ that utility is strictly increasing in α_a^P.

$$sgn(\frac{\partial u}{\partial \alpha_a^P}) = sgn\left(\alpha_a^i \alpha_a^P (1-k) + \alpha_a^i \frac{k\alpha_a^i}{2}\right) = +1$$

As utility is strictly increasing in α_a^P it is optimal to choose in these cases $\alpha_a^P = \overline{\alpha_a}$.

5.10.3 Utility Comparison in the Sequential Move Game

Without loss of generality we assume that the country a politician moves first. From the analysis we know that $\alpha_a^{P^*} = \overline{\alpha_a}$ and $\alpha_b^{P^*} = \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}$.

The utility of the first mover is (after using our results on m_a^* and m_b^*) given by

$$u_a = \frac{R\alpha_a^M \left(\alpha_a^P\right)^2 + R\alpha_a^M \alpha_a^P \alpha_b^P - R\left(\alpha_a^P\right)^2 \alpha_b^P}{\left(\alpha_a^P + \alpha_b^P\right)^2} + B_a.$$

The utility of the second mover is (after using our results on m_a^* and m_b^*) given by

$$u_b = \frac{R\alpha_b^M \left(\alpha_b^P\right)^2 + R\alpha_b^M \alpha_a^P \alpha_b^P - R\alpha_a^P \left(\alpha_b^P\right)^2}{\left(\alpha_a^P + \alpha_b^P\right)^2} + B_b.$$

Now use $\alpha_a^{P^*} = \overline{\alpha_a}$ and $\alpha_b^{P^*} = \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}$ and assume $B_a = B_b = B$.

$$\begin{aligned} u_a &= B + \frac{\overline{\alpha_a}^3 R}{\left(\overline{\alpha_a} + \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}\right)^2} \\ u_b &= B + \frac{\overline{\alpha_a}^3 R}{\left(\overline{\alpha_a} + \frac{\overline{\alpha_a}\alpha_b^M}{2\overline{\alpha_a} - \alpha_b^M}\right)^2} \frac{\left(\alpha_b^M\right)^2}{\left(2\overline{\alpha_a} - \alpha_b^M\right)^2} \end{aligned}$$

Now it is easily seen that $u_a > u_b$ whenever

$$\frac{\left(\alpha_b^M\right)^2}{\left(2\overline{\alpha_a} - \alpha_b^M\right)^2} < 1$$

For $\overline{\alpha_a}$ sufficiently large, i.e. $\overline{\alpha_a} > 2\alpha_b^M$, this is always true.

Chapter 6

A brief Survey on Overconfidence

The chance of gain is by every man more or less overvalued, and the chance of loss is by most men undervalued.

Adam Smith in *The Wealth of Nations* (1776, Book I, Chapter X)

6.1 Introduction

The widespread presence of overconfidence - in various forms - is a well understood and basically unchallenged fact. Several incidences of psychological trivia stem from the field like Svenson's (1981) study showing that 80% of drivers in Texas believe their driving ability is above average or Lehman and Nisbett's (1985) finding that people are well aware that half of US marriages fail but are convinced theirs won't fail. Another popular fact is reported by Taylor and Brown (1988) who report a survey that shows that depressive people have the most realistic self perception.

6.2 Overconfidence in Psychology

While in the Economics and Finance literature only recently researchers became interested in the analysis of causes and consequences of overconfidence there have been studies on the issue in psychology for a long time. These basically try to document the presence and the form of this cognitive bias using mostly data from interviews and surveys, partly also from experiments.

In this literature there is an array of phenomena that comes under the common label of overconfidence, like too narrow confidence intervals, self serving bias, illusion of control and overoptimism.

In psychological studies it is well documented that people tend to overestimate the precision of their predictions of uncertain events. E.g. in Fischhoff, Slovic and Lichtenstein (1977) or in Alpert and Raiffa (1982) it is found that people name dramatically too narrow confidence intervals for their estimates. Russo and Shoemaker (1992) find this also for their study of professional managers who perceive their judgement to be too exact.

The presence of a self serving bias is also well documented in numerous studies. E.g. Miller and Ross (1975), Langer and Roth (1975) or Nisbett and Ross (1980) find that people tend to account their success mainly on their own ability whilst it is mainly due to luck. Bettman and Weitz (1983) find evidence for this behavior amongst executives in their analysis of annual reports of firms.

Closely related to the self serving bias is the illusion of control. Langer (1975) finds evidence for it when she finds that people strongly prefer lottery tickets that they picked themselves as compared to randomly assigned ones. Fleming and Darley (1986) look at dice throwing experiments and find there, too, that players tend to believe that they could control the dice's outcome. Finally this phenomenon is documented also in the business world where studies by Langer (1975), Weinstein (1980) and March and Shapira (1987) show that CEOs who have chosen an investment project are likely to feel illusion of control and to strongly underestimate the likelihood of project failure.

The last phenomenon subsumed under the label of overconfidence is overoptimism where people believe favorable events to be more likely than they actually are. Alpert and Raiffa (1982), Buehler, Griffin, and Ross (1994), Weinstein (1980) and Kunda (1987) find that people think good things happen more often to them than to their peers. Langer and Roth (1975), Weinstein (1980) and Taylor and Brown (1988) find that people are overly optimistic about their own ability as compared to others.

Already early on psychologists understood the possible importance of their findings for businesses and started studying the phenomena in this environment. Kidd and Morgan (1969) found that electric utility managers consistently underestimated the downtime of generating equipment. Larwood and Whittaker (1977) studied a sample of corporate presidents and found them to be unrealistic in their predictions of success. Cooper, Woo, and Dunkelberg (1988) look at entrepreneurs who overestimate their chances of success with their business. In their sample of 2994 entrepreneurs 81% believe their chances to survive are better than 70% and 33% believe they will survive for sure. In reality 75% of new ventures did not survive the first 5 years.

Frank (1935) and Weinstein (1980) provide evidence that people are especially overconfident about projects to which they are highly committed. This would be a rationale for a CEO's overconfidence concerning his own projects. He can be thought of being highly committed since his compensation contract ties personal wealth to the company's stock price and, hence, to the outcomes of corporate investment decisions.

6.3 Foundations

The above section has shown that the several forms of overconfidence are well documented by psychological studies. Following a Friedman–type argument it appears that agents exhibiting overconfidence or overoptimism even in market environments (like the many business examples above have shown) are at odds with a rational actor using Bayesian techniques to process information. The latter is supposedly the type best equipped to pass the competitive market test. Thus recently there were several attempts to explain the presence and survival of overconfident types in an economic framework and environment.

Van den Steen (2002) and Compte and Postlewaite (2004) analyze the possible reasons for self serving biases leading to overconfidence. Van den Steen (2002) derives it from differing priors. Agents start out holding different priors. Dependent on the belief there is an optimal action (which can be observed by all agents) to be taken. If an agent is successful he will think his right action choice was the cause whilst he will assign others' success to luck. In effect he ends up with an explanation for overconfidence with respect to own ability and with self serving bias.

Compte and Postlewaite (2004) look at a situation where they assume that optimism per se increases performance and find that it is optimal to distort information processing such that successes are regarded as being due to own ability as overoptimism increases the welfare of agents.

Brunnermeier and Parker (2004) take a very different approach. In their normative model agents have to trade off current well being - which can be raised by overly optimistic estimates of the probability of good future events - and future well being - which is reduced by distorted decisions due to overoptimism, e.g. savings. In this setting beliefs are optimally, meaning in a utility maximizing way, distorted towards overconfidence.

In a different vein evolutionary approaches study the chances of survival for overconfident types. Heifetz and Spiegel (2001) employ such an evolutionary approach. In their dynamic evolutionary model they show that rational Bayesian players are not a necessary consequence of evolution but that generically optimism will survive. In their model the bias helps to commit to a higher degree of effort and thus gives an advantage.

Although they also look at evolutionary dynamics, Bernardo and Welch (2001) focus on another aspect. They look at an economy where private information is inefficiently underused as the agents are predominantly herding. Thus no new information is generated by experimenting agents. In their model an overconfident "entrepreneur" who underestimates the risk of his action is willing to take a chance and experiment. Thus overconfidence helps to provide a public good, namely new information about business opportunities. Therefore groups with (moderately) overconfident members have an evolutionary advantage. On the one hand group selection works in favor of overconfidence whilst individual selection works against it as overconfident entrepreneurs die more often due to their too risky endeavors. The social optimum trades off the informational externality provided by the entrepreneur against the attrition, i.e. higher death rates of entrepreneurs.

Hvide (2000) also makes a quasi evolutionary argument. In his model overconfidence serves as a commitment device in bargaining. As agents are overly optimistic about their own abilities they overestimate their outside option. He calls overconfidence therefore "pragmatic beliefs" as they are most useful to an agent.

Closely related to evolutionary approaches are tournaments, as evolution can be interpreted as a sequence of tournaments where prizes are higher offspring rates. Another approach is taken by Goel and Thakor (2002) and by Krähmer (2003). They show that overconfidence enhances the chances to succeed in tournaments or contests. Goel and Thakor (2002) look at managers who perceive their situation to be less risky than it actually is. Now groups of managers with performance pay compete in promotion tournaments where the most successful agent is going to be promoted. In this setting managers have to trade off the payoff from choosing high risk projects with higher return and the risk that means for their performance tied compensation. Overconfident managers are more willing to take the risk and are ceteris paribus more likely ending up winning the promotion.

Krähmer (2003) looks at a sequence of contests where effort and ability are complements. In this setting a better belief about one's own ability leads to exertion of more effort and therefore a higher chance of winning. Success in a contest leads to a positive updating of the belief about own ability and to a still better belief about this ability. This in turn gives higher chances of winning future contests. He can show that even with an infinite horizon only incomplete learning of true ability may occur and overconfidence is likely to persist. Moreover we can see that initial overconfidence enhances the chances of a player to succeed.

6.4 Applications in Finance

Finance was the first field of economics to employ overconfidence in order to explain market anomalies. In all the finance applications covered here overconfidence means being too optimistic about signal precision.

Kyle and Wang (1997) construct a model of competing funds that hire managers to trade in a model a la Kyle (1984,1985). In models of this type trading volume depends on signal precision and thus hiring overconfident fund managers can serve as a commitment device to trade more aggressively. They show that overconfidence is unilaterally beneficial but the funds end up in a prisoner's dilemma type of situation as both have lower profits than with standard managers. They also show that overconfidence can be imitated by an appropriately designed incentive scheme.

Daniel, Hirshleifer, and Subrahmanyam (1998) look at markets with overconfident investors and find that under this assumption there is under-reaction to public information.

Gervais and Odean (2001) develop a model where overconfidence emerges endogenously as success is attributed to own ability whilst failure is not. They find that more confident traders trade more. However, taking a dynamic perspective they show that over time overconfident traders converge back to a realistic assessment of the situation. It is important to note that though overconfidence is associated with wealth it is not its cause. Wealthier traders are successful traders who are, due to their previous success, overconfident. They develop three hypotheses that are all backed by the data. First, periods of market increases with many successful and thus overconfident traders are followed by periods with higher trading volume. This is confirmed by Statman and Thorley (1998). Second, periods with higher trading volumes (due to overconfidence) go in hand with lower profits. This is confirmed by Barber and Odean (2001). Third, the highest degree of overconfidence can be found by young successful traders. Those tend to trade more. This is again consistent with Barber and Odean (2001)[1].

6.5 Applications in other Fields

There are several papers using overconfidence in other fields as well. Manove (1995) looks at a dynamic context and shows that overconfident entrepreneurs who overestimate their success probability allocate resources inefficiently but may be more willing to exert effort or accumulate more capital as they overestimate future returns. In the long run they may survive even in a competitive equilibrium.

Manove and Padilla (1999) analyze a bank's problem to screen entrepreneurs looking for credit financing when a fraction of the latter is overconfident with respect to their project's quality. The standard screening methods do not have bite anymore as in fact bad

[1]Interestingly for the analysis in the next chapter Barber and Odean (2001) moreover find that observable characteristics can help in predicting a person's degree of overconfidence as they find that men are more prone to overconfidence than women.

entrepreneurs actually think that they have great projects. This leads to too conservative banking and an additional welfare loss.

Schultz (2001) addresses in a non–technical paper the point that despite dramatic progress in consumer research product failure rates have remained on a high level. He argues that overconfidence might account for the fact that managers constantly overestimate the success chances of their (pet) projects which leads to constantly high product failure rates despite better marketing research techniques.

Roll (1986) uses CEO overconfidence to explain why many mergers are ex–post value destroying. He argues that managers are too optimistic about the performance of their acquisitions as they overestimate synergies etc. This leads to too high take over bids and in turn ex–post to loss making takeovers.

Van den Steen (2001) interprets a manager's overconfidence in the success of a certain type of projects as vision. Similar to Rotemberg and Saloner (2000) this vision enhances lower tier workers' incentives as they can be more confident that their projects will be approved if they are of the right type. Van den Steen also addresses the issue of sorting and finds that visionary managers will attract workers with a preference for the manager's pet projects.

Malmendier and Tate (2003) and Malmendier and Tate (forthcoming) look at a sample of 477 *Forbes 500* companies from 1980 to 1994. They construct an instrument to control for CEO overconfidence where they use information on the CEOs stockholding in own company stock. Interestingly for the analysis in the next chapter they find that CEO overconfidence can be well predicted by observable characteristics like an MBA degree, the birth cohort, military service, etc.

In Malmendier and Tate (2003) they show that overconfident CEOs do more mergers as they overestimate their success probability due to their misperception of own ability. These mergers are value destroying. They can further show that this behavior is most common in firms with a lot of free cash flow as there is less of a market corrective balancing the CEO's overconfidence. In Malmendier and Tate (forthcoming) the investment behavior is analyzed. As overconfident CEOs overestimate the return of their investment projects they invest too aggressively. Again this effect is more pronounced in firms with a lot of free internal cash flow as there the market corrective is missing. They find all their hypotheses confirmed in their data.

Finally, Dubra (2004) looks at the role of overconfidence in a labor market search problem and finds that overconfident agents tend to search longer as they overestimate the chances to find a better offer.

All the above papers have focussed on the downside of overconfident agents. But there are also a couple of papers focussing on the possible advantages of overconfidence. Goel and Thakor (2002) and Gervais, Heaton, and Odean (2004) address similar points. Goel and Thakor model overconfident managers who perceive their situation to be less risky. In this framing overconfidence is beneficial for a firm as the risk averse managers' preferences are better aligned with the risk neutral firm owners' preferences. In the same vein is Gervais, Heaton, and Odean (2004). There the risk averse managers have to be given stock options to provide them incentives to maximize expected firm value. If a manager is overconfident he has to receive less stock options to choose optimal projects, i.e. overconfidence lowers agency costs. Moreover they argue that giving these overconfident managers the same level of stock options induces excessive risk taking and is thus counterproductive. In their model monetary incentives and overconfidence are therefore alternative solutions to the underlying agency problem.

Ando (2004) analyzes the role of overconfidence in contests. He models the contest as an all pay auction where an agent may overestimate his own ability which is interpreted as the agent's valuation in standard auction terminology. This leads to more aggressive bidding (or effort exertion) as the optimal bid is, as standard in the auction literature, strictly increasing in the valuation. He also analyzes an alternative way to model relative overconfidence and allows players to underestimate the opponent's ability. Under this specification low ability players increase their effort but high ability players decrease it.

Gervais and Goldstein (2004) look at a team production problem with complementarities. One of the team members now is overconfident, i.e. overestimates his own productivity. Thus it is optimal for this agent to exert more effort as his perceived marginal return is higher. The other team members anticipate this and due to the technological complementarities they also increase their effort. Thus overconfidence of team members leads to a more efficient outcome. Looking at the problem in a dynamic perspective the higher output is interpreted by the overconfident agent as a signal for his own high ability as he does not take into account the effect that the other's have exerted more effort due to his overconfidence. Thus there is only imperfect learning of true productivity types. Gervais and Goldstein also analyze the influence of monitoring and find that overconfidence and monitoring are substitutes.

The next section now focusses on the strategic commitment value a firm can extract from hiring an overconfident manager and thus gain a competitive edge in product market competition.

Chapter 7

A Strategic Rationale for Overconfident Managers

7.1 Introduction

In 2000, Steve Ballmer succeeded the comparatively modest Bill Gates as Microsoft's CEO. Ballmer is famous for his "frighteningly enthusiastic style" and "blatant arrogance". At that time, Microsoft was at the brink of losing its antitrust law suit following its web-browser "war" with Netscape and was even threatened to be split up into two separate companies. At the same time the free operating system Linux became increasingly important and gained market share especially amongst professional users. Thus Microsoft was challenged on its core market for operating systems, the basis of its dominant market position. In the face of the antitrust lawsuits it was hard for Microsoft to use observable contracts to commit to fight hard for its dominant position as the courts could take offence of that. However, relying on Steve Ballmer's personal characteristics remained a viable option.

Recent papers by Malmendier and Tate (2003) and Malmendier and Tate (forthcoming) as well as numerous studies in organizational behavior and psychology suggest that executives are especially prone to overconfidence[1]. Most of these studies find that managers

[1]Cf. e.g. Langer (1975), Weinstein (1980), or March and Shapira (1987) and the previous chapter for

with this trait take value–destroying actions. But why do firms hire managers who are apparently not the right type to deal with business as they misperceive the true environment? This is even more surprising as Malmendier and Tate's studies suggest that overconfidence is an observable characteristic.

There have been several attempts to highlight the upsides of overconfident managers but those focussed on intra–firm issues[2]. This paper suggests another interpretation: It might pay for a firm to hire an overconfident manager for strategic reasons. By hiring such an "irrational" type the firm can commit to act differently in product market competition and it might try to use this to get a competitive edge over its competitors[3].

We analyze two duopoly models capturing the polar cases of Bertrand and Cournot competition where the firms have the opportunity to carry out cost reducing R&D before they enter into product market competition. In the Bertrand model the R&D stage is modelled as a tournament, following Lazear and Rosen (1981) or Lazear (1989), where the winner of the tournament wins the market. An overconfident manager, however, thinks the tournament is biased in his favor and relaxes his efforts. By delegating to overconfident managers the firms can escape the rat race nature of these R&D tournaments. In the Cournot model I follow Brander and Spencer (1983) who were the first to analyze the strategic effects of R&D on later competition[4]. The overconfident manager here expects the product market to be more profitable than is the true expected value. Overconfidence helps to commit to more aggressive R&D.

As opposed to the literature on contractual strategic delegation we find that - under some qualifications - both in price and in quantity competition an overconfident manager can improve the situation for the firm and optimal delegation goes in the same direction.

The remainder of this chapter is structured as follows. Section 2 analyzes a model

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an extensive survey of this literature.

[2]Cf. e.g. Van den Steen (2001) or the previous chapter for a comprehensive survey of this literature.

[3]Kyle and Wang (1997) employ a similar idea with overconfident traders in a financial market.

[4]Zhang and Zhang (1997) and Kopel and Riegler (2004) take up the classic literature on strategic delegation, e.g. Vickers (1985), Fershtman (1985), and Fershtman and Judd (1987), and analyze a Cournot model with the possibility to ex–ante perform R&D. Here the firms can strategically distort their manager's compensation contract away from profit maximization. However, Zhang and Zhang (1997) and Kopel and Riegler (2004) come to conflicting conclusions.

capturing Bertrand competition. Section 3 turns to the analysis of Cournot competition. Section 4 discusses several possible extensions and Section 5 concludes. The Appendix contains some derivations.

7.2 Competition in Prices

7.2.1 The Model

We are looking at two firms competing in prices. Products are not differentiated, thus, consumers base their decisions solely on the prices. The marginal production cost of firm i, with $i = 1, 2$, equals $C_i = c_i - \theta_i - \epsilon_i$, where $\theta_i \in [0, c_i]$ is agent i's cost reduction effort and ϵ_i is a noise term, which is i.i.d. across players and distributed according to $G(\cdot)$ on $[-\bar{\epsilon}, \bar{\epsilon}]$[5]. This R&D technology resembles a tournament model as in Lazear and Rosen (1981) or Lazear (1989) where the winner is determined depending on effort and luck. The cost reducing R&D comes at a cost $\gamma(\theta_i)$ with $\gamma'(\cdot) > 0$ and $\gamma''(\cdot) > 0$.

There is a unit mass of consumers with valuation $v > \max[c_1, c_2]$. Overconfidence is modelled as the manager believing that his product is vertically differentiated by k_i (with $k_i \in R_+$) against his opponent's product. Thus he can charge a mark up of k_i given equal costs and consumers are still willing to buy his product. This is an extreme way of modelling the manager's belief that his firm's product is a particularly good fit to the consumers' demands. In tournament terminology, both managers believe the tournament is biased in their favor.

The timing of the model is as follows:

$t = 0$	The firms simultaneously hire possibly overconfident managers.
$t = 1$	The managers simultaneously determine their cost reduction investments θ.
$t = 2$	The actual production costs C_i are realized and observed.
$t = 3$	The firms compete in prices.

[5]To avoid $C_i < 0$ assume that c_i is large enough relative to $\bar{\epsilon}$.

7.2.2 Analysis

We are looking for a subgame perfect Nash equilibrium and solve the game by backward induction.

In the Bertrand Competition stage in $t = 3$ the profits are given by

$$\pi_i = \begin{cases} C_j - C_i - \gamma(\theta_i^*) & \text{if } C_i < C_j \\ -\gamma(\theta_i^*) & \text{otherwise} \end{cases}.$$

Note that these profits are independent of the absolute cost level but only depend on the difference. Thus, firms would like to spend as little on R&D as possible. In the R&D investment stage in $t = 2$ the possibly overconfident manager believes that consumers will buy his firm's product as long as $p_i \leq p_j + k_i$.

The manager is interested in winning the market as this allows the firm to stay in the market. This gives him private benefits B which can be thought of as promotion prospects or benefits of control [6].

Thus, the firm 1 manager maximizes

$$\max_{\theta_1} \quad Pr(c_1 > c_2 + k_1)B - \gamma(\theta_1)$$

$$\Longleftrightarrow$$

$$Pr(\epsilon_2 - \epsilon_1 < c_2 - \theta_2 - c_1 + \theta_1 + k_1)B - \gamma(\theta_1).$$

Let $z \equiv \epsilon_2 - \epsilon_1$ be the convoluted distribution. z is distributed according to $H(z)$ with $z \in [-2\bar{\epsilon}, 2\bar{\epsilon}]$. As standard in the tournament literature we assume

1) $E(z) = 0$

2) $\forall \hat{z} : H(\hat{z}) = 1 - H(-\hat{z})$

Assumptions 1 and 2 imply that z is symmetrically distributed around 0. They are satisfied e.g. if the ϵ are normally or uniformly distributed.

[6] One could also think of it as a simple bonus contract which would be the optimal contract if staying in or exiting the market is the only verifiable performance measure.

Thus the first manager's problem can be written as

$$\max_{\theta_1} \quad H(c_2 - \theta_2 - c_1 + \theta_1 + k_1)B - \gamma(\theta_1).$$

Manager 1's optimal choice depends on which action he thinks manager 2 will choose. I assume that manager 1 thinks he is advantaged and believes that agent 2 agrees with 1's perception[7]. Thus, manager 1 thinks that the fictitious manager 2 maximizes

$$\begin{aligned} \max_{\theta_2} \quad Pr(c_2 - \theta_2 - \epsilon_2 &< c_1 - \theta_1 - \epsilon_1 - k_1)B - \gamma(\theta_2) \\ &\Longleftrightarrow \\ \max_{\theta_2} \quad \{1 - H(c_2 - \theta_2 &- c_1 + \theta_1 + k_1)\}B - \gamma(\theta_2) \end{aligned}$$

The first order conditions of this game can be written as

$$\begin{aligned} h(c_2 - \theta_2 - c_1 + \theta_1 + k_1)B - \gamma'(\theta_1) &= 0 \\ h(c_2 - \theta_2 - c_1 + \theta_1 + k_1)B - \gamma'(\theta_2) &= 0. \end{aligned}$$

Dividing them yields

$$\frac{\gamma'(\theta_1)}{\gamma'(\theta_2)} = 1.$$

Remember that manager 2 is here only sort of fictitious. The above calculations give the standard tournament result that equilibrium effort levels coincide, $\theta_1^* = \tilde{\theta}_2^*$, where $\tilde{\theta}_2^*$ is the effort level manager 1 believes manager 2 chooses. For manager 2 we perform the same task and end up with the symmetric result $\theta_2^* = \tilde{\theta}_1^*$.

Now consider the case that firms are initially identical, i.e. $c_1 = c_2$. Using $\theta_i^* = \tilde{\theta}_j^*$ in the two above first order conditions we see that equilibrium effort is given by

$$\gamma'(\theta_i^*) = h(k_i)B.$$

From the symmetry assumptions on $H(\cdot)$ and $h(\cdot)$ it follows that effort decreases the further k_i is away from 0.

[7] This clearly violates Aumann's impossibility result on agreeing to disagree. However, this assumption is quite common in the literature on overconfidence. Cf. for example Van den Steen (2001).

We can use this when analyzing the firm's decision at the hiring stage. Given the agents' effort level firm i now maximizes over the type k_i. To ease exposition restrict attention to the case where the cost of R&D investment is given by $\gamma(\theta_i) = \frac{1}{2}\theta_i^2$. The problems for firm 1 and 2 are given by respectively

$$\max_{k_1} \quad H[h(k_1)B - h(k_2)B][h(k_1)B - h(k_2)B] - \frac{1}{2}(h(k_1)B)^2$$

and

$$\max_{k_2} \quad \{1 - H(h(k_1)B - h(k_2)B)\}[h(k_1)B - h(k_2)B] - \frac{1}{2}(h(k_2)B)^2.$$

The first order conditions for these problems are

$$\begin{aligned} 0 &= h[h(k_1)B - h(k_2)B][h(k_1)B - h(k_2)B]h'(k_1)B \\ &+ H[h(k_1)B - h(k_2)B]h'(k_1)B - h(k_1)Bh'(k_1)B \end{aligned}$$

and

$$\begin{aligned} 0 &= h[h(k_1)B - h(k_2)B][h(k_2)B - h(k_1)B]h'(k_2)B \\ &+ \{1 - H(h(k_1)B - h(k_2)B)\}h'(k_2)B - h(k_2)Bh'(k_2)B. \end{aligned}$$

Cancel out $h'(k_i)B$ and, since players are symmetric, focus on symmetric equilibria. This imposes $k_1 = k_2$ which yields

$$\begin{aligned} h(0) \cdot 0 + H(0) &= h(k_1)B \\ h(0) \cdot 0 + 1 - H(0) &= h(k_2)B. \end{aligned}$$

Note that due to our above assumptions on symmetry $H(0) = \frac{1}{2}$. Thus, we get

$$h(k_1) = h(k_2) = \frac{1}{2B}.$$

We can see that the θ_i a firm wants to implement is unaffected by B as $\theta_i = B \cdot \frac{1}{2B} = \frac{1}{2}$. Hence a symmetric equilibrium exists in which the optimal degree of delegation is given by the above equations.

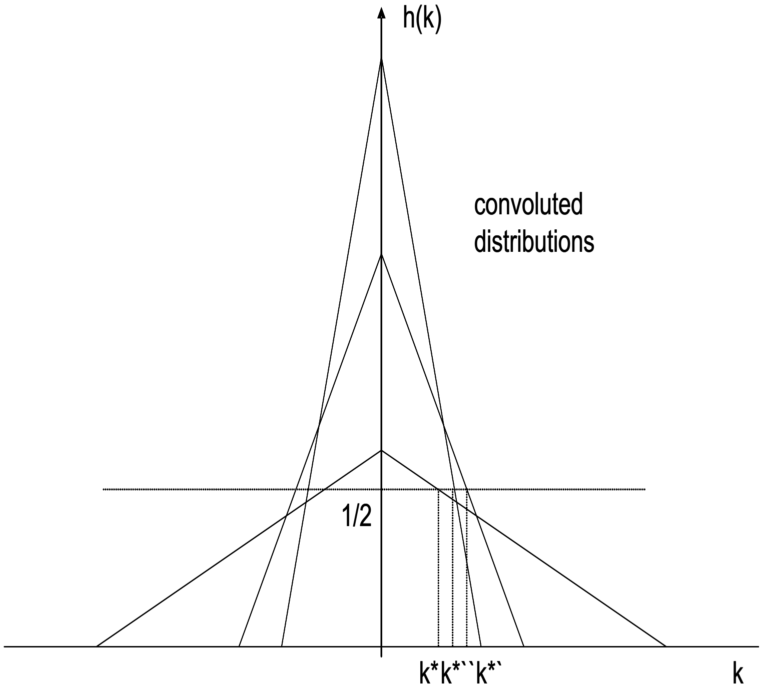

Figure 7.1: Convoluted Distributions

To ensure existence we have to assume $h(0) \geq \frac{1}{2B}$. $h(0)$ can be thought of measuring the importance of luck for the outcome of the tournament. The higher $h(0)$ is, the more deterministic is the tournament. Thus we require the tournament to depend not too much on luck.

Note that these equations do not uniquely characterize the exact equilibrium values since $h(\cdot)$ is symmetric around 0 and therefore there exist two values of k_i satisfying the conditions above. However, inspecting the second order conditions of the problem ensures that delegation to an overconfident manager, i.e. $k_i > 0$, will always occur[8].

Proposition 1 *In the unique symmetric equilibrium of the model with R&D and price competition, firms always hire overconfident managers.*

To illustrate an interesting point assume for the moment that the error terms ϵ_i are uniformly distributed on $[-\bar{\epsilon}, \bar{\epsilon}]$. This gives a triangular density function $h(\cdot)$ as shown in Figure 7.1. If the tournament becomes more deterministic the triangular densities are

[8]See the appendix for details.

contracted and become steeper. Carefully inspecting Figure 7.1 shows that the optimal degree of delegation is non-monotonic in the noisiness of the tournament. First, as the R&D tournament gets less noisy the optimal degree of delegation increases, then, from some level onwards it decreases again.

To gain intuition, note that it is a standard result in tournament theory that effort increases if luck is less important for the outcome of the tournament. One then can interpret our result as follows: Starting from a noisy situation and decreasing the noise increases the managers' effort levels. The firms are interested in keeping R&D spending down and therefore hire more overconfident managers who are less prone to spend much effort. But the less noise is in the tournament, the more tempting it is to invest just a little bit more to win the market almost certainly. In this situation it is too risky to stick with a manager who thinks he has a competitive edge and be probably expropriated by the opponent firm.

Note that the basic effect that delegation is most pronounced for an intermediate level of noisiness carries over to more general than linear convoluted distributions. Proposition 2 summarizes these findings.

Proposition 2 *The optimal degree of managerial overconfidence is non–monotonic in the riskiness of the R&D tournament. When the technology becomes less noisy the optimal degree of overconfidence first increases and then decreases again. Thus we should find the most overconfident types in industries with moderately risky R&D technologies.*

This concludes our analysis of price competition. In the next section we turn to the case of competition in quantities.

7.3 Competition in Quantities

7.3.1 Model

Here we consider a model where firms compete in quantities. They face a linear inverse demand $p = a - b\sum q_i$. Before they enter the product market competition stage, firms can invest in cost reducing R&D. By doing so they can reduce their initially identical marginal costs of production C by θ_i with $\theta_i \in [0, C]$[9]. Thus, firm i's final marginal costs of production are $c_i(\theta_i) = C - \theta_i$.

To ease exposition we assume that $a - C > 0$, i.e. the market is initially profitable. However, R&D does not come for free and the firm has to bear a convex cost $\gamma_i(\theta_i) = \frac{1}{2}(\theta_i)^2$ for cost reducing investments.

In an initial stage the firm has to hire a manager to carry out R&D and production. We abstract from agency conflicts within the firm. The manager can be overconfident, which is modelled as follows. As pointed out in the empirical literature, overconfident agents – maybe due to illusion of control – underestimate the probability of bad events. Here we assume that in the initial stage, when the R&D investments have to be taken, the market demand is not yet known. This is modelled as a lottery over different levels of a in the inverse demand, keeping b fixed. An overconfident manager underestimates the risk of low realizations of a and therefore expects a higher expected market size. Due to risk neutrality, we can solely focus on the expectations[10].

The managers that are hired correctly perceive their opponents' beliefs about the market but do not adjust theirs accordingly. Thus we have again a model of differing priors as in Van den Steen (2001) where agents observe differing beliefs but stick with their own.

However, once the true a has been realized the agents maximize profits given the previous R&D investments. The timing of the model is as follows:

[9] The R&D can be thought of as being stochastic with an additive error term with mean zero. As due to risk neutrality only the expected value matters, we suppress this here to ease exposition.

[10] One could think of alternative ways to model overconfidence. For example with respect to b or with respect to the manager's cost reduction ability. However approaches along these lines turned out to be not tractable.

$t = 0$ Firms simultaneously hire a (possibly overconfident) agent.

$t = 1$ The managers simultaneously decide about the R&D investment.

$t = 2$ The true market size is revealed.

$t = 3$ Firms compete in quantities.

7.3.2 Analysis

We are looking for a subgame-perfect Nash equilibrium and solve the game by backwards induction. In the product market competition stage the managers simultaneously maximize firm profits by setting quantities. The firms' problems are given by

$$\max_{q_1} \Pi_1 = ((a - b(q_1 + q_2)) - c_1(\theta_1))\, q_1 - \frac{1}{2}(\theta_1)^2$$

and

$$\max_{q_2} \Pi_2 = ([a - b(q_1 + q_2)] - c_2(\theta_1))\, q_2 - \frac{1}{2}(\theta_2)^2 .$$

From the resulting first order conditions we can derive the standard reaction functions

$$\begin{aligned} q_1^* &= \frac{a - C + \theta_1 - bq_2}{2b} \\ q_2^* &= \frac{a - C + \theta_2 - bq_1}{2b}, \end{aligned}$$

equilibrium quantities

$$\begin{aligned} q_1^* &= \frac{a - C + 2\theta_1 - \theta_2}{3b} \\ q_2^* &= \frac{a - C + 2\theta_2 - \theta_1}{3b}, \end{aligned}$$

and equilibrium profits

$$\begin{aligned} \Pi_1^* &= \frac{(a - C + 2\theta_1 - \theta_2)^2}{9b} - \frac{1}{2}(\theta_1)^2 \\ \Pi_2^* &= \frac{(a - C - \theta_1 + 2\theta_2)^2}{9b} - \frac{1}{2}(\theta_2)^2 . \end{aligned}$$

We use these profits in the R&D investment stage where managers maximize expected profits given their belief of the market size A_i by simultaneously choosing θ_1 and θ_2. The problems are given by

$$\begin{aligned}\max_{\theta_1} \Pi_1^* &= \frac{(A_1 - C + 2\theta_1 - \theta_2)^2}{9b} - \frac{1}{2}(\theta_1)^2 \\ \max_{\theta_2} \Pi_2^* &= \frac{(A_2 - C - \theta_1 + 2\theta_2)^2}{9b} - \frac{1}{2}(\theta_2)^2 .\end{aligned}$$

From the first order conditions we can solve for the reaction functions

$$\begin{aligned}\theta_1 &= \frac{4\widetilde{a} - 4C - 4\theta_2}{(9b-8)} \\ \theta_2 &= \frac{4\widetilde{a} - 4C - 4\theta_1}{(9b-8)}.\end{aligned}$$

These are now important for the optimal action of the firm in the hiring stage where firms can decide whether to hire an overconfident manager with a belief $A_i > a$. For such agents the reaction functions become

$$\theta_1 = \frac{4A_1 - 4C - 4\theta_2}{(9b-8)}$$

and

$$\theta_2 = \frac{4A_2 - 4C - 4\theta_1}{(9b-8)},$$

respectively. From these we can solve for the equilibrium values of θ_i^* as functions of the respective beliefs about the market size:

$$\begin{aligned}\theta_1^* &= \frac{48C - 36Cb - 32A_1 - 16A_2 + 36bA_1}{81b^2 - 144b + 48} \\ \theta_2^* &= \frac{48C - 36Cb - 16A_1 - 32A_2 + 36bA_2}{81b^2 - 144b + 48}.\end{aligned}$$

Note that for $A_1 = A_2 = a$ the equilibrium values boil down to

$$\theta_1^* = \theta_2^* = \frac{(36b - 48)(a - C)}{\left((9b-8)^2 - 16\right)}.$$

The firms' problem is to maximize expected profits by simultaneously choosing a manager with type A_i. The firms' problems take the form

$$\begin{aligned}
\max_{A_1} \Pi_1^* &= \frac{\left(a - C + 2\theta_1\left(A_1, A_2\right) - \theta_2\left(A_1, A_2\right)\right)^2}{9b} - \frac{1}{2}\left(\theta_1\left(A_1, A_2\right)\right)^2 \\
\max_{A_2} \Pi_2^* &= \frac{\left(a - C + 2\theta_2\left(A_1, A_2\right) - \theta_1\left(A_1, A_2\right)\right)^2}{9b} - \frac{1}{2}\left(\theta_2\left(A_1, A_2\right)\right)^2 .
\end{aligned}$$

As we have closed form solutions for $\theta_1\left(A_1, A_2\right)$ and $\theta_2\left(A_1, A_2\right)$, we can use them in this problem. Plugging these solutions in and differentiating the problems gives us the reaction functions:

$$\begin{aligned}
A_1 &= \frac{\left(24Cb - 32a + 144ab - 8bA_2 - 18Cb^2 - 198ab^2 + 81ab^3\right)}{160b - 216b^2 + 81b^3 - 32} \\
A_2 &= \frac{\left(24Cb - 32a + 144ab - 8bA_1 - 18Cb^2 - 198ab^2 + 81ab^3\right)}{160b - 216b^2 + 81b^3 - 32} .
\end{aligned}$$

However, this three stage game is not at all well behaved. Inspecting the second order condition of the problem shows that for low values of b, namely $b \leq 1.567\ldots$, the functions are all over the place[11]. Only for values of $b > 1.567$ does our analysis go through smoothly. For smaller values of b we get corner solutions either at $A_i = a$ or $A_i = \overline{A}$ where $\overline{A}$ is implicitly defined by $\theta_i^*(A_i) = C$.

Again, see the appendix for a brief discussion of this issue. In the remainder of the analysis we focus on the well behaved part, b$\geq$ 1.567, where we can gain economically more interesting insights.

From the above reaction functions we can solve for the equilibrium values of A_1^* and A_2^*

$$A_1^* = A_2^* = \frac{\left(8a - 6Cb - 30ab + 27ab^2\right)}{27b^2 - 36b + 8}.$$

This equilibrium is, given the parameters, symmetric and unique. Given that we are looking at the situation where $b \geq 1.567$ we easily see that the comparison of A_i^* and a clearly shows that the firms always choose to hire overconfident managers.

[11]Be aware that Zhang and Zhang (1997) in their analysis of strategic delegation via distorting managerial compensation employ a model similar to mine. They do not carefully check the second order conditions which casts some doubt on the validity of their results. See the Appendix for more details on the second order condition.

$$\begin{aligned} A_i^* &> a \\ \frac{(8a - 6Cb - 30ab + 27ab^2)}{27b^2 - 36b + 8} &> a \end{aligned}$$

After rearranging one can see that this holds whenever, as we assume, $(a - C) > 0$. Proposition 3 summarizes this result.

Proposition 3 *For $b > 1.567$ the unique and symmetric equilibrium has both firms delegating to overconfident managers.*

Given our equilibrium results for A_1^* and A_2^* we can solve for the equilibrium R&D levels

$$\theta_1^* = \theta_2^* = \frac{(12b - 8)(a - C)}{27b^2 - 36b + 8}$$

and equilibrium profits

$$\Pi_1^* = \Pi_2^* = \frac{(32 + 160b - 216b^2 + 81b^3)(C - a)^2}{1728b^2 - 576b - 1944b^3 + 729b^4 + 64}$$

chosen by the overconfident managers.

7.3.3 Profit Comparison

Though we have shown that for $b \geq 1.567$ it is the unique equilibrium to delegate symmetrically to overconfident managers it is interesting to see whether the possibility to delegate is actually beneficial for the firms or whether they are in a prisoner's dilemma type of situation. Remember that the profits with delegation $(_{OC})$ are given by

$$\Pi_{OC}^* = \frac{(32 + 160b - 216b^2 + 81b^3)(C - a)^2}{1728b^2 - 576b - 1944b^3 + 729b^4 + 64}$$

and without delegation $(_{nOC})$ by

$$\Pi_{nOC}^* = \frac{(9b - 8)(C - a)^2}{(9b - 4)^2}.$$

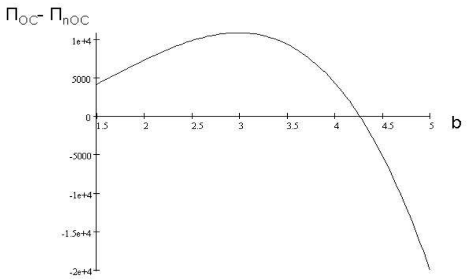

Figure 7.2: Difference in Profits

Comparing these two expressions we find that

$$\begin{aligned} \Pi^*_{OC} &> \Pi^*_{nOC} \\ &\Leftrightarrow \\ 6624b^2 - 4928b - 1296b^3 + 1024 &> 0 \end{aligned}$$

which holds whenever $b < 4.2625\ldots$. I.e. for moderate values of b firms improve by delegating to managers which are possibly overconfident while later on they loose out. See Figure 7.2 for a graph of the profit difference. Proposition 4 summarizes this result.

Proposition 4 *For moderate values of b firms can gain from the possibility to delegate. For high values of b they are, however, locked into a prisoner's dilemma.*

7.3.4 R&D Level Comparison

One can also take a more welfare oriented point of view and compare the R&D activities under the different regimes. Recall from the above analysis the equilibrium R&D levels for the duopoly case without delegation

$$\theta_1^* = \theta_2^* = \frac{(48 - 36b)(C - a)}{\left((9b - 8)^2 - 16\right)}$$

and for the duopoly with delegation to an overconfident manager

$$\theta_1^* = \theta_2^* = \frac{(8 - 12b)(C - a)}{27b^2 - 36b + 8}.$$

We can compare these to the monopoly case[12]

$$\theta_1^* = \frac{a - C}{2b - 1}$$

and to the social planner's R&D decision[13]

$$\theta_1^* = \frac{a - c}{b - 1}.$$

If we compare the duopoly with delegation to the duopoly without delegation we find that

$$\frac{(8 - 12b)(C - a)}{(27b^2 - 36b + 8)} > \frac{(48 - 36b)(C - a)}{\left((9b - 8)^2 - 16\right)}$$

holds for all $b > 1.567$, i.e. in the parameter region under consideration there is always more R&D investment in the case of delegation.

If we compare the duopoly without delegation to the monopoly case we find that

$$\frac{(36b - 48)(a - C)}{\left((9b - 8)^2 - 16\right)} > \frac{(a - C)}{(2b - 1)}$$

never holds for $b > 1.567$. I.e. in monopoly there is always more R&D investment. If we however compare the duopoly with delegation to the monopoly case we find that

$$\frac{(12b - 8)(a - C)}{(27b^2 - 36b + 8)} > \frac{(a - C)}{(2b - 1)}$$

holds for some interval of b, i.e. if $b \in \left[1.567, \frac{8}{3}\right]$. However, even under delegation we never reach the social planner's R&D investment as

$$\frac{(12b - 8)(a - C)}{(27b^2 - 36b + 8)} > \frac{(a - c)}{(b - 1)}$$

[12]See the Appendix for the derivation of this result. There it is also shown that a monopolist never wants to delegate decisions to an overconfident manager.

[13]See the Appendix for the derivation of this result.

never holds.

Though delegation can never lead to the first best investment in R&D it can for some parameter region improve upon the monopoly investment level. Proposition 5 summarizes the findings.

Proposition 5 *Delegation to overconfident managers is desirable from a welfare point of view as it increases the R&D spending as compared to non–delegation. For some intermediate values of b the investment level can even be higher than in the monopoly case.*

7.4 Extensions

Now, having analyzed the two polar cases of competition there are a number of extensions which could help to gain some valuable insights into the problem.

7.4.1 Separate Tasks

One could set up a model with two different tasks, one with strategic dimension and one purely operative in nature. Almost surely one would want different types to perform the different tasks. Whilst for strategic considerations an overconfident type should be found in positions with strategic significance, the holders of purely operative positions should probably better not be biased, as there is no (strategic) upside counterbalancing eventually distorted actions due to overconfidence. This could have possible implications for promotion policies for such different jobs or tasks. Krähmer (2003) and Goel and Thakor (2002) give some guidance on how to think about this problem.

7.4.2 Optimal Contracts

In this paper the focus was solely on the interfirm interaction whilst possible agency issues within the firm were neglected. It would be interesting to see how optimal contracts for overconfident managers look and how they interact with the market environment.

However, the interaction of optimal contracts with the market environment is a tricky issue even with fully rational agents.

7.4.3 Entry

Camerer and Lovallo (1999) show in an experimental study that overconfidence can lead to excessive entry in competitive markets. One could analyze this theoretically by incorporating the location decision and see how overconfidence distorts decisions in this.

7.5 Conclusion

The analysis has shown that two models of price and quantity competition, under some qualifications, both predict delegation to overconfident types. This contrasts the findings in the classic literature, e.g. Fershtman (1985) and Fershtman and Judd (1987), on strategic delegation where delegation under Bertrand and Cournot competition runs in different directions.

However, the two models in this chapter are quite distinct in their setup. Therefore, it would be desirable to find a common framework in order to analyze both problems and get clear predictions on common ground. It would be especially interesting to see whether the result by Miller and Pazgal (2001) holds in the framework with overconfidence as well. They show the equivalence of price and quantity competition under strategic delegation. Their intuition is that delegation makes competition more aggressive under Cournot and less aggressive under Bertrand competition. If now the contract set is rich enough the solutions to the two problems will coincide.

Already the two models in this chapter deliver testable predictions. First we find that overconfident managers are more likely to be found in industries with moderately risky R&D technologies. Second we find, that overconfident managers are more likely to be found in industries where strategic interaction plays a role. I.e. they should be less widespread in strongly differentiated or monopolized industries[14].

[14]Note, however, that if entry to the industry is possible overconfident managers might still find their

7.6 Apppendix

7.6.1 Second Order Condition for the Bertrand Case

Since B does not affect the optimal choice of θ_i, we normalize it to one to ease notation. A symmetric equilibrium exists in which the optimal degree of delegation is given by the above derived equations

$$\begin{aligned} h(0)\cdot 0 + H(0) &= h(k_1)B \\ h(0)\cdot 0 + 1 - H(0) &= h(k_2)B. \end{aligned}$$

Note that $H(0) = \frac{1}{2}$. Thus we get

$$h(k_1) = h(k_2) = \frac{1}{2B}.$$

Note that these equations do not uniquely characterize the exact equilibrium values since $h(\cdot)$ is symmetric around 0 and therefore there may exist two values of k_i satisfying the conditions above. A look at the second order conditions however confirms that only delegation to an overconfident type will occur in equilibrium.

The second order condition for firm 1 is given by

$$\begin{aligned} \frac{\partial^2}{\partial k_1 \partial k_1} &= h'[h(k_1) - h(k_2)][h(k_1) - h(k_2)]h'(k_1) + h'(k_1)h[h(k_1) - h(k_2)] \\ &+ h[h(k_1) - h(k_2)]h'(k_1) - h'(k_1), \end{aligned}$$

which can be rearranged to

$$h'(k_1)\left\{h'[h(k_1) - h(k_2)][h(k_1) - h(k_2)] + 2h[h(k_1) - h(k_2)] - 1\right\}.$$

Now focus on the second order condition at the symmetric solution to the first order condition. We obtain

$$h'(k_1^*)\{2h(0) - 1\}.$$

place.

Since $h(0) > \frac{1}{2}$ has to hold to ensure existence, $h'(k_1^*) < 0$ must hold for the second order condition to be satisfied. Note that $h'(\cdot) < 0$ only if $k_i > 0$, hence the result that $k_1^* > 0$.

For completeness we check the second order condition of firm 2 as well

$$\frac{\partial^2}{\partial k_2 \partial k_2} = h'[h(k_1) - h(k_2)][h(k_2) - h(k_1)]h'(k_2) + h'(k_2)h[h(k_1) - h(k_2)] \\ + h[h(k_1) - h(k_2)]h'(k_2) - h'(k_2),$$

Rearranging and focussing on the symmetric solution gives us the following condition

$$h'(k_2^*)\{2h(0) - 1\},$$

which by the argument above again implies delegation to an overconfident manager.

7.6.2 Second Order Condition for the Cournot Case

The second order condition is given by

$$\frac{\partial^2 (\Pi_i)}{\partial A_1 \partial A_1} = \frac{3456b^2 - 2560b - 1296b^3 + 512}{2304b - 13\,824b^2 + 28\,512b^3 - 23\,328b^4 + 6561b^5}$$

Inspecting Figure 7.3 shows that the condition is far from well behaved. For $b \leq 1.567$ we get corner solutions either at $A_i = a$ or $A_i = \overline{A}$ where $\overline{A}$ is implicitly defined by $\theta_i^*(A_i) = C$.

Comparing the profits for a and $\overline{A}$ shows that the nature of the corner solution depends on the difference $(a - C)$. For small differences we are more likely to get $A_i = a$ and for larger differences we get $A_i = \overline{A}$ as the symmetric equilibrium.

Looking at Figure 7.4 in contrast ensures that for $b > 1.567$ the second order condition is strictly negative and the problem is well behaved.

7.6.3 Derivation of θ_M for the monopoly case

The monopolist solves first for the solution to

$$\max_{q_M} \Pi_M = ((a - b(q_M)) - (C - \theta_M))\, q_M - \frac{1}{2}(\theta_M)^2$$

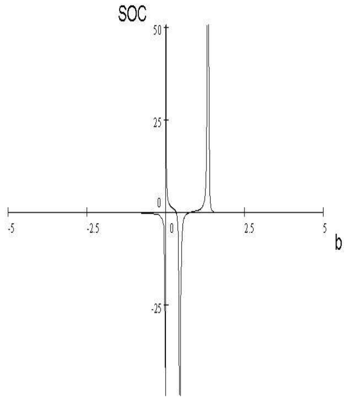

Figure 7.3: Second Order Condition – Overview

which gives his optimal quantity

$$q_M = \frac{a - C + \theta_M}{2b}.$$

From that we get the equilibrium profits as a function of R&D spending θ_M .

$$\max_{\theta_M} \qquad \Pi_M = \frac{(a - C + \theta_M)^2}{4b} - \frac{1}{2}(\theta_M)^2$$

Differentiating with respect to gives us the optimal R&D investment

$$\theta_M^* = \frac{a - C}{2b - 1}$$

and we can derive the monopolists profit

$$\Pi_M = \frac{(a - C)^2}{(2b - 1)}.$$

We briefly address the question whether a monopolist would ever want to delegate to an overconfident manager. To check this we plug in equilibrium the values for θ_M with $A_M > a$ in the monopolists problem:

$$\theta_1^* = \frac{A_M - C}{2b - 1}$$

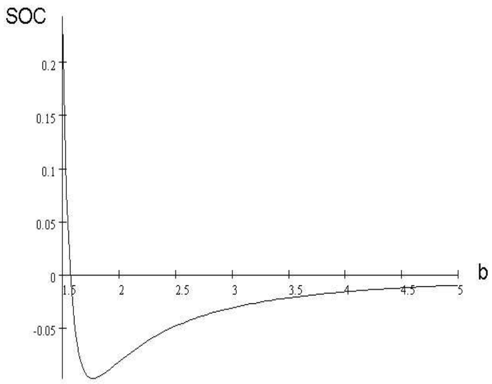

Figure 7.4: Second Order Condition – details

$$\max_{A} \Pi_1 = \frac{\left(a - C + \frac{C - A_M}{1-2b}\right)^2}{4b} - \frac{1}{2}\left(\frac{C - A_M}{1 - 2b}\right)^2.$$

Solving for A_M^* gives

$$A_M^* = a$$

and we can conclude that a monopolist never delegates. Absent the strategic rationale for doing so that comes at no surprise.

7.6.4 Derivation of θ_{SP} for the Social Planner

The social planners would offer $q_{SP}^* = \frac{(a+\theta_{SP}-c)}{b}$.

Thus his initial problem

$$\underset{\theta_{SP}}{max} \Pi_{SP} = \frac{1}{2} q_{SP} \left(a - C + \theta_{SP}\right) - \frac{1}{2} \left(\theta_{SP}\right)^2$$

becomes

$$\underset{\theta_{SP}}{max} \Pi_{SP} = \frac{1}{2} \frac{\left(a + \theta_1 - c\right)}{b} \left(a + \theta_{SP} - c\right) - \frac{1}{2} \left(\theta_{SP}\right)^2.$$

From the resulting first order condition we can easily solve for the efficient R&D spending

$$\theta^*_{SP} = \frac{a - C}{b - 1}.$$

Chapter 8

Concluding Remarks

When I started to work on this thesis four years ago I was, after writing my *Diplomarbeit* on reciprocity, very much interested in behavioral economics. My first paper, which became chapter 2 of this thesis, was in fact in this field. Whilst working on this paper, during my PhD course work, attending conferences and summer schools and particularly in the beginning of my one year spell in London, my enthusiasm for behavioral issues attenuated significantly and I turned again to standard theory.

At some point, however, I became again interested and now I firmly believe that it is the combination of those two fields - mainstream and behavioral economics - which promises to yield a large crop. Amending standard models carefully with well–founded facts from behavioral, experimental and psychological studies will help us develop better models of economic behavior and will improve our ability to give good policy advice.

Especially in the fields of Corporate Governance and Organizational Economics this shall prove to be a fruitful avenue to pursue. I hope the papers in this thesis will prove to be at least humble contributions to our voyage on this avenue.

Chapter 9

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Lebenslauf

Persönliche Angaben

Name:	Florian Englmaier
Geburtsdatum:	6 Juli 1974
Geburtsort:	Rosenheim / Oberbayern
Staatsangehörigkeit:	Deutsch

Schulischer Werdegang

1981 - 1985	Grundschule Prinzregentenstrasse, Rosenheim
1985 - 1994	Finsterwalder Gymnasium, Rosenheim; Abitur (Note: 1.0)

Akademischer Werdegang

1996 - 2000	Studium der Volkswirtschaftslehre Ludwig–Maximilians-Universität München Diplom-Volkswirt (Abschlussnote: 1.37)
seit 09 / 2000	Wissenschaftlicher Mitarbeiter am Seminar für Versicherungswissenschaft der Ludwig–Maximilians-Universität München
2002 - 2003	Marie Curie Fellow am University College London (UCL)

Sonstiges

1994 - 1995	Zivildienst im Klinikum Rosenheim

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