Reputation and Competition in Organisations and Markets

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Abstract

This thesis investigates the effects of competition in settings where agents are motivated primarily by reputational concerns. This is typically the case when explicit contracts are difficult to write due to the lack of verifiability of the task performed by the agent, or of output quality. Such situations are widespread in the case of expert advice or professional services. Competition can generate interesting effects when interacting with reputational incentives. The first chapter contains a selective review of the literature on reputational incentives and on the market for expert advice. The second chapter analyses how competition affects the incentives to report truthful information of experts competing to influence a decision maker. The complex interaction between reputational incentives and competition provides important implications for organisational design, and there are situations when delegating decision powers, or adopting forms of favouritism improve upon letting experts communicate their information and compete to influence the decision maker. The third chapter contains an analysis of the effect of competition on the incentives of an important class of experts, financial analysts. A theoretical model is developed to highlight how the behaviour of sell side analysts is affected by the presence of non - sell - side analysts. The predictions of the model are then tested on a dataset of financial analysts recommendations. The main result is that stronger competition decreases the degree of optimism of sell side analysts. Finally, the fourth chapter investigates the effect of entry in a market for experts where customers have different valuation for the service and there is positive sorting, so that higher valuation clients prefer to be served by more reputable experts. The main result is that entry decreases effort incentives for more reputable agents, unless the type of customers also affects the likelihood of successful provision of the service.

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This thesis is dedicated to my parents who greatly supported and encouraged me throughout this "journey".

Preface

The role of experts has become progressively more important in modern economies. Firms, consumers, investors, public organisations increasingly rely upon experts to acquire information or professional services. Correspondingly, the economic analysis of the market for experts and for information transmission developed greatly. Most transactions involving experts reporting information or performing a professional activity are characterized by the impossibility to explicitly contract the content of the performance. Sometimes, experts provide an experience good whose value for the client becomes known after the transaction took place. Often experts may have a vested interest to induce the client to make a decision and conflicts of interest may arise. In all such situations reputational concerns play a critical role in providing incentives for experts to offer a service or specialistic information at their best and in the interest of their "principal". The impact of competition on the incentives created by reputational concerns is an important element in the analysis of the workings of markets for experts. Experts interact not only in the market place, but often also within organisations. The flow of information inside organisations relies upon the reports of agents specialized in performing specific tasks who acquire private information important for the decision making of the whole organisations. It is seldom possible to provide explicit incentive schemes to motivate such agents to report their information truthfully, and they are often motivated by reputational concerns. Then, the investigation of the interaction among experts competing to influence a decision maker is relevant also for the optimal design of institutions and decision rules.

This thesis investigates the effects of competition on the incentives of experts, motivated by reputational concerns, and possibly having conflicts of interest with their principal, to report information truthfully or to provide a high quality service. The thesis investigates the activity of experts in both market and non market settings. The first chapter contains a brief overview of the literature on reputational incentives and on the market for expert advice, especially underlying results that are not examined in detail in the main chapters of the thesis. The second chapter investigates the interaction between competition and reputational incentives and derives implications for organisational design, showing that delegation and favouritism can arise to improve the flow of information within the organisation. The third chapter contains an application of some of the results derived in the second chapter to the market for financial analysts recommendations. A model is derived to investigate how the behaviour of analysts (experts) who can have a stronger conflict of interest with investors (decision makers) is affected by competition from other analysts who are less informed but have more tenuous conflicts of interest with investors. The predictions of the model are empirically tested on a sample of recommendations about Initial Public Offerings (IPOs) in the United States during the period January 1995 to June 2002. The empirical evidence shows that analysts affiliated with the lead underwriter of the IPO (who can be expected to have stronger conflict of interests with investors) tend to issue less optimistic recommendation when analyst not affiliated with the lead underwriter of the IPO cover the same stock. The chapter also provides evidence suggesting that the optimism shown by affiliated analysts cannot be attributed to psychological biases, and is thus likely to be induced by the incentive system in place. The fourth chapter investigates the effect of entry in a market for experts who provide consumers with a service whose quality depends upon the unobservable talent and costly effort of experts. Increased entry of experts induces heterogenous consumers to sort, and this impacts the equilibrium fees both in the current period, and, crucially, in future periods. The latter impacts reputational incentives to provide a high quality service in the current period. Sorting of clients can also affect the informativeness of a successful provision of the service as a signal of experts' talent. Finally, sorting of clients can also affect the degree of complexity of the service to be provided, and thus the marginal efficiency of effort. These are additional channels through which entry, by inducing changes in clients' sorting, can affect incentives to exert effort. The model shows that in most cases increased entry of new experts reduces incentives to exert effort to provide a high quality service and identifies situations in which competition can instead be beneficial in fostering the provision of high quality services.

The main message of the thesis is that competition can have an ambiguous impact on the incentives of experts motivated by reputational concerns. The thesis shows situations in which competition may be beneficial in spurring incentives for "good" behaviour, and other situations in which it is detrimental. The thesis highlights the main forces generated by competition in its interaction with reputational concerns, and it may therefore provide guidance for regulators and policy makers interested in identifying situations when competition should be fostered and situations when it should be constrained.

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Chapter 1

Reputation and Competition: a Brief Overview of the Literature

The literature on reputational incentives and that on the economics of expert advice and services are very large. However, the interaction between the incentives created by competition among experts and the incentives created by reputational concerns have been left largely unexplored. This interaction is very important in practice as it is often the case that experts compete to provide a service or information to other uninformed parties, both within organisations and on the marketplace. The way competition impacts the incentives to build, or keep, own reputation has critical implications for the incentives of experts to provide their advice or service at the best standard for final users. This introduction briefly overviews the existing literature trying to highlight the issues that represent the starting point for this thesis. I firstly discuss the most relevant contributions on the effects of competition on incentives. Secondly, I present a short review of the literature on reputational concerns. Thirdly, I outline a brief description of the main issues in the economics of markets for expert advice. Finally, I discuss how the analysis of the thesis relates to the literature. Each chapter of the thesis contains a more detailed review of the literature relevant for the topics treated within the chapter.

1.1 Competition and Incentives

This thesis is related both to the literature on incentives and product market competition, and to that on tournaments as incentive schemes. Strictly speaking, the latter involves competition among agents, while the former involves competition among principals, and, indirectly, among agents working for each different principal[1]. However, the insights of the early literature on incentives and product market competition are applicable to competition among agents (e.g. managers) inside an organisation.

The first contributions to this literature focused on the role of competition or tournaments as providers of information that allows principals to use relative performance evaluation to incentivise agents. Lazear and Rosen (1981) showed that tournaments, which provide a stark form of relative performance evaluation, are efficient when agents are risk neutral. However, Green and Stokey (1983) proved that this result does not hold when agents are risk averse and tournaments are typically not even second best in this case. Another drawback of tournaments is that fostering competition among agents may undermine co-operation and induce various kinds of "dysfunctional" behaviour like destroying or hiding output produced by other competing agents. Itoh (1991) shows that reducing competition among agents may be beneficial when cooperation is necessary to generate output. Holmstrom (1982 - I) underlined that relative performance evaluation may be useful in filtering out noise from a performance measure, thus reducing the costs of providing incentives in a standard moral hazard model with a risk averse agent. Competition may be useful in providing such information. Hart (1983) shows that competition may reduce managerial slack in a somewhat special environment. However, Nalebuff and Stiglitz (1983), Scharfstein (1988) and Hermalin (1992) argue that the effects of competition in providing incentives in agency problems are ambiguous. All these contributions mainly stress the role of competition in enhancing the information available to principals to evaluate the performance of agents. The main focus is on the design of optimal explicit incentive schemes. Most of these results can be applied to competition among agents within an organisation and are not specific to product market competition.

Schmidt (1997) enlarges the focus. In his work, more competition has no informational benefit, but enhances incentives through two effects. The first is the desire to avoid costly liquidation[2], which induces agents to exert more effort to reduce production costs as this decreases the likelihood of being liquidated and it is assumed that competition raises the impact of cost differences on the probability of being liquidated. On the other hand, changes in competition alter the value of inducing a cost reduction. In other terms, changes in competition modify the optimal incentive scheme, and principals may find it optimal to induce a lower effort level as tougher competition decreases the benefits from reducing costs[3]. Raith (2003) elaborates on this point and shows that when the

[1] Of course also in this case there can be multiple agents working for a principal and competing for a promotion.

[2] Schmidt (1997) assumes that liquidation imposes a turnover cost on the manager, but the same result would hold if the manager enjoys private benefits from being in charge and liquidation had no cost. Then the cost of liquidiation would be the loss of private benefits.

[3] The results of Schmidt (1997) can still be applied to competition within an organisation if costly

market structure is endogeneized, taking into account entry and exit of firms, tougher competition, modelled as higher product substitutability, induces stronger incentives to exert effort aiming at reducing costs[4]. This literature focuses on situations where explicit performance contracts can be offered. Two recent papers analyse the role of competition in settings where incentives are provided by reputation. Horner (2002) shows that competition strengthens reputational incentives as it provides principals with the option to switch to different agents. This enforces repeated exertion of good behaviour even when much has been learnt about an agent's type and reputational incentives would therefore fade out. Park (2005) analyzes a repeated cheap talk model and shows that competition may reduce the sustainability of an equilibrium with honest transmission of information. Park (2005) and Horner (2002) differ critically in the way of modelling reputation. Park models reputation in a folk theorem sense as reputation consists in playing the ("cooperative" or "good") equilibrium strategy. Competition reduces the continuation value to abide by the strategy of reporting information honestly. Horner (2002) on the contrary models reputation as an asset. The agent has an intrinsic type and principals learn information about it over time. Agents are thus motivated by the desire to be perceived as being of the "best" type and this provides incentives to exert effort. The difference in the modelling of reputation is an important point and it is discussed at further length in the next section.

1.2 Reputational Incentives

There exists a large literature on reputational incentives, and different ways to model reputation have been proposed. Bar-Isaac (2004) suggests the literature used three main approaches to model reputation. The first is reputation as beliefs. Agents are characterized by some unknown characteristic (type) which is learnt over time. This characteristic can be unknown to the agent herself. The agent can take some action which is more likely to produce an output providing favourable information about her type, where "favourable information" means "information that raises the likelihood the agent has a type which is more valuable to principals". Agents face a trade off between a larger payoff in the current period which can be obtained by taking an action that harms her reputation, and a lower payoff in the current period which provides the benefit of raising the chances that her reputation increases. This in turn allows the agent to profit more from future interactions

liquidation is interpreted as the loss of private benefits for the agent, while profits of agents are interpreted as performance schemes, or private benefits, of higher level managers, such as heads of a division. The latter should also have the freedom to choose the compensation mechanism being offered to employees within their division.

[4]Raith (2003) also provides results on the important topic of the relationship between risk and incentives.

with the principal(s). There is an early literature employing this approach to modelling reputation, including the classical papers of Kreps and Wilson (1982) and Milgrom and Roberts (1982). For reputation to have a role, there must exists some uncertainty about the type of the agent. Mailath and Samuelson (2001) provide a clarifying treatment of this point and Mailath and Samuelson (2006) offer a review of the literature. The second approach to reputation, according to the taxonomy of Bar-Isaac (2004) is viewing reputation as a commitment device in an infinitely repeated game, and reputation is intended as "reputation for playing the cooperative equilibrium in previous periods". Reputation here is used to interpret the play of one of the equilibria of an infinitely repeated game, but has no value in itself. An early example in this line is the classical paper by Klein and Leffler (1981). Finally, Bar-Isaac (2004) suggests that reputation can be viewed as a coordination device. Reputation allows players to coordinate actions and expectations, so that a particular equilibrium could arise in settings where multiple equilibria are possible. In my view the third and the second approaches to modelling reputation are similar, and much less appealing than that of reputation as beliefs which is at the basis of most of the recent literature on reputational incentives.

Part of the literature assumes that agents are informed about their type, so that there exists both an hidden action and an hidden information problem. This literature typically posits that there is a commitment type and one or more opportunistic, or biased types who may want to pool with or separate from the commitment type. Another strand of the literature assumed that agents do not know their type, so that the agency problem is one of hidden action, and all players are symmetrically uninformed about an agent's type. The latter route has been taken by the original literature on career concerns which started to address the issue of whether market forces could solve moral hazard problems. Holmstrom (1982 - II) showed that this is not the case, although reputational incentives can alleviate agency problems. He also underlined that such incentives fade out as learning about the agent type becomes more precise. Dewatripont, Jewitt and Tirole (1999 - I and 1999 - II) clarify most of the issues about the role of the information structure, generalize the results of Holmstrom (1982 - II) and provide additional results about multitasking and several applications.

Following the seminal contribution of Holmstrom the literature developed along different lines, and I will discuss those that are most relevant for this thesis. The first is the interaction of reputational incentives with other kind of incentives. Gibbons and Murphy (1992) investigate the interaction of implicit and explicit incentives in a "traditional" moral hazard problem with a trade off between risk and incentives. In this setting risk includes also the uncertainty about the type (talent) of the agent, and not only that inherent in the realization of the performance measure. They derive an optimal incentive contract showing that explicit incentives should be stronger later in the career when reputational incentives become weaker as more information about the type of the agent is revealed. This is the first example analysing the interaction of reputational incentives with other incentives. The second is the importance of distinguishing among reputation of individuals, reputation of firms, reputation of groups (collective reputations). This issue is relevant for this thesis, as there are some interesting contributions showing the impact of organisational design on incentives. Organisational design modifies the way external evaluators in the market observe the performance of an agent, and thus the extent to which career concerns provide incentives. A recent interesting contribution is Harstad (2007) who investigates the interplay between product market competition, organisational design and reputational incentives. He shows how different market structures affect the choice of organisational form and how that is optimally chosen to optimise reputational incentives. The latter depend upon the exposure of the worker to the external labour market and that in turn depends upon the transparency of the organisation. Other papers discussing the interaction between organisational form and learning about an agent's talent are Demougin and Siow (1994), Meyer (1994), Jeon (1996) and Carrillo (2003). In all these papers organisational form is important in that it affects the way information about the agent performance gets transmitted either inside, or outside the organisation. The third is the dark side of reputational incentives. An early contribution in this direction is Holmstrom and Ricart-i-Costa (1986) who show that career concerns may induce agents to have different preferences towards risk than principals. Scharfstein and Stein (1990) showed that career concerns may induce herd behaviour, and their result is further analyzed by Ottaviani and Sorensen (2000). These authors investigates this issue further and show (Ottaviani and Sorensen 2006 - I, 2006 - II and 2006 - III) that agents may distort the information they transmit in order to appear more talented. In their setting, experts just provide information and are not affected by the decision made. Thus, experts have no gain, in terms of higher current period payoff by misreporting their information. The distortion stems exclusively from the desire to show the market they observed a precise signal about the state of the world. Two very interesting contributions investigate distortions induced by the desire to pool with, or separate from, a given type of agents. Morris (2001) and Ely and Valimaki (2003) show that the presence of reputational concerns may distort the incentives of agents who would otherwise have preferences aligned to those of principals. In these models there is an action which is always preferred by a type. Then, "unbiased" types prefer not to take that action in order to increase their reputation as "unbiased" types, even if that action raises their current period payoff. Other interesting contributions in this direction are Levy (2004) who shows that careerist decision makers can inefficiently try to differentiate themselves to signal their talent, Levy (2005) proposing an interesting application of this mechanism to the judiciary, Prat (2005) showing that transparency may raise reputational concerns and distort decision making by inducing agents to act in a conformist way[5], and Levy (2007) who is concerned with the design of optimal decision making rules in committees made by agents motivated by reputational concerns. Finally, Acemoglu, Kremer and Mian (2006) investigate how the incentives created by markets, firms, and governments, each characterized by a different degree of transparency, interact with reputational incentives and induce agents to take actions which inflate performance measures but do not create any value for principals.

These contributions do not explicitly investigate the effects of the interaction of competition and reputational incentives, but some of them implicitly suggest that if the agency relationship was "exclusive", some of the negative effects generated by reputational incentives could be dampened. For example, in Scharfstein and Stein (1990) if the second agent was not able to observe the decision of the first, and this is likely to happen in a non market setting, then she would use her information efficiently. Also, market forces may affect the survival of certain types of agents, so that distortions induced by the desire to pool or to separate may change over time. For example biased types may be forced to exit the market at a higher rate as competition becomes tougher, and then unbiased types may have less incentives to distort their actions in order to separate from biased types. On the other hand, if appearing as a biased type entails a larger risk of being kicked out of the market, competition may raise the distortion induced by the desire to separate from biased types. However, this issue has not received a formal investigation in the literature, and it may be a possibly fruitful route for future research.

1.3 Markets for Experts

There is a relatively large literature studying markets for expert services. Dulleck and Kerschbamer (2006) provide a thorough critical review of the existing literature, and this section draws heavily on their work. The literature developed to analyse the market for the provision of credence goods. Darby and Karni (1973) define credence goods as goods and services for which the provider of the good (the expert) has better information about the needs of the consumer than the consumer herself. Often the output of such goods is difficult to verify and contracts based upon performance measures are not frequent. Typically the literature distinguishes the provision of the diagnosis from the provision of the good or service. The informational advantage of experts can give rise to two forms of inefficient provision of the good or service. The first is *undertreatment,* occurring when the consumer gets a service at a standard which is not sufficient to solve her problem, or the opposite problem of *overtreatment,* occurring when the consumer gets a service at a

[5] Prat (2005) also underlines the importance of distinguishing between information about the consequences of the agent's action and information directly on the agent's action.

standard which is too high with respect to her need. The second is *overcharging,* occurring when the consumer pays too much for the service that was actually provided. The latter is different from overtreatment because the consumer gets the treatment she needs, but is charged as if she got a more expensive treatment. This implies that *overcharging* can arise if the treatment provided is not verifiable to court. On the contrary *over-* or *undertreatment* can arise even if the treatment provided is verifiable as long as the correctness of the diagnosis, or the true needs of the customer cannot be verified to court.

The existing work in the area is heterogeneous. There are many differences in the technology assumed for the provision of the service, in the market structure under which experts operate, in the degree of verifiability of the service and diagnosis provided, and in the extent to which the expert is liable in case of malpractice. The main focus of the literature is on the conditions ensuring that equilibria with honest provision of the service arise. In general such equilibria exist if either the quality of the provided treatment is verifiable, or experts are liable so that they cannot provide less treatment than contracted, and consumers are homogeneous. When some of these assumptions are relaxed, inefficiencies arise. If both liability and verifiability do not hold, consumers face a lemons problem and the market may break down. Another important assumption is that consumers can commit to undergo treatment once a diagnosis has been performed. When that assumption is dropped, equilibria are characterized by inefficiencies induced by duplication of either search or diagnosis costs, or both.

Typically this literature does not consider reputational concerns as an incentive mechanism. A partial exception is Wolinsky (1993) who models reputation as playing the "honest" equilibrium in an infinitely repeated game. Another exception is Ely and Valimaki (2003) who model reputational incentives in a market for expert services (car repairs by mechanics), but they are not concerned with the effects of competition or of changes in marker structure. Reputational incentives can be a way to ensure that an equilibrium with honest treatment exists, even if verifiability and liability does not hold. In practice reputational considerations seem to be important in markets for experts. In fact it is often difficult to verify whether the expert provided the service at the agreed level, or whether the expert provided the appropriate service. The fact that reputational concerns are important is signalled by the fact that in some of such markets there exist league tables for experts, like in the market for investment banking services, while in other markets word of mouth advice or consumer reviews are a common way for customer to gather information about which expert to choose. Another important aspect that has been largely overlooked by the literature is consumers' heterogeneity. The latter can have important consequences on the equilibrium fees through the way consumers sort into experts of differing perceived quality. In turn equilibrium fees are critical in determining the incentives of experts.

1.4 This Thesis and the Literature

This thesis focuses on settings where explicit incentives are not available due to the non verifiability of the activity performed by agents, and incentives are provided by reputational concerns. Typically an agent faces a trade off between enjoying a gain in the current period by taking an action that reveals unfavourable information about her characteristics, and foregoing that opportunity to enhance her reputation. Competition impacts the value of both actions, and therefore the incentives to build a reputation. In contrast to much of the literature, competition does not necessarily provide more information about an agent's type. That is surely an important aspect, and it has been extensively studied by both the literature on incentives and product market competition, and by the literature on reputational incentives. However, this thesis shows that competition induces other important effects, by altering the value of building own reputation, on top of providing more information about an agent's performance or type. This is quite a different approach from that taken by the traditional literature on tournaments, on product market competition and incentives, and on reputational incentives. This approach is similar in spirit to Schmidt (1997) as competition alters the value of choosing the "desirable" behaviour, but it does so in a context where explicit incentives are not feasible.

The second chapter of the thesis investigates in detail the effects of competition on reputational incentives. This topic has been analyzed by Park (2005), as he shows that competition reduces the value of having a reputation. Moreover Park deals with a setting where explicit incentives schemes are not feasible. However Park (2005) models reputation as a commitment device in an infinitely repeated game, and there is no issue of asymmetric information or learning about an agent's type. On the contrary, in this thesis reputation is modelled as an asset and the principal interacts with the agents as a function of their reputation. In some cases (for examples in chapters 1 and 2), when the reputation of an agent is too low, the principal stops interacting with the agent forever. In the paper of Park (2005) the principal knows the type of an agent after a deviation, but may decide to revert to interact with her after the "punishment phase" is over.

The second chapter of the thesis also provides implications for organisational design. The latter has a role in that it can act as a commitment device for the principal to grant agents power to influence decisions. This is close in spirit to the important contribution of Aghion and Tirole (1997) on delegation of authority, but it is pretty much different in the set up and in the fact that the main source of incentives are reputational concerns. The chapter is also close to the idea that organisational form responds to the problem of fostering the transmission of relevant information within the organisation. Dessein (2002) shows how delegation can be preferred to communication as the latter entails a loss in the amount of information that can be transmitted in equilibrium. The chapter builds on the work of Dessein (2002) by introducing dynamics, asymmetric information about the motives of the informed parties, and multiple informed parties. The chapter shows that different organisational forms affect learning about agents' types. Delegating decision powers shuts down information about the agents who are not delegated decisions. This point recalls the results of the literature investigating how organisational form impacts the availability of information about agents performance.

The third chapter of the thesis provides specific results on the effects of competition among financial analysts on the degree of optimism of their recommendations. This is a novel contribution to the literature as no previous work analyzed either theoretically, or empirically, whether competition relaxes conflicts of interests between investors and analysts. The literature on the distortion generated by the desire to be perceived as talented may provide some guidance on this issue. If tougher competition raises the gains from being perceived as especially talented, then analysts may tend to bias their forecasts more. However, the mere presence of multiple analysts is not sufficient to generate effects on the incentives of each single analyst as shown in Ottaviani and Sorensen (2006 - III). This thesis takes a different approach. Competition reduces the current gains of reporting distorted information, because if investors observe multiple reports, and some of these are conflicting, each report will have a weaker impact on their investment strategies. The literature on reputational cheap talk instead attributes the distortion created by reputational concerns (which can be maybe exacerbated by tougher competition) to the process of Bayesian updating through which agents type is evaluated. That induces agents to distort their information.

The fourth chapter provides results about the effect of entry in a market for expert advice where experts are motivated by reputational concerns. The chapter shows how entry impacts on the incentives to provide a high quality service. The economic forces at work are different from those prevalently studied by the literature on expert advice. In fact, the chapter introduces the possibility that consumers differ in their valuation for the service. This, in turn implies that in equilibrium clients sort into experts of different reputation. Then, entry affects the sorting behaviour of clients and in this way the equilibrium fees. This affects the payoff from building a reputation and consequently the incentives to provide a high quality service.

Chapter 2

Competing Influence

2.1 Introduction

This chapter aims at a better understanding of delegation and favouritism in organisations through the analysis of the incentives created by competition to influence decision making. This chapter argues that the choice between delegating decision powers versus relying on communication of information from multiple experts is crucially shaped by the incentives created by competition for influence. The results are based on the analysis of the effects of competition in a dynamic game of information transmission where those senders (experts) who have a conflict of interest with the decision maker are motivated by reputational concerns to report information truthfully. The novel theoretical feature of this chapter is that it introduces multiple senders in this framework and identifies two conflicting forces generated by competition among senders. On the one hand competition for influence induces a reduced influence effect: biased senders will have less chances to influence decision making both in the current and in the future period. Reduced future influence decreases biased senders' incentives to maintain an untarnished reputation as the presence of competitors makes it less likely that a sender who behaves in the present is able to cash in the benefits of her undamaged reputation. Reduced current influence limits a biased sender's opportunity to mislead the decision maker in the current period and increases his incentives to report information truthfully. On the other hand competition generates a lost reputation effect which has an ambiguous impact on truthtelling incentives: a sender fears other senders gaining more influence as his own reputation flutters when other senders may have non congruent preferences with his own. However, if the decision maker has no reliable senders she may choose an action that harms the sender. The balance between these effects is ambiguous and facing multiple senders is not always beneficial for the receiver. This result has important implication for organizational choice. Organisations can decide to let agents compete to influence decision making, thus aggregating all the available information. When the reduced future influence effect is very strong, however, organisations might find it optimal to commit to delegate decision powers to only one sender. The model shows that experts might be delegated decision powers on certain tasks in order to limit competition for influence and spur truthtelling incentives. The model also shows that it can be optimal to commit to bias the competition for influence as favouring one of the experts helps creating additional incentives to report information truthfully. Although favouritism characterizes the every day life of many organizations, it has received little attention in formal economic analysis and this work shows it could arise as a rational organizational response to the problem of fostering truthtelling incentives. Finally, the model shows that different organisational forms are preferred as a function of the importance of the decision at stake. In particular, delegation should be used when the importance of the decision is neither very low nor too high. In the latter situations it is optimal to aggregate different opinions, so that decision makers will be better off relying upon communication of information.

The results can be applied to describe many real world situations in which a decision maker relies on the information provided by experts who may have a vested interest in inducing some decisions. A major application is the analysis of resources allocation within a firm: the chief financial officer, CFO (the decision maker), is allocating funds among projects in a firm and wants to elicit information about such projects from project leaders (experts) in order to allocate funds to the most promising project. However, project leaders may derive a private benefit if more funds are allocated to the project they work on. This chapter shows how the incentives of project leaders to report the truth change if the CFO collects information from all competing projects leaders and centralizes the decision as opposed to delegating decisions to one project leader. The results of the chapter can be applied to describe other interesting economic interactions such as: politicians competing to be elected, lobbies willing to influence politicians, financial analysts providing information to investors, investment banks providing advice to corporate clients.

2.1.1 Related literature

The analysis of this chapter is related to the literature investigating the transmission of information from possibly biased experts. The contribution of Sobel (1985) is especially related. Sobel investigates the incentives for reputation building in a finite horizon model where the only sender is perfectly informed about the state of the world. The sender can have perfectly aligned incentives with the decision maker or perfectly opposed interests.

Sobel derives conditions ensuring the existence of a truthtelling equilibrium and illustrates an application to a lender-borrower relationship. Benabou and Laroque (1992) is also related as they extend the framework of Sobel (1985) by allowing the sender to observe a noisy signal about the state of the world. This allows them to generate more realistic dynamics for reputation. The present work differs from these two contributions as it introduces a second informed sender, and then is extended to allow for n senders, so that truthtelling incentives are created both by the desire to keep a reputation and by competition for influence (which can also harm truthtelling incentives). Finally, it differs in the way the bias of senders is modelled: in both Sobel and Benabou and Laroque a biased sender always has a conflict of interest with the decision maker, while in this model senders always prefer a given decision which might coincide with the preferences of the decision maker according to the realization of the state of the world. This can be a more interesting way to model the preferences of experts in many applications.

The work of Horner (2002) is also related as he shows how reputation and competition interact to create incentives for "good" behaviour. He analyses a model featuring both moral hazard and adverse selection where "good" agents are able to produce a high quality product at some cost. Competition has the role of enforcing a good behaviour (production of goods of high quality) because it creates an outside option for consumers: they will switch to a different producer upon receiving a low quality good. This allows to preserve incentives for good behaviour even when reputational incentives fade out as uncertainty about a producer's type dissipates. The present model is different as it deals with an environment where monetary transfers are not allowed, so that the economic forces at work will have a different bite on the incentives of the informed parties. Furthermore, the uninformed party can observe the good (the information) produced by all the informed parties. Finally, Horner does not discuss the implications of the interactions of reputational incentives and competition on organisational form, in particular on the choice of delegating authority.

The latter issue is investigated by a large and rich economic literature, with Aghion and Tirole (1997) being one of the most important contributions, but few papers deal with settings where transfers are not allowed and the rationale for delegation is based upon the desire to improve the transmission of information within an organisation. The contribution of Dessein (2002) is the first to discuss delegation in a cheap talk setting. Dessein compares the use of delegation in contrast to communication in a model a la Crawford and Sobel (1982), where the sender's bias is public knowledge. Delegation is shown to improve upon communication as the latter involves a garbling of information due to the sender bias. In the contribution of Dessein delegation always improves upon communication when the latter is feasible and the true state is distributed uniformly. Under more general distributions, communication can improve upon delegation when the bias of the sender is large with respect to the uncertainty of the environment. Using numerical simulation he shows that *"only if communication is very noisy it beats delegation"*. On the contrary, the present work shows that sometimes communication (letting the agents compete for influence while the receiver chooses the course of action) is preferable to delegation, depending on the importance of the decision and independently of the bias of the experts (which is unknown in this model). This model also shows that a combination of communication and delegation can improve upon both pure communication and pure delegation. This seems to be a broader view of organisational life, as delegation and communication coexists in practice and the choice between the two is often dictated by the importance of the decision at hand, as predicted by the model[1]. A few recent works analyse the optimal design of delegation as a way to promote information transmission. Alonso and Matouschek (2007 - I) investigates the optimal design of decision rules and show situations in which agents are delegated decision powers as a function of their bias. They also show that agents can be delegated power over some decisions and that rules may contain gaps. Alonso and Matouschek (2007 - II) analyze a repeated interaction between a principal and an agent and show how optimal decision rules evolve as a function of the principal commitment power to use the information provided by the agent. Both papers do not discuss the effects of competition and in both papers reputational incentives are absent as the bias of the agent is known.

Melumad and Shibano (1991) and Szalay (2005) also provide related results. They investigate whether the decision maker can improve information transmission by committing to follow certain decision rules. Both papers, however, do not deal with competition and rather focus on the role of the alignment of interest between the sender and the decision maker.

This chapter is related to the literature on favouritism. There exists a few papers in economics dealing with this issue: the literature mainly developed in sociology and to the best of my knowledge, there are only two contributions from economists in the area. The first is Prendergast and Topel (1996) who show that allowing managers to reward their favourite employees might be a cheap way of providing incentives. However the authors assume that managers utility is increasing if their subordinates get promoted. This assumption is key to generate a role for favouritism. The second is Kwon (2006) who generates endogenously a preference for favouritism in a model where inventors compete to have their project implemented and the decision maker designs an optimal incentive

[1] An important point to stress is that Dessein studies communication versus delegation with one sender. In my model, in the one sender case, communication and delegation yield the same truthtelling incentives. On the contrary, communication differs from delegation in the two senders case due to the incentives effects created by competition for influence.

scheme. However, he deals with a model where inventors become informed after exerting costly effort and the effects generated by competition are rather different. Moreover, "fairness" would improve upon favouritism because it induces the same effort exertion by both agents, which is more efficient than asymmetric effort exertion because effort costs are convex, while in my model "fairness" (which I rather define "communication") can induce stronger truthtelling incentives not because of assumptions about the technology but because of the incentives created by competition for influence.

This work is related to the literature on influence activities. Milgrom and Roberts (1988) represents an early important contribution in the area. They show that employees might want to allocate effort to produce information about their ability. Such information is valuable for the firm, but comes at the cost of subtracting effort away from other productive activities. Milgrom and Roberts discuss organisational responses to the presence of excessive influence activities. My model shares the view that organisational form is an instrument that can be employed to improve the transmission of important information. However, influence activities are modelled rather differently and this literature has placed little attention on the explicit analysis of the effects of competition in inducing the correct transmission of information[2].

Another related paper is Baliga and Sjostrom (2001) who deal with a similar set of issues: they investigate the effects generated by using peer review to evaluate a project whose quality provide information about the inventor's talent. Both the inventor and the peer compete for a promotion and this generates incentives to misreport information. They derive the optimal renegotiation proof incentive scheme and show that self assessment can always replicate peer review, so that delegating self assessment to the inventor cannot be improved upon by using communication of information by both the inventor and the peer.

This work is also related to the theoretical literature on cheap talk. However, the fact that agent's bias is unknown and that the game is dynamic differentiates this work from most part of the literature in this area. Following the seminal contribution of Crawford and Sobel (1982), a large literature developed focussing on different variations on the theme, taking both a purely theoretical and an applied perspective. Among these contributions, Krishna and Morgan (2001) is the reference closest to the present work. The authors investigate the effects of the presence of a second sender in a static cheap talk game a la Crawford and Sobel (1982). They show that unless the bias of the senders is extreme, the presence of a second sender is beneficial in that the informativeness of equilibria increases.

[2]Rotemberg and Saloner (1995) is also broadly related as the authors show that conflict between members of an organisation can foster information production. The bad side of conflict is that producing information is costly, and too much conflict can lead to excessive effort being devoted to information production.

They also show that when the bias of senders goes in the same direction, the information provided by the more biased expert is redundant. Krishna and Morgan (2001) assume that the bias of the agents is publicly known. The presence of a second sender in their model helps in assessing the credibility of information transmitted and is especially useful when senders have opposed biases. This is clearly different from the role competition plays in my set up. Finally, Krishna and Morgan do not study organisational form. Gilligan and Krehbiel (1989) discuss a static game with two senders to describe the desirability of open versus closed rule in the legislative process. In their model, the bias of informed parties is known and they do not consider repeated interactions.

When discussing information transmission from multiple parties, it is important to deal with the role played by information aggregation. Battaglini (2002) and Levy and Razin (2004) provide important results in this respect. The model of Battaglini shows conditions ensuring full information revelation in the case where information is multidimensional, while Levy and Razin provide an analysis of situations when Battaglini's result hold and conditions when it does not, even when information is multidimensional. It is important to notice that the result of Battaglini does not hold in the setting of this model, even if information were multidimensional, as the bias of senders is their private information.

The chapter is structured as follows: section 2.2 introduces the base model and competition is modeled as a situation where two senders interact with one decision maker, section 2.3 derives the equilibrium when the receiver cannot commit to delegate decision powers to a given sender, section 2.4 discusses the role of establishing an organization and delegating authority to one of the senders, section 2.5 shows why favouritism can be optimal, section 2.6 discusses the welfare of the decision maker, section 2.7 shows when it can be optimal to delegate decision powers to an agent with a less established reputation, such as a junior, section 2.8 extends the model to the case of n senders competing to influence the decision maker, section 2.9 contains a discussion of the assumptions, the modelling strategy, results and applications, section 2.10 concludes, the appendix contains proofs of propositions and lemmas.

2.2 The model

The strategic interaction between the decision maker (she) and senders (he) is modelled as a two period game. The same stage game is repeated in each period.

Players and actions: The decision maker interacts with one or two senders. In each period the decision maker has to implement a decision $d \in \{-1, 0, 1\}$. Senders provide a message $m \in \{-1, 0, 1\}$, suggesting the appropriate course of action. After observing the messages, the decision maker decides what action to implement.

Information structure: At the beginning of the first period nature draws the types of senders. They might be unbiased, left biased or right biased. A sender's type is his private information, is constant over time, and is distributed according to the probability distribution $\Pr(i = Honest) = p_i$, $\Pr(i = Left\ biased) = \Pr(i = Right\ biased) = \frac{1-p_i}{2}$. Firstly both senders will be assumed to have the same ex-ante chance of being honest. In such a case, $\Pr(i = H) = \Pr(j = H) = p$. This assumption will be removed later. The type of each sender represents his preferences. An unbiased sender has no conflict of interest with the decision maker, left biased senders always prefer the decision maker to take action -1, while right biased senders always prefer the decision maker to take action 1.

Every period, nature draws a random variable $y \in \{-1, 0, 1\}$ representing the state of the world. Define state 0 as the status-quo. State zero occurs with probability $\frac{1}{2}$, while states -1 and 1 occur with probability $\frac{1}{4}$ each, so that the decision maker chooses state zero and gets an expected payoff of zero when she is uninformed. States of the world in different periods are drawn independently. Senders privately observe a perfect signal about the realization of the state of the world. Moreover, nature draws a random variable that defines period importance. This is represented by the random variable A with support $\Gamma = [\underline{A}, \overline{A}]$ and distributed according to a continuous distribution function $G(\cdot)$ for the decision maker, and by the random variable B, with support $\Phi = [\underline{B}, \overline{B}]$ and distributed according to the continuous distribution function $H(\cdot)$, for senders. The distribution H is atomless. Both $\underline{A}$ and $\underline{B}$ are non negative. The realization of period importance is common knowledge and observed before messages are sent and decisions taken. Finally, decision maker's payoff is commonly observed, while each sender's payoff is his private information[3].

Player's payoffs: The decision maker would like to implement the decision that matches the state of the world. Formally, $U^{DM} = A$ if $d = y$ and $U^{DM} = -A$ if $d \neq y$[4]. Honest senders have the same preferences over actions as the decision maker, so that $U^H = B$ if $d = y$, and $U^H = -B$ otherwise. On the contrary, left biased senders always prefer the decision -1 to be implemented, so that $U^L = B$ if $d = -1$ and $U^L = -B$ if $d \neq -1$. Analogously right biased senders always prefer decision 1 to be implemented, so that $U^R = B$ if $d = 1$ and $U^R = -B$ if $d \neq 1$. Notice that I am assuming that biased types

[3]This assumption is needed to avoid perfect revelation of a sender's type when payoffs are realized. However, decision maker's payoffs could be assumed to be unobservable without altering any of the results.

[4]The subscripts DM, H, L, R denote, respectively, the payoff functions of Decision Maker, Honest, Left biased and Right biased.

suffer the same "damage" if their preferred decision is not implemented, independently of the "distance" of the decision from their preference. In fact, a left biased sender incurs a loss of $-B$ both if decision 0 is made and if decision 1 is made. It could well be the case that left biased senders prefer decision 0 over decision 1 and right biased senders prefer decision 0 over decision -1. Allowing for this possibility complicates the notation adding little to the economic intuition and determining limited changes in results. I am also assuming the decision maker cannot adjust the intensity of the action as a function of the reputation of each sender nor as a function of the magnitude of the "consensus": the decision maker might want to trust more the information provided by senders if the senders agree, and less if there is disagreement. I will explore this possibility further in the chapter when I extend the model to allow for the presence of more than two senders. Finally, I am assuming there is no type biased towards the status-quo. This is both interesting in itself, as it allows to explore the effect of having a decision that is "unbiased"[5], and useful to keep the model simple and tractable.

Contracts: this model aims at describing an environment where it is difficult to write complete contracts to govern agents interactions. Sender's private signals are not verifiable to court, and money cannot be transferred among players. The main contractible variable is the power to influence decision making. In the first part of the chapter, it will be assumed that the decision maker is not able to credibly commit to delegate decision powers to a sender. This assumption will be removed in the sections on delegation and on favouritism.

Timing: there are two periods (stages). At the beginning of the first period, sender's types are drawn and privately observed by each sender only[6]. Then the state variable is drawn and privately observed by senders only, while the decision maker observes an imperfect signal. The period importance realization for decision maker and senders is drawn and commonly observed[7]. Senders simultaneously report messages, the decision maker chooses a course of action, possibly on the basis of senders reports, and payoffs are realized. The same stage game is repeated in the second period, with the exception that sender's types are drawn once and for all at the very beginning of the game.

Strategies and beliefs: for ease of exposition it is assumed that honest senders are committed types and always report information truthfully. Therefore, attention should be placed on biased senders. Left biased sender i reports the state realization truthfully

[5] I mean a decision who is not preferred by any biased type.

[6] Sender i knows his type, but not sender j's type.

[7] There is no loss of generality in assuming that the decision maker observes her own period importance realization and senders observe theirs. However, to decide whether delegation or favouritism are better than communication, the decision maker should be able to get at least an informative signal about the realization of period importance for the senders. This point will be discussed further later on.

in period t with probability $q^s_{i,t}(h_t)$, where s represents the true realization of the state of the world, and h_t is the history of the game at the beginning of date t. Analogously, right biased senders report the true realization truthfully with probability $z^s_{i,t}(h_t)$. The dependence on the state of the world follows because the true state can coincide with the preferred decision for the sender, and this affects the willingness to report the state truthfully. The decision maker updates her beliefs about sender i type through Bayes rule. At the beginning of the first period, $p_1 = p$ while at the beginning of the second period

$$
\begin{aligned}
p_2 &= \frac{p}{p + \frac{1-p}{2} q^s_{i,1} + \frac{1-p}{2} z^s_{i,1}} && \text{if } m = y \text{ (report was truthful)} \\
p_2 &= 0 && \text{if } m \neq y \text{ (report was false)}
\end{aligned}
$$

Strategies for the decision maker are mappings from the set $\{m_1, m_2\} \times \{i, -i\}$ to the set of actions. In words, the decision maker chooses decision d, when sender i reported message m_i, and sender $-i$ reported message m_{-i} in period t, with probability $\nu^{i,m_i,m_{-i}}(h_t) \in [0,1]$, where again h_t is the history of the game at the beginning of date t. Such probabilities depend upon the credibility of the sender's report and upon the messages sent.

From now on, until section 7, the probability a sender is honest will be denoted simply by p when $t = 1$.

2.3 Communication

This section derives the equilibrium of the game under the assumption that the decision maker cannot commit to grant decision powers to a given sender. Senders communicate their information to the decision maker who deliberates on the appropriate course of action.

The equilibrium concept is Perfect Bayesian Equilibrium. Only strategies based upon current history are considered. An equilibrium is a set of strategies $q^s_{i,t}(h_t)$, $z^s_{i,t}(h_t)$ for left and right biased senders and $\nu^{i,m_i,m_{-i}}(h_t)$ for the decision maker, as defined above, and a set of beliefs $\{p, p_2\}$ for the decision maker, such that strategies are sequentially rational for a given set of beliefs and beliefs are consistent given the strategy profile. To ease notation I will drop the dependence of q, z and ν on h_t.

The assumptions that honest senders are committed types and those about the distribution of the state of the world, rule out the existence of babbling equilibria, at least if the probability senders are honest (which I define as "sender's credibility") is large enough to ensure the existence of equilibria where information transmission can take place. When the credibility of a sender is too low, the decision maker discards the messages received and biased senders randomise.

It is useful to state two preliminary results, common to the one and two senders games.

Lemma 2.1 *A biased sender always suggests his preferred decision to be implemented in the last period if he has enough credibility to transmit information*

Proof. See Appendix to Chapter 2 ■

Lemma 2.2 *A biased sender always reports the truth when the state of the world coincides with his preferences.*

This is obvious as by reporting the true state of the world he enjoys a current gain without incurring any loss in reputation. Furthermore, it never pays to lie by falsely reporting the true state is the status quo. This follows because the sender would suffer both a current period loss, and a reputational loss. The latter is implied by the assumptions that the true state is observed perfectly. Otherwise, it could happen that a biased sender lied in order to gain a reputation for being unbiased. This mechanism would be similar to that unveiled by the Morris (2001) paper.

The decision maker is willing to implement the decision proposed by the sender with positive probability in period t if and only if

$$A[p_t + \frac{(1-p_t)}{2}(q_t^s - (1-q_t^s)) + \frac{(1-p_t)}{2}(z_t^s - (1-z_t^s))] > 0 \qquad (2.1)$$

where 0 is the expected payoff from making an uninformed decision[8] and p_t is the probability that the sender is honest conditional on the information available in period t. Then, the sender will be able to credibly transmit information in period 2 if and only if $p_2 + \frac{(1-p_2)}{2}(-\frac{1}{2}) + \frac{(1-p_2)}{2}(-\frac{1}{2}) > 0$, or $p_2 > \frac{1}{3}$. This follows because the sender is honest with probability p_2 and then reports the truth. With probability $\frac{1-p}{2}$ he is left biased, and with probability $\frac{1}{4}$ the true state is -1, so he is reporting the truth, while with probability $\frac{3}{4}$ the state is either zero, or 1, and the left biased sender lies. The same reasoning describes

[8]The uninformed decision coincides with the status quo, as this is the most likely state of the world ex-ante. Then the expected payoff is zero because the true state is zero with probability $\frac{1}{2}$, it is -1 with probability $\frac{1}{4}$ and it is 1 with probability $\frac{1}{4}$. Therefore, the expected payoff by choosing the status quo is $\frac{1}{2}A - \frac{1}{4}A - \frac{1}{4}A = 0$. Assuming the states of the world are equally likely and thus that the expected payoff from an uninformed decision is different from zero does not alter the results.

the behaviour of a right biased sender. In period 1 the sender is able to credibly transmit information if and only if $p + \frac{(1-p)}{2}[\frac{1}{4} + \frac{3}{4}q_1^s - \frac{3}{4}(1-q_1^s)] + \frac{(1-p)}{2}[\frac{1}{4} + \frac{3}{4}z_1^s - \frac{3}{4}(1-z_1^s)] > 0$. In order to ensure the existence of truthtelling equilibria in pure strategies, it is necessary that $p > \frac{1}{3}$. In fact, in such a case, both types of biased senders report the truth in the first period setting $q_1^s = z_1^s = 1$, so that $p_2 = p$ and information can be credibly transmitted if and only if $p_2 > \frac{1}{3}$.

I firstly analyse the game where one sender tries to influence the decision maker, then I will turn to the two senders game. I describe the behaviour of a left biased sender, as that of a right biased sender is analogous.

One sender. In the second period a left biased sender always reports that the true state is -1, which implies $q_2^{-1} = 1$ if the state is -1, and $q_2^0 = q_2^1 = 0$, otherwise. In the first period a left biased sender trades off current gains with the possibility of influencing the decision in the future. If the true state is -1, the sender reports the truth for sure, as this involves no reputational loss. If instead the true state is either zero or 1, the payoff of a left biased sender by reporting the truth in period 1 is

$$V_T = -B + I_{\{p_2 > \frac{1}{3}\}} \delta E(B) \tag{2.2}$$

where $I_{\{p_2>\frac{1}{3}\}}$ is the indicator function taking the value 1 if $p_2 > \frac{1}{3}$ and zero otherwise, $\delta \in (0;1]$ is a discount factor and $E(\cdot)$ denotes the expectation operator, so that $E(B) = \int_\Phi BdH(B)$. The payoff from lying is given by

$$V_L = B - \delta E(B) \tag{2.3}$$

This follows because if a sender lies in the first period, his second period reputation is destroyed as the posterior probability he is honest is $p_2 = 0$. Therefore the decision maker will not listen to the sender in the second period, and will make an uninformed decision which corresponds to choosing the status quo. As the sender is not believed because his reputation is gone, a biased sender without reputation randomizes among messages. When the true state is different from his preferred state, a biased sender reports the state truthfully in the first period if and only if $V_T > V_L$, while randomizes in the knife edge case occurring when $V_T = V_L$. In the pure strategy equilibrium it is necessary that reputation is large enough for information transmission to take place. Assuming therefore that $p > \frac{1}{3}$, it is possible to prove the following

Proposition 2.1 *In the one sender case, a biased sender reports information truthfully in pure strategies in the first period if and only if the decision at stake is not too important.*

Proof. See Appendix to Chapter 2 ■

The intuition for this result is standard and is analogous to that in Sobel (1985): if the realization of decision importance in the first period is not too high, a biased sender is willing to incur a current loss in order to be able to influence the decision maker in the second period. The proof of the proposition shows that the truthtelling equilibrium in pure strategies exists if and only if

$$B < \delta E(B) \tag{2.4}$$

while there is a continuum of equilibria in mixed strategies, where senders report information truthfully with probability $q_1^{s=0} \in (0, \frac{2p}{1-p}]$, when the true state is the status quo and $q_1^{s=1} \in (0, \frac{5p-1}{1-p}]$,when the true state is 1, if and only if $B = \delta E(B)$. However the mixed strategy equilibrium is a zero probability event as period importance is drawn from a continuous and atomless distribution.

I now turn to the analysis of the game where two senders report information and show the effects of competition on truthtelling incentives. Then, I will discuss the behaviour of the decision maker and derive the equilibria.

Two senders. It is useful to state two preliminary results that allows to ease the exposition. Firstly, the decision maker never benefits from discarding information when senders have enough credibility to ensure information transmission takes place.

Lemma 2.3 *The decision maker always uses the information provided by senders if they have enough credibility. Formally,* $\nu^{i,m_i,m_{-i}} + \nu^{-i,m_i,m_{-i}} = 1$

Proof. See Appendix to Chapter 2 ■

Secondly, from the assumptions of the model, it follows that action 0 (the status quo) is not preferred by any biased type. Therefore when the decision maker observes conflicting messages, and one of the messages is zero, she knows that zero is the true state. This implies that if $m^{-i} = 0$ and $m^i \neq 0$, the decision maker sets $\nu^{i,m_i,0} = 0$. Then

Lemma 2.4 *There is always truthtelling in the first period if the true state is the status quo*

This follows because the status quo is the "unbiased" action. In a truthtelling equilibrium, the opponent reports the truth. When the true state is the status quo, the decision maker observes a message suggesting the status quo from the opponent. Then, there is no profitable deviation to lying because the decision maker knows that zero is not the preferred action of any biased type and it must be the true state. Thus, in a truthtelling equilibrium, a left (or right) biased sender derives no benefit from reporting false information when observing a true state equal to the status-quo (state zero).

Then, it remains to discuss the behaviour of a biased sender when the observed state is opposite to his preferences. I assume the biased sender is left biased and the true state is 1[9]. Biased senders always lie in the last period. Therefore, I denote as q_i^1 the probability a left biased sender i reports the truth in period 1 when the true state is 1, and I thus drop the reference to the time period. The payoff of a left biased sender i, in such a case, is given by

$$\begin{aligned} V_T^i=&[p+\frac{(1-p)}{2}+\frac{(1-p)}{2}q_{-i}^1](-\nu_1^{i,1,1}-\nu_1^{-i,1,1})B+\frac{1-p}{2}(1-q_{-i}^1)(-\nu_1^{i,1,-1}+\nu_1^{-i,1,-1})B+ \\ &\delta E(B)[\frac{(1-p)}{2}q_{-i}^1(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})+p(\frac{1}{4}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})-\frac{1}{2}+ \\ &\frac{1}{4}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1}))+\frac{(1-p)}{2}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1})+\frac{(1-p)}{2}(1-q_{-i}^1)] \end{aligned} \tag{2.5}$$

if he reports truthfully in the first period, and

$$\begin{aligned} V_L^i = &[p+\frac{(1-p)}{2}+\frac{(1-p)}{2}q_{-i}^1](\nu_1^{i,-1,1}-\nu_1^{-i,-1,1})B+ \\ &\frac{1-p}{2}(1-q_{-i}^1)(\nu_1^{i,-1,-1}+\nu_1^{-i,-1,-1})B \\ &+\delta E(B)[\frac{(1-p)}{2}q_{-i}^1-\frac{(1-p)}{2}+p(\frac{1}{4}-\frac{1}{2}-\frac{1}{4})] \end{aligned} \tag{2.6}$$

if he lies. Both equations have been simplified relying on the fact that

$$p_{-i,2}=\frac{p}{p+\frac{1-p}{2}q_{-i}^1+\frac{(1-p)}{2}} \tag{2.7}$$

and on the fact that a right biased sender reports the truth when the true state is 1, thus setting $z_1^1=1$. The intuition for the expression for the expected payoff from reporting the truth can be described as follows: when the left biased sender reports the truth in period 1, the decision maker observes two agreeing messages if the opponent is unbiased, or is right biased, or is left biased but is reporting the truth. This happens with probability $[p+\frac{(1-p)}{2}+\frac{(1-p)}{2}q_{-i}^1]$. In such a case the decision maker follows the advice of sender i with probability $\nu_1^{i,1,1}$ and that of sender $-i$ with probability $\nu_1^{-i,1,1}$, where the superscripts $1,1$ denote the fact that the decision maker is observing two messages suggesting the true state is 1. The payoff is negative because the left biased sender suffers a loss as messages

[9]The case of a right biased sender observing the true state is -1 is identical.

suggest implementing decision 1. With probability $\frac{1-p}{2}(1-q^1_{-i})$ the opponent is left biased and is lying. Then the decision maker faces two conflicting messages, one suggesting the true state is 1 coming from sender i, the other suggesting the true state is -1 coming from sender $-i$, and she implements the decision suggested by sender i with probability $\nu_1^{i,1,-1}$ leading to a loss for that sender (this explains the negative sign), or the decision suggested by sender $-i$ with probability $\nu_1^{-i,1,-1}$ and this benefits a left biased sender i (this rationalizes the positive sign). The other terms represent expected continuation payoffs. With probability $\frac{(1-p)}{2}q^1_{-i}$ the opponent is left biased and reported the truth and in the second period both senders i and $-i$ are credible. They report the true state is -1 as they are both left biased and in the last period they have no reputational concerns. In this case the decision maker implements the suggested decisions with probabilities $\nu_2^{i,-1,-1}$ and $\nu_2^{-i,-1,-1}$ leading to an expected gain of $\delta E(B)$. With probability p the opponent is honest and with probability $\frac{1}{4}$ the true state is -1, the honest sender reports the truth and the decision maker observes two agreeing messages suggesting decision -1 should be implemented. She follows the advice of sender i with probability $\nu_2^{i,-1,-1}$ and that of sender $-i$ with probability $\nu_2^{-i,-1,-1}$. With probability $\frac{1}{2}$, the true state is zero, the status - quo. Then, the honest sender reports the truth, and the decision maker observes two conflicting messages, with sender i reporting the true state is -1 and sender $-i$ reporting the true state is zero. As proved above, in this case, the decision maker learns the true state is zero, because only an honest sender has an interest in reporting the state is zero in the last period, so she sets $\nu_2^{i,-1,0} = 0$ and $\nu_2^{-i,-1,0} = 1$, and this leads to an expected loss for the left biased sender, as decision 0 is implemented. Finally, with probability $\frac{1}{4}$ the true state is 1, the honest sender reports the truth, the decision maker is faced with two conflicting messages, the first reporting -1, the other reporting 1. In this case the decision maker learns nothing about the true realization of the state and she implements decision -1 as suggested by sender i with probability $\nu_2^{i,-1,1}$ and decision 1 as suggested by sender $-i$ with probability $\nu_2^{-i,-1,1}$. The former leads to an expected gain of $\delta E(B)$, the latter to an expected loss of $\delta E(B)$. With probability $\frac{(1-p)}{2}$ sender $-i$ is right biased and the decision maker observes conflicting messages -1 from sender i and 1 from sender $-i$, no matter the state, and implements those actions with probability respectively $\nu_2^{i,-1,1}$ and $\nu_2^{-i,-1,1}$. The former leads to an expected gain of $\delta E(B)$, the latter to an expected loss of $\delta E(B)$. Finally, with probability $\frac{(1-p)}{2}(1-q^1_{-i})$ sender $-i$ is left biased and lied in the first period. In such a case, sender i is left exerting full influence on the decision maker in the second period, and induces her to implement decision -1, leading to an expected payoff of $\delta E(B)$. The payoff from lying in the first period (i.e. reporting that the true state is -1 when instead it is 1) can be understood following the same logic.

By examining payoffs, it can be seen that the presence of a second sender generates two effects. There is a reduced influence effect both in the current period and in the future.

Reduced future influence implies that now a biased sender who maintained his reputation, will not be able to influence the decision maker for sure in the second period. So it is less important to be trusted and this reduces incentives for building a reputation for being an honest adviser. This can be seen by noting that the expected continuation payoff from reporting the truth

$$\delta E(B)[\frac{(1-p)}{2}q^1_{-i}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})+p(\frac{1}{4}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})-\frac{1}{2}+\\ \frac{1}{4}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1}))+\frac{(1-p)}{2}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1})+\frac{(1-p)}{2}(1-q^1_{-i})] \tag{2.8}$$

is smaller than $\delta E(B)$, the continuation payoff from telling the truth in the one sender case, as

$$\frac{(1-p)}{2}q^1_{-i}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})+p(\frac{1}{4}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})-\frac{1}{2}+\frac{1}{4}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1}))\\ +\frac{(1-p)}{2}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1})\frac{(1-p)}{2}(1-q^1_{-i})]<1 \tag{2.9}$$

Reduced current influence softens the temptation to deplete own reputation because the sender might not be able to influence first period decision either, as the decision maker follows the advice of sender i with probability $\nu^{i,m_i,m_{-i}} \leq 1$. In other words, reduced current influence decreases the opportunity cost of keeping own reputation. Therefore reduced future influence and reduced current influence determine opposite effects on truthtelling incentives.

Finally, competition has a lost reputation effect when senders messages are credible: if a biased sender lets competitors gain influence, he expects decisions against his preferences more than half of the times. However, if the decision maker makes an uninformed decision, that may go against the preferences of the sender. This is represented by the expected continuation payoff from lying:

$$[-\frac{(1-p)}{2}(1-q^1_{-i})-\frac{p}{2}]\delta E(B) > -\delta E(B) \tag{2.10}$$

which represents the cost of a lost reputation[10]. The balance between the reduced influence (current and future), and the lost reputation effect determines whether competition increases or reduces truthtelling incentives.

[10]Notice that the "sign" of this effect depends upon assumptions about the "status quo" decision. In this model the "status quo" is bad for a biased sender, but under different hypotheses it could be that depleting own reputation does not lead to a very unfavourable decision when the decision maker goes for the status quo, while with multiple sender, there will be some chances another sender with the same bias is able to influence future decisions away from the status quo.

It is now important to discuss the behaviour of the decision maker in order to derive the equilibrium. It was proved above that when the decision maker observes a message suggesting decision zero should be implemented and another message suggesting decisions -1 or 1, she knows the true state is zero, as no biased sender prefers decision zero. However, when the decision maker observes a message suggesting action -1 and a message suggesting action 1, she cannot extract any information about the true state of the world. The following lemma shows the equilibrium behaviour of the decision maker in such a case

Lemma 2.5 *In equilibrium the decision maker always randomizes between messages when she observes conflicting messages* -1 *and* 1 *from senders with the same reputation.*

Proof. See Appendix to Chapter 2 ∎

The next lemma shows that there cannot exist equilibria where the decision maker always takes an action or always implements the message of a given person in case of disagreement

Lemma 2.6 *There cannot exist equilibria when the decision maker always follows the advice of a given sender.*

Proof. See Appendix to Chapter 2 ∎

This is true as long as the decision maker cannot credibly commit to implement the advice of a given sender.

It is now possible to derive the equilibria. In a pure strategy equilibrium, by definition, $q^1_{i,1} = q^1_{-i} = 1$. Also, as proved by Lemma 5 and 6, $\nu^{i,m_i,m_{-i}} = \nu^{-i,m_i,m_{-i}} = \frac{1}{2}$ where $m_i, m_{-i} = -1, 1$. Consider now mixed strategy equilibria. When the sender is left biased, he is willing to randomize if the true state in the first period is 1, otherwise when the true state is zero, or -1 there is truthtelling in pure strategies. Then q^1_{-i} has to be such that $V^i_T = V^i_L$, and to ease notation, drop the dependence of q on the observed state. Then, by rearranging equations 2.5 and 2.6, it follows that

$$\begin{aligned}
&[p(-\nu_1^{i,1,1}-\nu_1^{-i,1,1}-\nu_1^{i,-1,1}+\nu_1^{-i,-1,1})+\\
&(\frac{1-p}{2})(-\nu_1^{i,1,1}-\nu_1^{-i,1,1}-\nu_1^{i,1,-1}+\nu_1^{-i,1,-1}-\nu_1^{i,-1,1}+\nu_1^{-i,-1,1}-\nu_1^{i,-1,-1}-\nu_1^{-i,-1,-1})]B+\\
&\delta E(B)[p(\frac{1}{4}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1})-\frac{1}{2}+\frac{1}{4}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1}))+\\
&\frac{(1-p)}{2}(\nu_2^{i,-1,1}-\nu_2^{-i,-1,1})+\frac{(1-p)}{2}+\frac{(1-p)}{2}+\frac{p}{2}]=\\
&q_{-i}^1[(\nu_1^{i,-1,1}-\nu_1^{-i,-1,1}-\nu_1^{i,-1,-1}-\nu_1^{-i,-1,-1}+\nu_1^{i,1,1}+\nu_1^{-i,1,1}+\nu_1^{i,1,-1}-\nu_1^{-i,1,-1})\frac{1-p}{2}B+\\
&\delta E(B)(\frac{1-p}{2}+\frac{1-p}{2}-\frac{1-p}{2}(\nu_2^{i,-1,-1}+\nu_2^{-i,-1,-1}))] \qquad (2.11)
\end{aligned}$$

Plugging the equilibrium values of $\nu^{i,m_i,m_{-i}}$:

$$q_{-i}=\frac{2[\delta E(B)(1-\frac{3}{4}p)-B]}{\delta E(B)(1-p)} \qquad (2.12)$$

the equilibrium is clearly symmetric and therefore $q_{-i}=q_i=q$. In order for this to be an equilibrium, two additional conditions have to be met. Firstly, q has to be a well defined probability, hence $0<q<1$, secondly $p_2>\frac{1}{3}$, i.e., second period reputation must be high enough for senders to exert influence. This implies $\frac{p}{p+\frac{(1-p)}{2}+\frac{(1-p)}{2}q}>\frac{1}{3}$, or $q<\frac{5p-1}{1-p}$, which requires $p>\frac{1}{5}$ as $q>0$. The following proposition summarizes these results.

Proposition 2.2 *When the true state is different from the status quo, the two senders game has both pure and mixed strategy equilibria. The pure strategy equilibrium with truthtelling exists as long as the realization of first period importance is not too high. The mixed strategy equilibrium is unique and symmetric and it exists for intermediate realizations of first period importance.*

Proof. See Appendix to Chapter 2 ■

The proof of the proposition shows that the pure strategy equilibrium occurs if and only if

$$B<\delta E(B)(\frac{1}{2}-\frac{p}{4})\equiv B_2^* \qquad (2.13)$$

and $p>\frac{1}{3}$. The mixed strategy equilibrium occurs when

$$\max\{\delta E(B)(\frac{1}{2}-\frac{p}{4});\delta E(B)(\frac{6-13p}{4})\}<B<\delta E(B)(1-\frac{3}{4}p)\equiv B_2^{mix} \qquad (2.14)$$

and $p > \frac{1}{5}$. Biased senders report truthfully (when the true state is neither zero, nor their preferred state) with probability

$$q = \frac{2[\delta E(B)(1 - \frac{3}{4}p) - B]}{\delta E(B)(1 - p)} \tag{2.15}$$

The intuition is analogous to that of the one sender game: if period importance is low enough, it pays to give up current period payoffs to retain influence on future decisions. If period importance is larger, it is optimal to report information truthfully only at times. Finally, if period importance is very high, it is optimal to influence the decision maker in the current period as the stakes are high and it is unlikely that future decisions will be even more important.

The discussion so far makes it possible to investigate whether competition fosters truthtelling incentives. The following proposition summarizes one of the main results of the chapter.

Proposition 2.3 *If the true state is the status quo, competition raises truthtelling incentives. On the contrary, when the true state is different from the status quo, competition reduces truthtelling incentives.*

Proof. See Appendix to Chapter 2 ■

If the true state is the status quo, competition has a beneficial effects as aggregating information ensures the decision maker learns about the true state of the world. If instead the true state of the world is not the status quo, the proposition shows that when there is truthtelling in pure strategies under competition there always is truthtelling in pure strategies with one sender only, and there are levels of period importance such that there is no truthtelling under competition (not even in mixed strategies) and truthtelling in pure strategies with one sender. Therefore, competition for influence can reduce the incentives of biased senders to report the truth. Truthtelling incentives are greatest if a sender is certain that his effort to gain influence on future decisions will not be jeopardized by the analogous effort of another player. However the fear the other sender gains influence on future decisions and turns these against own preferences generates incentives to preserve credibility to influence future decisions. Moreover, the presence of a second sender reduces the value of a current deviation and this softens the temptation of giving up reputation to enjoy current payoff. The balance among these effects determines whether competition raises truthtelling incentives. A key factor is the likelihood the other sender is honest. If that is high, then it does not pay very much to retain influence on future decisions as the honest sender will surely influence the future decision if the true state is the status quo.

2.4 Delegating authority

Previous discussion made clear how the interplay of two forces (reduced current and future influence, and lost reputation effect) shapes truthtelling incentives when the decision maker cannot commit to follow the advice of a specific sender. This section investigates whether organisational design can be used to improve matters for the decision maker. In particular, delegating decision making powers to a sender could be a way to soften the reduced future influence. In order to achieve this, the decision maker needs to be able to commit to implement the decision proposed by one sender. A way to reach a credible commitment is to delegate authority to make decisions. Decision making powers can be awarded to a sender until he maintains his reputation. When the latter is depleted the agent is fired and another agent gets the authority to decide in the second period. Intuitively this might be beneficial because it eliminates the reduced future influence effect and raises incentives for having a reputation in the future. On the other hand, however, this policy increases the gains from a deviation in the current period. For ease of exposition the sender who is delegated decision powers will be called "the influential sender". A strategy of full delegation implies that $\nu_1^i = 1, \nu_1^{-i} = 0$[11], under the assumption that $p^i = p^{-i} = p > \frac{1}{3}$, so that player i denotes the influential sender. If he does not lie in the first period, $\nu_2^i = 1, \nu_2^{-i} = 0$, and the opposite otherwise. Notice that in this situation the strategy of the decision maker is not contingent on the observed messages as the decision of the influential sender can not be overturned: the decision maker credibly committed to delegate decision making powers to that sender. If the decision maker could overturn the influential sender decision, the equilibrium would be the same as in the communication case.

An important aspect to stress is what the set of available contracts is. The only assumptions needed are that the decision maker cannot overturn the decision chosen by the influential sender after observing the reports and that senders cannot be fined for a wrong report. Then contracts can be made contingent on different variables. Firstly, a contract could just state that decisions in the first period are made by sender i. Then after a good report in the first period, the decision maker is indifferent between letting sender i influence second period decision or remove him. Alternatively, contracts can be contingent on the importance of the decision. Then delegation could be implemented by stating that an agent will be delegated powers (in both the current and the future period) as a function of current period importance: this will take care of equilibrium behaviour of biased senders. Finally, a contract could state that a sender can fully influence decisions

[11]The decision maker could prefer to commit to follow the advice of a sender in the first period with a probability $\nu_1^i < 1$, promoting him to full delegation in the second period, if first period outcome was good. This possibility is discussed in the next section.

and if he is fired after the first decision, the principal (the decision maker) has to pay penalties for breaching the contract. This is self enforcing because the sender would prefer to fire the agent and pay the fine only when the first decision was wrong[12]. This is very similar to a severance payment system.

I am assuming the decision maker can fully commit not to renegotiate the contract offered. However, it is interesting to examine whether such contracts are renegotiation proof. The influential sender would need a payment of $2B$ to accept a contract that overturns the decision, so the benefit for the decision maker has to be larger than this quantity. Moreover, the possibility of renegotiation would reduce incentives for a biased non influential sender to report information truthfully: in fact when reports do not coincide, the biased non influential sender might induce the decision maker to overturn the influential sender decision. Hence, the decision maker will have to pay $2B$ and will implement the correct decision only with probability $p+\frac{(1-p)}{2}q+\frac{(1-p)}{2}z$. This might not be in the interest of the decision maker and will not be the case if period importance for her is perfectly correlated to that for senders[13].

It will now be established whether setting up an organization and delegating decision powers leads to stronger truthtelling incentives than communication does. Suppose the sender is left biased (the right biased case is analogous). If the true state is -1, he will report the truth. When the true state is either zero, or 1, a left biased sender i reports the truth when delegated authority if and only if:

$$V_T^i = -B + \delta E(B) > V_L^i = B + \delta E(B)[\frac{1-p}{2} + \frac{p}{4} - \frac{p}{2} - \frac{p}{4} - \frac{1-p}{2}] \tag{2.16}$$

The first term represents the expected payoff from reporting the truth: the biased sender implements the action preferred by the decision maker (and thus gets a payoff of $-B$) in the first period, and is able to fully influence the decision in the second period when he implements his preferred action yielding $\delta E(B)$. If he lies he gets the current period payoff B. In the second period he is fired and the other sender is delegated authority. This agent tells the truth if he is honest (this occurs with probability p), and implements an action which accords with sender i preferences if next period state is -1, which occurs with probability $\frac{1}{4}$, and implements an action against sender i preferences when the state is either zero or 1 (these states occur respectively with probability $\frac{1}{2}$ and $\frac{1}{4}$). The other sender is left biased with probability $\frac{1-p}{2}$ and implements action -1, while he is right biased with probability $\frac{1-p}{2}$ and implements action 1. Therefore a left biased sender tells

[12]Provided, of course, the fine is not too large.
[13]In this case $A = B$.

the truth (in the first period, if the true state is 1) under delegation as long as

$$B < \frac{\delta E(B)(1+\frac{p}{2})}{2} \equiv B^{del} \tag{2.17}$$

Notice that mixed strategy equilibria here exists only for a set of parameters whose joint occurrence is a measure zero event. This follows because the sender who is not delegated authority reports the truth with probability one in the first period. The following proposition shows in what circumstances delegation is optimal.

Proposition 2.4 *When the true state is different from the status quo, delegating decision powers to one sender induces stronger truthtelling than letting senders compete for influence.*

Proof. See Appendix to Chapter 2 ■

The proof shows that there are values of period importance such that there is truthtelling in pure strategies under delegation, while under communication with two senders there is truthtelling in mixed strategies only. Furthermore, if the probability the opponent is honest is large enough ($p > \frac{1}{2}$), there is truthtelling under delegation, while there is not even truthtelling in mixed strategies under communication with two senders[14]. Delegating decision powers to an agent amounts to let the agent influence the decision both in the first and in the second period if he does not jeopardise his reputation. Thus, delegation protects influence. On the other hand, if the influential sender destroys his reputation, he will not have any chance to influence the decision maker in the future and newcomers will have full decision powers. In every equilibrium with information transmission both senders must have a large enough prior reputation. Thus each sender thinks the opponent is relatively more likely to be honest. Therefore the fear that future decisions will be influenced by an agent with opposed interests raises truthtelling incentives of the influential sender.

Hence, the relative benefits and costs of delegation as opposed to communication, are to be identified along two dimensions. First, delegation protects influence. The dark side of delegation is obvious: the influential sender has unfettered ability to implement his preferred action in the current period. Moreover, under competition, the decision maker implements the correct action for sure, whenever the true state requires the unbiased action to be chosen.

[14]When instead, $p < \frac{1}{2}$, there are values of period importance such that $B^{del} < B^2_{mix}$.

2.5 Favouritism

Thus far, the analysis showed that a policy of full delegation has the drawback that the influential sender has unfettered ability to cash in the full value of a false report in the current period. A way to overcome this problem is to commit to follow the advice of sender i with a given probability $\nu_1^i < 1$ in the first period, and to commit to delegate decision making to one of the senders in the last period, so as to preserve future influence. This can be regarded as a form of favouritism, as the decision maker biases the competition for influence in favour of one of the senders. This helps to reduce the temptation to deviate in the first period, with respect to the case of full delegation. Then, assume, without loss of generality, that sender i is delegated decision powers in the second period, provided he reports information truthfully in the first period. Call sender i the "influential sender". The policy consists in offering the influential sender the following contract: the decision he proposes is implemented with probability $\frac{1}{2} < \nu_1^i < 1$ in the first period. The probability ν_1^i can be regarded as the degree of favouritism and as ν_1^i is close to one, the degree of favouritism is said to be "strong". If the report turns out to be correct, the sender gets full decision powers in the second period. Formally $\nu_2^i = 1$ if $m_{i,1} = y_{i,1}$, $\nu_2^i = 0$ otherwise[15]. It is assumed the decision maker commits to follow the advice of each sender with probability ν_1^i and $\nu_1^{-i} = 1 - \nu_1^i$, and that the probability senders are honest is large enough so as to ensure information transmission occurs in equilibrium. Under favouritism players can behave asymmetrically: in fact, when the influential sender finds it optimal to report information truthfully, a biased non influential sender prefers to lie in the first period as he will not have any chance to influence second period decision. On the other hand, he might tell the truth, when the influential sender is lying, provided that current period importance is not too large.

I assume sender i is left biased. When the true state is -1 he trivially reports the truth. When the true state is not -1, it is important to distinguish the case when the true state is the status quo, from that when the true state is 1. In fact, in the latter case, a right biased opponent surely reports the truth, while, if the true state is the status quo, a right biased sender might prefer to lie. Therefore, the payoff of a left biased influential sender

[15]Essentially, I am assuming that the decision maker has access to a commitment technology that does not allow to condition the decision about who influences the decision in the first period on the messages received. Another possibility is that the decision maker, in the first period, does not rely on favouritism when she observes conflicting messages and one of these messages suggests the status quo. This would change very little in the results, and would just increase the desirability of favouritism.

is given by:

$$V_T^i(0) = -\nu_1^i B + (1-\nu_1^i)[-\frac{1-p}{2}z - \frac{1-p}{2}(1-z) - p - \frac{1-p}{2}q + \frac{1-p}{2}(1-q)]B + \delta E(B) \tag{2.18}$$

$$V_L^i(0) = +\nu_1^i B + (1-\nu_1^i)[-\frac{1-p}{2}z - \frac{1-p}{2}(1-z) - p - \frac{1-p}{2}q + \frac{1-p}{2}(1-q)]]B + \delta E(B)[\frac{1-p}{2}q + \frac{p}{4} - \frac{p}{2} - \frac{p}{4} - \frac{1-p}{2}z] \tag{2.19}$$

when the true state is the status quo, and by

$$V_T^i(1) = -\nu_1^i B + (1-\nu_1^i)[-\frac{1-p}{2} - p - \frac{1-p}{2}q + \frac{1-p}{2}(1-q)]B + \delta E(B) \tag{2.20}$$

$$V_L^i(1) = +\nu_1^i B + (1-\nu_1^i)[-\frac{1-p}{2} - p - \frac{1-p}{2}q + \frac{1-p}{2}(1-q)]B + \delta E(B)[\frac{1-p}{2}q + \frac{p}{4} - \frac{p}{2} - \frac{p}{4} - \frac{1-p}{2}] \tag{2.21}$$

when the true state is 1. When the true state is the status quo, the right biased sender reports the truth with probability z, and reports his preferred state otherwise. Therefore, he retains his credibility with probability z. On the contrary, when the true state is 1, a right biased sender always reports the truth and retains his credibility. The first term of equation 2.18 is current period payoff when reporting the truth. The decision of the influential sender is implemented with probability ν_1^i leading to a payoff of $-B$, while the decision of the non influential sender is implemented with probability $1 - \nu_1^i$. The non influential sender can be right biased and reports the truth (this occurs with probability $\frac{1-p}{2}z$), or right biased and reports the true state is 1 (this occurs with probability $\frac{1-p}{2}(1-z)$) and in both cases the left biased influential sender suffers a loss of $-B$. The non influential sender could be honest, reporting the true state is zero (this occurs with probability p), or left biased reporting the true state is zero (this occurs with probability $\frac{1-p}{2}q$), and in both cases the left biased influential sender suffers a loss of $-B$. Finally, the non influential sender could be left biased and lies reporting state -1, this occurs with probability $\frac{1-p}{2}(1-q)$, and leads to a gain of B. In the second period the influential sender exerts full influence on the decision and expected payoff is $\delta E(B)$. Equation 2.19 is similar, although now the left biased influential sender lied. Then, if the decision he suggests is implemented in the first period the payoff is B, this occurs with probability $\nu_1^i B$, but he will have no opportunity to influence second period decision. The latter will instead be influenced by the non influential sender, unless he lied in the first period.

Therefore, with probability $\frac{1-p}{2}q$ the non influential sender is left biased and reported the truth in the first period, so that he will induce the decision maker to choose action -1 in the second period, leading to an expected payoff of $\delta E(B)$. With probability p the non influential sender is honest, and with probability $\frac{1}{4}$ the true state is -1, so that expected payoff is $\delta E(B)$, while with probability $\frac{1}{2}+\frac{1}{4}$ the true state is either the status quo, or state 1, and the honest sender induces the decision maker to implement the true state leading to a loss of $\delta E(B)$ for the left biased influential sender. Finally, the non influential sender could be right biased and reported the truth in the first period. Then he will induce the decision maker to implement action 1 in the second period, leading to an expected loss of $\delta E(B)$ for the left biased sender. The intuition underlying equations 2.20 and 2.21 is analogous, with the difference that a right biased influential sender would report the truth for sure in the first period (thus $z = 1$) and will retain credibility to influence second period decision.

A biased non influential sender always lies in a truthtelling equilibrium, as he will not have any chance to influence future decisions, unless the true state coincides with his preferences. Thus, when the true state is the status quo, biased non influential senders lie (and $q = z = 0$) and a left biased influential sender reports the truth in the first period if and only if

$$B < \frac{\delta E(B)(2+p)}{4\nu_1^i} \tag{2.22}$$

When the true state is 1 and the influential sender reports the truth, a right biased non influential sender report the truth (so that $z = 1$), while a left biased non influential sender lies (so that $q = 0$) and a left biased influential sender reports the truth if and only if

$$B < \frac{3}{4\nu_1^i}\delta E(B) \tag{2.23}$$

If the influential sender lies, a biased non influential sender might prefer to report the truth. Again it is important to distinguish the case when the true state is the status quo from the case when the true state is 1. In the former situation, both a left and a right biased non influential senders behave analogously. Payoffs for such senders are given by

$$V_T^{-i}(0) = -\nu_1^i Bp - (1-\nu_1^i)B + \delta E(B)(1-p) + p\frac{\delta E(B)}{2} \tag{2.24}$$

$$V_L^{-i}(0) = -\nu_1^i Bp + (1-\nu_1^i)B - \frac{p}{2}\delta E(B) \tag{2.25}$$

The continuation payoff follows because with probability $\frac{(1-p)}{2}+\frac{(1-p)}{2} = (1-p)$ the influential sender is either left, or right biased, and lies in the first period, so that the non influential sender can influence second period decision. On the contrary, with probability p, the influential sender is honest, reports the truth in the first period and influences second period decision leading to an expected payoff of $-\frac{\delta E(B)}{2}$. The payoff from lying can be understood analogously. Therefore, biased non influential senders are willing to report the truth if and only if

$$B < \frac{\delta E(B)(1-p)}{2(1-\nu_1^i)} \tag{2.26}$$

If the true state is 1 a right biased sender always reports the truth, while a left biased sender has the following payoff functions:

$$\begin{aligned} V_T^{-i}(1) &= -\nu_1^i Bp - (1-\nu_1^i)B + \frac{1-p}{2}\delta E(B) - p\frac{\delta E(B)}{2} - \frac{1-p}{2}\delta E(B) & (2.27) \\ V_L^{-i}(1) &= -\nu_1^i Bp + (1-\nu_1^i)B - p\frac{\delta E(B)}{2} - \frac{1-p}{2}\delta E(B) & (2.28) \end{aligned}$$

and he is willing to report the truth if and only if

$$B < \frac{\delta E(B)(1-p)}{4(1-\nu_1^i)} \tag{2.29}$$

It is now possible to show the following

Proposition 2.5 *Depending upon the degree of favouritism there can exists two equilibria.*

Proof. See Appendix to Chapter 2 ■

The proposition shows that there can exist two possible equilibria. One in which a biased non influential sender always lies when the true state does not coincide with his preferences, and another in which there are values of period importance such that a biased non influential sender is willing to report the truth while a biased influential sender lies. Their existence depends upon whether the threshold for period importance that ensures a biased non influential sender reports the truth is larger or smaller than the threshold ensuring a biased influential sender reports the truth. In fact, if the latter is larger than the former, there does not exist values of period importance such that a biased influential sender lies while a biased non influential sender is willing to report the truth. Then, in equilibrium biased non influential senders always lie. In the opposite case, it is possible that biased non influential senders report the truth for values of period importance such that the influential sender lies, as biased non influential senders, with a conflict of interest with the decision maker[16], are willing to report the truth only if they have some

[16]This refers to left biased senders when the true state is either the status quo, or state 1, and right biased sender when the true state is the status quo. Right biased non influential senders always report the truth when the true state is 1, independently on the strategy of the influential sender.

chances to influence second period decision and this may occur if the realization of period importance is such that a biased influential sender is willing to lie in the first period.

The results of this section are summarised in the following

Proposition 2.6 *Favouritism induces stronger truthtelling incentives for the influential sender than delegation. It induces stronger truthtelling incentives than communication when the true state is different from the status quo. When favouritism is strong, a biased non influential sender chooses to report the truth for intermediate realizations of period importance.*

Proof. See Appendix to Chapter 2 ■

Favouritism allows the decision maker to provide the influential sender with stronger truthtelling incentives. On the other hand, the non influential sender might lie, and a wrong decision suggested by the non influential sender is implemented with positive probability. When the degree of favouritism is very strong[17], a biased non influential sender reports the truth for period importance realizations that ensure a biased influential sender lies, and that are not extremely large. Therefore, favouritism leads to stronger truthtelling incentives than pure delegation and communication when the true state is different from the status quo.

2.6 Decision Maker Payoff

Previous discussion made clear how competition for influence shapes truthtelling incentives. This section investigates the conditions ensuring the decision maker prefers communication rather than delegation[18]. This choice depends upon four factors. The first is truthtelling incentives, the second is the distribution of period importance for the decision maker, the third is the distribution of period importance for senders, the fourth is the distribution of the states of the world. It should be noticed that the assumed distribution of states of the world is "biased" towards making communication more beneficial than delegation. This follows because it was assumed that the status quo is the most likely state of the world and it was shown that under communication there is always truthtelling, in the first period, when the true state is the status quo. Assuming a different prior distribution of states of the world would not alter the results about truthtelling incentives,

[17]The degree of favouritism is a choice variable of the decision maker who will set ν_1^i so as to maximize her expected payoff.

[18]The comparison with favouritism is similar, it just involves more tedious algebra.

at least as long as states -1 and 1 have the same probability of occurrence, but would make communication less desirable.

In order to establish whether decision maker payoff is larger under delegation or under communication it is crucial to distinguish two cases: in the first the decision maker chooses whether to delegate decision powers to one sender or to rely upon communication, after observing first period importance (both for himself and for the senders), but before senders propose a decision; in the second, decision maker chooses communication or delegation before observing the realization of first period importance. The main intuition can be gained from the analysis of the first case. When the decision maker chooses organizational form after observing the realization of first period importance, the optimality of communication as opposed to delegation depends exclusively upon truthtelling incentives and the distribution of period importance for the decision maker. Then, it is possible to prove the following

Proposition 2.7 *Communication leads to a larger payoff for the decision maker if period importance for senders is low. When period importance is intermediate, delegation can be preferred to communication. When period importance for senders is very high, delegation can be preferred to communication only if period importance for the decision maker and for senders features strong negative correlation.*

Proof. See Appendix to Chapter 2 ■

The first part of the result refers to the case when there is truthtelling in pure strategies both under delegation and under communication. In general (unless period importance for senders and for the decision maker have a very large negative correlation), communication is preferred to delegation for low and high values of period importance[19]. In other terms, when there is truthtelling both under communication and under delegation or when there is no truthtelling either under communication, or under delegation, the former is preferred. The main reason is that communication allows to fully exploit the presence of a non biased action and the conflict of interest between senders with opposed bias. On the contrary, when period importance is intermediate, delegation can be preferred to communication thanks to the stronger truthtelling incentives it induces.

This analysis underlines that truthtelling incentives can be interpreted as incentives for biased senders to pool with honest senders. Delegation can increase such incentives, thus delaying learning about senders' type. Notice that if the decision maker attaches

[19] In fact, when $B > B^{del} = \delta E(B)\frac{2+p}{4}$ and $corr(A, B) > 0$, the condition $A < \delta E(A)\frac{\frac{5}{2}p-1}{3+p}$ is very difficult to meet.

the same importance to decisions as senders do, truthtelling occurs for decisions that the decision maker does not regard as especially important. As truthtelling incentives represent conditions under which biased types pool with honest, the decision maker learns senders types when it is more costly for him to do so. To see this, notice that truthtelling incentives under delegation and communication imply that there is never truthtelling for values of period importance $B > \delta E(B) \max\{(\frac{1}{2} + \frac{p}{4}); (1 - \frac{3}{4}p)\}$, and $\max\{(\frac{1}{2} + \frac{p}{4}); (1 - \frac{3}{4}p)\} < 1$, so that if biased senders pool there is a benefit today of implementing a decision yielding $B < \delta E(B)$, but there are greater chances of making a wrong decision in the second period, when expected importance is $\delta E(B)$. Essentially, the decision maker cannot hedge against agency conflicts, so that when her period importance is very positively correlated with that for senders she prefers to learn as quickly as possible about senders' types. In such a case truthtelling incentives might be bad as they reduce learning about a sender's type.

A further effect arises when the decision maker has to choose between relying upon communication or upon delegation before knowing the realization of first period importance: now, the distribution of first period importance for senders plays a role. Intuitively, the distribution of period importance for senders attributes different weights into the decision maker payoff to the four regions for period importance realizations identified above. In order to provide further results it is necessary to make specific assumptions on the distribution of period importance for the decision maker and that for senders.

These results show that the optimality of delegation as opposed to communication essentially depends upon the importance of the decision for senders.

2.7 Promoting a junior

Previous discussion showed that the decision maker can raise truthtelling incentives by delegating decision powers to a sender elected as "more influential". Delegation is beneficial because it protects influence while maintaining the lost reputation effect. The latter is larger, the more the influential sender fears the opponent is honest. It is thus interesting to extend the model and analyze a situation in which one sender has already an established reputation (the senior), while the other is promising, but has still to prove his qualities (the junior). This is modelled by assuming that one sender has a larger prior probability of being honest, although both have enough reputation to ensure truthtelling occurs in equilibrium. Suppose, without loss of generality, that player s (the senior) is more likely to be honest ex ante. Thus the lost reputation effect will be stronger if player j (the junior) is chosen as the influential sender. The decision maker faces an interesting trade off: on the one hand, delegating power to the player with the more established reputation yields a larger probability to get truthful reporting in both periods because it is more likely that he is honest; on the other hand, a biased sender has stronger incentives to report the truth, the higher the reputation of the opponent. This is reminiscent of the result in the reputation literature that once a player's reputation is more established its incentivizing role fades out. However, in this model, the intuition is very different as it is rather the reputation of the opponent that acts as an incentive mechanism. This can be verified by inspecting the condition for truthtelling for biased senders, under delegation. This is

$$B < \frac{\delta E(B)(1+\frac{p_{-i}}{2})}{2} \equiv \widehat{B}^i \tag{2.30}$$

If the senior is delegated powers, $p_{-i} = p_j$, while if the junior is delegated decision powers, $p_{-i} = p_s$ and it is clear that if $p_s > p_j$, player j has stronger incentives to report the truth in the first period than player s. The choice between a junior and a senior trades off a larger chance that a biased influential sender reports the truth in the first period, against a lower chance that the influential sender is honest. The results for the case when the decision maker delegates power to either sender after observing period importance is along the lines of the analysis conducted in the previous section. Therefore, I will explicitly discuss the case when the decision maker chooses the influential sender before knowing the realization of period importance. By delegating powers to the senior, she gets an expected utility of

$$\begin{aligned} W_s &= p_s[E(A)+\delta E(A)] + (1-p_s)\{[\Pr(B<\widehat{B}^s)[E(A \mid B < \widehat{B}^s) - \frac{\delta E(A)}{2}]+ \\ \Pr(B &> \widehat{B}^s)[\frac{-E(A \mid B > \widehat{B}^s)}{2} + \delta E(A)p_j - (1-p_j)\frac{\delta E(A)]}{2}]\} \end{aligned} \tag{2.31}$$

The first term represents the case in which a biased sender reports truthfully in the first period because the realized first period importance is low enough to sustain truthtelling, while the second represents the opposite case. Following a wrong report in the first period, sender 2 becomes influential in the second period. The expression for the case in which the junior is chosen as the influential sender is analogous and given by

$$\begin{aligned} W_j &= p_j[E(A)+\delta E(A)] + (1-p_j)\{[\Pr(B<\widehat{B}^j)[E(A \mid B < \widehat{B}^j) - \frac{\delta E(A)}{2}]\}+ \\ \Pr(B &> \widehat{B}^j)\Pr(B>\widehat{B}^j)[\frac{-E(A \mid B > \widehat{B}^j)}{2} + \delta E(A)p_s - (1-p_s)\frac{\delta E(A)]}{2}]\} \end{aligned} \tag{2.32}$$

The decision maker is better off by delegating power to sender j if $W_j > W_s$ and this can occur in equilibrium depending upon the distribution of the decision maker's payoff, so that

Proposition 2.8 *Delegating decision powers to a junior can be an optimal policy if the decision maker is interested in ensuring that early decisions are made correctly.*

This analysis predicts that organisations can decide to transfer powers from a senior to a junior as a function of the relative importance of period decisions. A junior has stronger incentives to behave in first period because he has more to loose by misbehaving in early periods. In fact in such a case, if the senior is appointed in the second period, it is very likely he will distort decision making against the preferences of a biased junior.

2.8 Competition among many senders

All results so far rest on the assumption that the decision maker does not interact with more than two senders. This implies that each sender can be pivotal for the decision at least if the true state is different from the status quo. On the contrary, if there are at least three senders, all with the same reputation, there will trivially be truthtelling under communication, if, as assumed in the model so far, the decision maker cannot adjust the intensity of the action as a function of the breadth of the "consensus", or as a function of the probability the message is correct. Notice that this would be true even in a static game. In that case, there would not be any truthtelling equilibrium with two senders, while there could be a truthtelling equilibrium when at least three senders report information. To see what happens if more than two senders report information and the decision maker can adjust the intensity of the decision, suppose there are 3 senders and focus attention on the last period[20]. In a truthtelling equilibrium all senders report the same state. If the decision maker observes two senders reporting state -1 and one sender reporting state 1, she knows at least one sender is lying. She must attach probability $3p^2\frac{1-p}{2}+6p(\frac{1-p}{2})^2+3(\frac{1-p}{2})^3$ that state -1 is correct, because conflicting messages can arise if two senders are honest and one left biased (this occurs with probability $3p^2\frac{1-p}{2}$), one sender is honest, one left biased, one right biased (this occurs with probability $6p(\frac{1-p}{2})^2$), two senders are left biased and one sender is right biased (this occurs with probability $3(\frac{1-p}{2})^3$). On the contrary, state 1 is the true state with probability $3p(\frac{1-p}{2})^2 + 3(\frac{1-p}{2})^3$ because it must be that there are two left biased senders and either one honest or one right biased sender. Then decision -1 is correct with probability

$$\frac{3p^2\frac{1-p}{2} + 6p(\frac{1-p}{2})^2 + 3(\frac{1-p}{2})^3}{3p^2\frac{1-p}{2} + 6p(\frac{1-p}{2})^2 + 3(\frac{1-p}{2})^3 + 3p(\frac{1-p}{2})^2 + 3(\frac{1-p}{2})^3} \tag{2.33}$$

[20] This just simplifies the exposition as it is clear that right biased senders would always report the true state is 1, and left biased senders that the true state is -1. The analysis of the first period would be essentially the same, with the difference that right biased senders might be willing to report information truthfully.

where the denominator represents the probability of observing two messages suggesting the true state is -1 and one message suggesting the true state is 1. If the decision maker observed 3 agreeing messages suggesting the true state is -1, it could be that all senders are honest, or that two senders are honest and one left biased and the true state is -1, one sender is honest, two left biased, and the true state is -1, that all senders are left biased. The total probability of this is $p^3 + 3p^2\frac{1-p}{2} + 6p(\frac{1-p}{2})^2 + \frac{1}{4}(\frac{1-p}{2})^3$. The message can be wrong only if all senders are left biased and the true state is not -1, this event has probability $\frac{3}{4}(\frac{1-p}{2})^3$. Then, action -1 is correct, when observing three agreeing messages with probability

$$\frac{p^3 + 3p^2\frac{1-p}{2} + 6p(\frac{1-p}{2})^2 + \frac{1}{4}(\frac{1-p}{2})^3}{p^3 + 3p^2\frac{1-p}{2} + 6p(\frac{1-p}{2})^2 + \frac{1}{4}(\frac{1-p}{2})^3 + \frac{3}{4}(\frac{1-p}{2})^3} \tag{2.34}$$

Thus, decision -1 is more likely to be correct when the decision maker observes three agreeing messages, than when she observes two messages suggesting it, and one message suggesting action 1 instead. In any equilibrium with information transmission the decision maker would take the action suggested by the majority. However, if she can adjust the intensity of the action she will be more willing to take an action closer to the true state, the larger is the majority. Then, it is reasonable to think that the decision maker will be willing to put more resources on decision -1 in the first case, than in the second. This is true even if senders observe perfectly the state of the world and there is no direct information aggregation effect about the true state of the world. In fact, observing more senders reporting the same message provides information about the type of senders, as in equilibria with information transmission it must be relatively more likely that each sender is reporting information truthfully. In order to investigate the effects of competition for influence when an arbitrary, but finite number of senders report information to the decision maker, I assume the decision maker can adjust the intensity of the decision as a function of the breadth of the consensus among senders. In particular, assuming there are n senders, the decision maker adjusts the intensity of the action so that the payoff will be A^n and B^n in case of maximum consensus, and $A^{\frac{n}{2}+1}$, $B^{\frac{n}{2}+1}$, if there are $\frac{n}{2}+1$ concordant messages and therefore a majority of one or two messages, depending upon whether n is odd or even. As in the two senders model, there will not be equilibria where, in case of disagreement, the decision maker always implements the suggestion of a given sender. If there is no consensus, but at least one of the conflicting messages suggests the status quo, then the latter is implemented, while if there are conflicting messages suggesting actions -1 and 1 and there is no majority, the decision maker prefers to randomize. Consider the case of a left biased sender observing the true state is 1. Suppose also that there are $n+1$ senders, with n even[21]. I denote with l the number of left biased senders, with r that of right biased and with h that of honest senders. Then in a pure strategies truthtelling

[21] The case n odd is essentially analogous.

equilibrium, payoffs under communication from reporting the truth and lying are given by

$$V_T = -B^{n+1}+$$
$$\frac{1}{4}[\sum_{r=0}^{\frac{n}{2}}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{n+1-r})+$$
$$\sum_{r=\frac{n}{2}+1}^{n}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(r+l)}(\frac{1-p}{2})^{l+r}(-\delta E(B^{r}))]$$
$$+\frac{1}{2}\{\sum_{h=1}^{n}\binom{n}{h}p^{h}(\frac{1-p}{2})^{n-h}(-\delta E(B^{f})+$$
$$(\frac{1-p}{2})^{n}[\sum_{r=0}^{\frac{n}{2}}\binom{n}{r}(\delta E(B^{n+1-r})-\sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}(\delta E(B^{r})]\}+$$
$$\frac{1}{4}[\sum_{l=\frac{n}{2}}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{l+1})+$$
$$\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}(-\delta E(B^{n-l}))] \tag{2.35}$$

and

$$V_L = -B^{n}+$$
$$\frac{1}{4}[\sum_{r=0}^{\frac{n}{2}-1}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{n-r})+$$
$$\sum_{r=\frac{n}{2}+1}^{n}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(r+l)}(\frac{1-p}{2})^{l+r}(-\delta E(B^{r}))]$$
$$+\frac{1}{2}\{\sum_{h=1}^{n}\binom{n}{h}p^{h}(\frac{1-p}{2})^{n-h}(-\delta E(B^{f})+$$
$$(\frac{1-p}{2})^{n}[\sum_{r=0}^{\frac{n}{2}-1}\binom{n}{r}(\delta E(B^{n-r})-\sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}(\delta E(B^{r})]\}+$$
$$\frac{1}{4}[\sum_{l=\frac{n}{2}+1}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{l})+$$
$$\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}(-\delta E(B^{n-l}))] \tag{2.36}$$

The expressions follow by the same reasoning as in the two senders case and by noting that senders are "drawn" from a trinomial distribution, with parameters n, p, $\frac{1-p}{2}$. If the sender reports the truth in a truthtelling equilibrium, current period payoff is $-B^{n+1}$ as all $n+1$ senders are reporting the same message. Then in the second period the true state is -1 with probability $\frac{1}{4}$. There will be a majority of messages suggesting state -1 as long as there are no more than $\frac{n}{2}$ right biased senders. This is captured by the term

$$\sum_{r=0}^{\frac{n}{2}}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}\delta E(B^{n+1-r}) \tag{2.37}$$

With probability $\frac{1}{2}$ the true state is 0. If there is at least an honest sender, he reports the truth and the decision maker knows the true state is 0 and sets the intensity to the maximum, which I denote B^f. If there is no honest sender, the decision depends upon whether the majority is left or right biased. The former case occurs with probability $(\frac{1-p}{2})^n\sum_{r=0}^{\frac{n}{2}}\binom{n}{r}$ and the expected payoff is given by $(\frac{1-p}{2})^n[\sum_{r=0}^{\frac{n}{2}}\binom{n}{r}(\delta E(B^{n-r})$, because there is a majority of left biased senders and decision -1 is implemented. The latter case occurs with probability $(\frac{1-p}{2})^n\sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}$, and the expected payoff is given by $-\sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}(\delta E(B^r)]$ because there is a majority of right biased senders and decision 1 is implemented. Then, with probability $\frac{1}{4}$ the true state is 1. With probability $\sum_{l=\frac{n}{2}+1}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}$ there is a majority of left biased senders who induce the decision maker to choose action -1, with intensity $\delta E(B^{l+1})$, while with probability $\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}$ there is a majority either of unbiased, or of right biased senders, and decision 1 is implemented with intensity $\delta E(B^{n-l})$. The payoff from lying can be understood analogously. It should be noticed that when sender i lies, the total number of credible senders in the second period is n. Then, if the true state of the world in the second period is -1, (this occurs with probability $\frac{1}{4}$), decision -1 is implemented when there is a majority of either left biased or of unbiased senders, and this occurs with probability $\sum_{r=0}^{\frac{n}{2}-1}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}$. It can be seen that when there are $\frac{n}{2}$ left biased or unbiased senders, and $\frac{n}{2}$ right biased senders, the decision maker observes exactly the same number of conflicting messages and she randomizes, while, if the $(n+1)^{th}$ sender reported the truth in the first period, he could be pivotal and create a majority of messages suggesting decision -1. The other terms can now be easily understood, and I omit a detailed explanation.

The main effects of competition highlighted in the two senders version of the model are still at work. There is a reduced future influence effect, as the sender does not know whether he will be able to influence next period decision. In fact, there can be a majority of right biased senders, or the true state can be different from -1 and there can be a majority of honest senders. On the other hand there is a lost reputation effect, as next period decision could be influenced by right biased senders, or the true state might be different from -1 and there can be a majority of honest senders. Both effects are further affected by the adjustment in action intensity: if the sender maintains his reputation, he can affect next period decision by changing the breadth of the majority: if all senders are left biased, the intensity will be B^{n+1}, if there is one right biased, the intensity will be B^n, etc. Similarly, the reduced current influence effect depends now upon the ability of the sender to affect the intensity of the decision. There is truthtelling in pure strategies if and only if $V_T > V_L$ which can be rewritten as

$$
\begin{aligned}
& \frac{1}{4}\{\sum_{r=0}^{\frac{n}{2}-1}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}][\delta E(B^{n+1-r})-\delta E(B^{n-r})]\}+ \\
& \frac{1}{4}\{\sum_{l=0}^{\frac{n}{2}}\binom{\frac{n}{2}}{l}p^{\frac{n}{2}-l}(\frac{1-p}{2})^{l+\frac{n}{2}}[\delta E(B^{\frac{n}{2}+1+l})]\}+ \\
& \frac{1}{2}(\frac{1-p}{2})^{n}\sum_{r=0}^{\frac{n}{2}-1}\binom{n}{r}[\delta E(B^{n-r+1})-\delta E(B^{n-r})]+ \\
& +\frac{1}{2}(\frac{1-p}{2})^{n}\binom{n}{\frac{n}{2}}\delta E(B^{\frac{n}{2}+1}) \\
& \frac{1}{4}\{\sum_{l=\frac{n}{2}+1}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}[\delta E(B^{l+1})-\delta E(B^{l})] \\
& +\frac{1}{4}\{\sum_{r=0}^{\frac{n}{2}}\binom{n}{\frac{n}{2}+r}p^{\frac{n}{2}-r}(\frac{1-p}{2})^{r+\frac{n}{2}}[\delta E(B^{\frac{n}{2}+1})]\} \\
> \; & B^{n+1}-B^{n}
\end{aligned}
\tag{2.38}
$$

Now, competition induces a further "consensus" effect: if the sender lies in the current period, he changes the decision from B^{n+1} to B^n. Analogously, keeping a reputation allows to increase the intensity of the decision when this is favourable, and to decrease it when it is unfavourable. Thus, the choice between giving up own reputation and giving up current period payoff will depend upon the interplay of the reduced influence, lost reputation and consensus effects. The latter contributes to determine both the magnitude of the opportunity cost of keeping own reputation and the strength of the future benefit of keeping own reputation. In fact, if the difference $(B^{n+1} - B^n)$ is very small, the sender will not be able to modify much the intensity of the decision in the current period. The benefit of keeping own reputation will depend upon the likelihood next period decision accords to the preferences of the sender. This crucially depends upon the probability distribution of types and upon the strength of the change in intensity of the action when the majority gets larger. The latter is represented by the differences $\delta E(B^{n+1-r}) - \delta E(B^{n-r})$, $\delta E(B^{n-r+1}) - \delta E(B^{n-r})$, $\delta E(B^{l+1}) - \delta E(B^{l})$. Such consensus effect stems from the assumption that the decision maker can now adjust the intensity of the decision. This creates a new dimension to be analysed also when discussing delegation of authority: the decision maker might delegate decision powers, while constraining the ability to set decision intensity. Denoting the latter as B^d, the payoff of a left biased sender who is delegated authority and the state is different from -1 is

$$V_T = -B^d + \delta E(B^d) \tag{2.39}$$
$$V_L = B^d + \delta E(B^d)[\frac{1-p}{2} + \frac{p}{4} - \frac{p}{2} - \frac{p}{4} - \frac{1-p}{2}] \tag{2.40}$$

This follows as it is assumed the proportion of honest, left biased and right biased is the same in the sample of n senders. Then, there is truthtelling as long as

$$B^d < \frac{\delta E(B^d)(1+\frac{p}{2})}{2} \equiv B^{del} \tag{2.41}$$

Whether delegation or communication leads to stronger truthtelling incentives depends upon the parameters of the problem, and it is necessary to impose more structure on the model to get a precise threshold[22]. However, it is clear that in principle either organizational form could be superior, and the main insight of the two senders model carry forward to the n senders case extended to the possibility that the decision maker adjusts the intensity of the decision. This is formalized in the following

Proposition 2.9 *All effects highlighted in the two senders case are still present if n senders compete for influence and the decision maker can adjusts the intensity of the decision.*

Proof. See Appendix to Chapter 2 ■

2.9 Discussion

This section discusses the role of the main assumptions, the modelling strategy, and applications of the model.

[22]For example, it is necessary to establish the way the difference $B^n - B^{n-1}$ evolves as n changes, as well as how large this is in comparison with B^d.

2.9.1 Assumptions and modelling strategy

The model captures, in a parsimonious way, the effects of introducing competition in a dynamic game of information transmission when the bias of senders is not known. The set up of the model is quite standard, and alternative ways to model the bias of senders (such as in Sobel 1985, or in Benabou and Laroque (1992)) would not alter the main results of the model. The assumption that one action is not preferred by any biased type is not critical, as different specifications would work, although it makes communication with multiple senders naturally more attractive, as biased senders would always report information truthfully when observing the state corresponding to the unbiased action. Similarly, the assumption that biased senders derive the same disutility when actions different from their preferred one are implemented, is not essential. Assuming left biased senders prefer state 0 over state 1, would slightly complicate the analysis, but would not alter any of the results.

An important element that deserves further discussion is the definition of competition. Most part of the analysis models competition as a situation where two senders are interacting with the decision maker. However, situations where an arbitrary, but finite, number of senders provide information to the decision maker is discussed in section 8, where it is shown that the main forces at work are the same as in the two senders case. Moreover, with n senders, a further effect, which I label "consensus effect", contributes to shape truthtelling incentives. In order to provide a full treatment of the n senders case it would be necessary to impose more structure on preferences: however, even at a greater level of generality it is possible to conclude that due to the interaction of the reduced influence, lost reputation and consensus effects, there can be cases when delegation may improve upon competition, and situations when the opposite occurs.

Another assumption that deserves further discussion is that senders observe perfectly the state of the world. This impacts on the dynamics of reputation: once a sender makes a mistake his reputation is gone. If he observed the state imperfectly, a mistake could be attributed to him receiving a wrong message, rather than to opportunistic behaviour. In that case, reputation would evolve more realistically over time as, for example, in the paper of Benabou and Laroque. Furthermore, the assumption makes information aggregation useless, and shuts a potential important benefit of competition: if the state of the world was observed noisily, aggregating the messages of multiple senders would increase the precision of the information received, even if some senders reported information strategically. This is clearly an important element, but its inclusion would complicate substantially the analysis preventing a clear investigation of the other effects generated by competition (reduced influence and lost reputation effect). Moreover, situations where experts observe a variable, relevant for decision making, without noise are quite common. Take as an example the evaluation of a report about the prospects of a firm: even if the report is a noisy signal of the true value of the firm, the latter might be observed very far in the future, and the right decisions in the short-medium term could be dependent upon the content of the report. This in turn can influence short or medium term payoffs, which could be the relevant performance measure for the decision maker.

Finally, the assumption that honest senders always report information truthfully is with little loss of generality. Without that assumption, there could exist babbling equilibria in which the decision maker discards all information transmitted and senders randomize among messages, as well as "partial babbling equilibria" in which the decision maker only listens to one sender and discards the messages of the other who randomizes. There are two points to stress on this issue: firstly, all the equilibria derived under the assumption that honest senders always report the truth are still equilibria when that assumption is removed; secondly one could still compare the communication case, in which the decision maker listens to all senders if they have enough reputation, with the partial babbling equilibrium which would coincide with the pure delegation case, and identify the different forces that shape truthtelling incentives.

2.9.2 Applications

The model lends itself to analyse situations characterized by the presence of experts who can provide information relevant for sound decision making and who are interested in influencing the decision making process. The leading application is the analysis of the interaction among managers competing for corporate resources. Managers (the experts) observe information relevant to determine what is the most appropriate decision to maximize firm profits, or financial ratios, or other measures of performance. Managers can be of two types: biased managers derive private benefits from an action which is not necessarily in the best interest of the firm; honest managers do not derive any private benefit and are thus willing to report information truthfully. For example one manager can be the head of domestic operations and another manager the head of overseas operations. The state of the world can be the state of the economy: if the domestic economy is very strong, the central management of the firm (the decision maker) should allocate more resources to the domestic operations department, but not if the overseas economy is growing strongly. If global markets are stagnating, the firm should allocate resources neither to domestic, nor to overseas operations. Biased managers prefer more money to be allocated to their department, irrespective of the state of the economy. The central management observes whether the information provided was correct, and evaluates the reliability of managers for future decisions. The central management can choose to collect information from managers and decide on the appropriate corporate strategy, or can delegate decisions to one of the managers, say, the head of domestic operations. The results of the chapter show that delegation can improve the quality of the decision making process when the importance of the decision is neither too low, nor too high. In the latter cases, the central management should collect information from all managers.

Another interesting application is the analysis of the financing of a new technology on part of governmental bodies. Suppose one team of scientists is working to improve the technology to derive fuel from ethanol, while another team is working on wind energy. The government might be interested in allocating scarce funds to the project which is most likely to succeed. The government can hire different experts from the academia to assess the relative merits of the two and evaluate the one that deserves funds the most. However, some experts could be captured by agricultural lobbies supporting ethanol as it would boost the value of corn crops, while other experts could be captured by some corporations producing components for wind farms. The chapter shows the relative benefits of consulting multiple experts as opposed to rely only on one and shows conditions under which the latter can be preferable.

The results of the chapter can also be applied to the investigation of other important real world interactions such as politicians competing to be elected, lobbies trying to influence politicians, financial analysts providing information to investors, investment banks providing advice to customers, and in general all those situations where experts can have a vested interest in the decision maker choosing a particular action.

2.10 Conclusion

This chapter analysed truthtelling incentives of players competing for influence. Two conflicting forces are identified. On the one hand competition for influence determines a "reduced influence" effect both in the current and in the future period: a biased sender knows he is less likely to influence future decisions, so that he is less willing to sacrifice current payoffs to build a reputation for providing sound advice; however a biased sender is not able to enjoy the full value of a current deviation, thus the opportunity cost of maintaining a reputation is reduced. On the other hand, competition for influence determines a lost reputation effect: biased senders fear that if they deplete their reputation, other senders will influence future decisions. The interplay among these effects generates interesting results and offers novel insights for organisational design. The first is that the decision making process can be less prone to errors if only one sender reports information, as competition may harm decision making. Thus, the quality of decision making can be improved if one sender is delegated authority to make decisions, becoming an "influential sender". This happens because delegation preserves influence. The second result is that decision making could be further improved if the decision maker biases the competition for influence: this shows favouritism can arise as an optimal way to foster truthtelling incentives. The third result is that delegation is optimal if the importance of the decision is neither very low, nor too high. Both routine and very important decisions should rather be assigned to a committee. Thus, this chapter provides a new theory for the allocation of authority and for the use of favouritism in organisations: they arise endogenously as rational organizational responses to the incentives created by competition to influence decision making. The leading application of these results is the analysis of resource allocation among divisions within an organisations, but the insights of the model can be applied to investigate a variety of economic interactions: politicians competing to be elected, lobbies willing to influence politicians, financial analysts providing information to investors, investment banks providing advice to corporate clients.

2.11 Appendix to Chapter 2 - Proofs

Proof of Lemma 2.1

In the last period the sender has no reputational concerns. By reporting his preferred decision he can enjoy a positive payoff, while his payoff is non positive if he does not report his preferred decision. When he does not have enough credibility, he randomizes and the decision maker puts zero weight on the message provided.

Proof of Lemma 2.3

This follows from the fact that when senders have enough credibility, the expected payoff from following their advice is larger than that from making decisions without information. When this is true, as the decision maker has a linear payoff function, it is optimal to set $\nu^{i,m_i,m_{-i}} + \nu^{-i,m_i,m_{-i}} = 1$.

Proof of Lemma 2.5

The expected payoff by randomizing is

$$4p\frac{1-p}{2}(\frac{1}{2}A - \frac{1}{2}A) + 2(\frac{1-p}{2})^2(-\frac{1}{2}A) = -\frac{(1-p)^2}{4}A \tag{A2.1}$$

In fact, conflicting messages -1 and 1 can occur when the decision maker faces an honest sender and a biased sender (this occurs with probability $4p\frac{1-p}{2}$, or when both sender are biased, but one is left biased and the other right biased (this occurs with probability $2(\frac{1-p}{2})^2$). The decision maker might use a strategy that implements action $k \in \{-1, 0, 1\}$ when observing disagreeing messages -1 and 1. In such a case, suppose the true state is -1 and the strategy is "implement state 1 when messages disagree": a left biased sender will report the truth because he has no way to influence the decision maker. A right biased sender, on the contrary, can decide to ensure getting the current period payoff by lying. When observing conflicting messages -1 and 1, the decision maker knows the true state is -1 and will want to deviate from the proposed strategy. The same applies to strategies prescribing to choose 0 when observing messages -1 and 1. The decision maker gets $-\frac{(1-p)^2}{4}A$ by randomizing while gets $4p\frac{1-p}{2}(-A) + 2\frac{(1-p)^2}{4}(0)$ by choosing 0. The latter follows because if there is at least one honest sender, and messages are -1 and 1, by choosing decision zero, the decision maker surely implements a wrong action. If both senders are biased, and messages are conflicting, expected payoff by choosing action zero is $\frac{1}{2}A - \frac{1}{2}A = 0$. It can be seen that $-\frac{(1-p)^2}{4}A > -2p(1-p)A$ which is verified as long as $p > \frac{1}{9}$, and it will be shown that this occurs in any equilibrium with information transmission.Using the same reasoning it is possible to rule out strategies that implement action k in mixed strategies, with asymmetric probabilities.

Proof of Lemma 2.6

Suppose not and suppose that when there is disagreement the action of sender i is implemented. This cannot be true if sender i suggests action -1 and sender $-i$ suggests action zero. In general, sender $-i$ will prefer to tell the truth as she will not be able to influence the current decision, but then, in case of disagreement, the decision maker knows sender i is lying and she will prefer not to abide by the proposed equilibrium strategy.

Proof of Proposition 2.1

The payoff of a biased sender, when the true state is different from the one he prefers, is given by

$$V_T = -B + \delta E(B) \tag{A2.2}$$

if he tells the truth in the first period, and

$$V_L = B - \delta E(B) \tag{A2.3}$$

if he lies in the first period. The necessary condition for a pure strategy equilibrium with truthtelling is $V_T > V_L$, which is verified when

$$B < \delta E(B) \tag{A2.4}$$

The model has a continuum of mixed strategy equilibria. When the true state is 0, both a left and a right biased senders lie. As payoffs are the same, the equilibrium is symmetric and $q^0 = z^0 = q$, therefore, $p_2 = \dfrac{p}{p+(1-p)q}$. The posterior probability that an agent is honest should be high enough in the second period, in particular $p_2 = \dfrac{p}{p+(1-p)q} > \dfrac{1}{3}$ which is verified as long as $q < \dfrac{2p}{1-p}$ which is a necessary condition for a mixed strategy equilibrium to exist. When instead the true state is 1, $z^1 = 1$, and $p_2 = \dfrac{p}{p+\frac{(1-p)}{2}+\frac{(1-p)}{2}q}$, the condition $p_2 > \frac{1}{3}$ then is verified as long as $q < \dfrac{5p-1}{1-p}$. These mixed strategy equilibria occur over a set of measure zero. In fact, it is a measure zero event that parameters are exactly such that the first period importance happens to be

$$B = \delta E(B) \tag{A2.5}$$

Proof of Proposition 2.2

The proof of the first and the second part follows by comparing payoffs from lying and telling the truth and imposing the condition $V_T > V_L$. The fact that the symmetric mixed strategy equilibrium is unique follows by the non-existence of asymmetric equilibria, established by Lemma 5 and 6. Other necessary conditions, for a mixed strategy equilibrium are $0 < q < 1$ and $q < \frac{5p-1}{1-p}$. These yield

$$B < \delta E(B)(1 - \frac{3}{4}p) \tag{A2.6}$$

$$B > \delta E(B)(\frac{1}{2} - \frac{p}{4}) \tag{A2.7}$$

which implies that if a mixed strategy equilibrium exists, a pure strategy equilibrium will not exist and vice-versa. Finally, the condition $q < \frac{5p-1}{1-p}$ implies,

$$B > \delta E(B)(\frac{6 - 13p}{4}) \tag{A2.8}$$

Hence, a mixed strategy equilibrium exists if and only if

$$\delta E(B) \max\{\frac{6 - 13p}{4}; \frac{1}{2} - \frac{p}{4}\} < B < \delta E(B)(1 - \frac{3}{4}p) \tag{A2.9}$$

and it is easy to see that this set is non empty.

Proof of Proposition 2.3

When the true state is zero, the status quo, there always is truthtelling with two senders, while there is truthtelling with one sender only if period importance is not too large. When the true state is different from the status quo, in the one sender case there is truthtelling (in pure strategies) if and only if

$$B < \delta E(B) \equiv B_1^* \tag{A2.10}$$

In the two senders case, truthtelling in pure strategies in the first period occurs iff

$$B < \delta E(B)(\frac{1}{2} - \frac{p}{4}) \equiv B_2^* \tag{A2.11}$$

Truthtelling in pure strategies occurs over a set of parameters of larger measure when there is only one sender, iff

$$\delta E(B) > \delta E(B)(\frac{1}{2} - \frac{p}{4}) \tag{A2.12}$$

which is always verified. There is truthtelling in mixed strategies with two senders if and only if

$$B < \delta E(B)(1 - \frac{3}{4}p) \equiv B_{mix}^2 \tag{A2.13}$$

and

$$\delta E(B) > \delta E(B)(1 - \frac{3}{4}p) \quad \text{(A2.14)}$$

Therefore there is truthtelling in pure strategies with one sender and no truthtelling with two senders.

Proof of Proposition 2.4

It can be seen that delegation generates stronger truthtelling incentives than communication in both the one and the two senders cases. In fact, it is easy to see that

$$\delta E(B)(\frac{1}{2} + \frac{p}{4}) > \delta E(B)(\frac{1}{2} - \frac{p}{4})\} \quad \text{(A2.15)}$$

Moreover,

$$\delta E(B)(\frac{1}{2} + \frac{p}{4}) > \delta E(B)(1 - \frac{3}{4}p) \quad \text{(A2.16)}$$

if and only if $p > \frac{1}{2}$ so that, when the true state in the first period is different from the status quo, and the probability the opponent is honest is relatively large, delegation improves upon communication, as there are values of period importance for which there is truthtelling in pure strategies under delegation and not even truthtelling in mixed strategies under communication.

Proof of Proposition 2.5

I show the conditions ensuring the existence of the equilibria both if the true state is the status quo and if the true state is 1. When the true state is the status quo, a left biased influential sender reports the truth in the first period as long as

$$B < \frac{\delta E(B)(2 + p)}{4\nu_1^i} \quad \text{(A2.17)}$$

and lies otherwise, while non influential senders always lie if

$$\frac{\delta E(B)(1 - p)}{2(1 - \nu_1^i)} < \frac{\delta E(B)(2 + p)}{4\nu_1^i} \quad \text{(A2.18)}$$

which is verified as long as

$$\nu_1^i < \frac{2 + p}{4 - p} \quad \text{(A2.19)}$$

There exists another equilibrium where a left biased influential sender reports the truth as long as

$$B < \frac{\delta E(B)(2 + p)}{4\nu_1^i} \quad \text{(A2.20)}$$

and biased non influential sender lie, while the influential sender lies and biased non influential senders report the truth as long as

$$\frac{\delta E(B)(2+p)}{4\nu_1^i} < B < \frac{\delta E(B)(1-p)}{2(1-\nu_1^i)} \tag{A2.21}$$

and they all lie when

$$B > \frac{\delta E(B)(1-p)}{2(1-\nu_1^i)} \tag{A2.22}$$

and this occurs when

$$\nu_1^i > \frac{2+p}{4-p} \tag{A2.23}$$

In the latter equilibrium, the degree of favouritism is quite strong, so that the non influential sender has little chances to influence current period decision and therefore is more willing to report the truth. This ensures that there are values of period importance such that the influential sender lies and a biased non influential sender is willing to report the truth.

Similarly, when the true state is 1, there exists an equilibrium where the influential sender reports the truth as long as

$$B < \frac{3\delta E(B)}{4\nu_1^i} \tag{A2.24}$$

and lies otherwise, and a left biased non influential sender always lies. Such equilibrium occurs when

$$\frac{\delta E(B)(1-p)}{4(1-\nu_1^i)} < \frac{3\delta E(B))}{4\nu_1^i} \tag{A2.25}$$

which is verified when

$$\nu_1^i < \frac{3}{4-p} \tag{A2.26}$$

There also exists an equilibrium where the influential sender reports the truth and the non influential sender lies for

$$B < \frac{\delta E(B)(2+p)}{4\nu_1^i} \tag{A2.27}$$

the influential sender lies, and the left biased influential sender reports the truth for

$$\frac{\delta E(B)(2+p)}{4\nu_1^i} < B < \frac{\delta E(B)(1-p)}{4(1-\nu_1^i)} \tag{A2.28}$$

which occurs for

$$\nu_1^i > \frac{3}{4-p} \tag{A2.29}$$

Proof of Proposition 2.6

The influential sender reports the truth as long as

$$B < \frac{\delta E(B)(2+p)}{4\nu_1^i} \tag{A2.30}$$

if the true state is the status quo and

$$\frac{(2+p)\delta E(B)}{4\nu_1^i} > \frac{\delta E(B)}{2}(1+\frac{p}{2}) \tag{A2.31}$$

as $\nu_1^i \leq 1$. Moreover, the non influential sender reports the truth if he is honest, or if favouritism is not too strong. According to the degree of favouritism there can be values of period importance such that non influential senders report the truth. When the true state is 1, a left biased sender reports the truth as long as

$$B < \frac{3\delta E(B)}{4\nu_1^i} \tag{A2.32}$$

and obviously

$$\frac{3\delta E(B)}{4\nu_1^i} > \frac{\delta E(B)}{2}(1+\frac{p}{2}) \tag{A2.33}$$

Moreover, the non influential sender reports the truth if he is honest, right biased, or left biased and the degree of favouritism is large enough and period importance is intermediate.

Proof of Proposition 2.7

The proposition can be proved by comparing payoffs for the decision maker for different realizations of period importance. I will also assume that $p > \frac{1}{2}$ so that $B^2_{mix} < B^{del}$ which implies that there exists realizations of period importance such that there is truthtelling in pure strategies under delegation and no truthtelling (not even in mixed strategies) under communication. The logic of the proof for the opposite case is similar and is thus omitted (although the optimality of delegation as opposed to communication over that range of period importance realizations may differ).

- if $B \in [\underline{B}, B_2^*]$, there is truthtelling in pure strategies both under communication and under delegation. In this case expected payoff for the decision maker under communication is

$$\begin{aligned} U^{DM}_{Comm} &= p^2[A+\delta E(A)] + 4p\frac{(1-p)}{2}[A+\frac{3}{4}\delta E(A)] + \\ & (\frac{1-p}{2})^2[4A - 2\frac{1}{2}\delta E(A))] \end{aligned} \tag{A2.34}$$

while that under delegation is

$$U_{Del}^{DM} = p^2[A+\delta E(A)] + 2p\frac{(1-p)}{2}[A+\delta E(A)] + 2p\frac{(1-p)}{2}[A-\frac{1}{2}\delta E(A)] + (\frac{1-p}{2})^2[4A - 4\frac{1}{2}\delta E(A))] \tag{A2.35}$$

The intuition for these expressions is as follows: with probability p^2 both senders are honest and report the truth no matter the state and period importance. Then, the decision maker implements the correct decision ensuring a payoff of A in the first period, and an expected payoff of $\delta E(A)$ in the second. With probability $p\frac{1-p}{2}$, one sender is honest, and the other is biased and as the latter can be left or right biased, the total number of such cases is four. Period importance is low enough so that there is truthtelling in pure strategies in the first period, and payoff is A both under delegation and under communication. In the latter case expected second period payoff is $\frac{3}{4}\delta E(A)$, because with probability $\frac{1}{2}$ the true state is zero, and the decision maker observes a zero message from the honest sender and a non zero message from the biased sender, and learns the true state is zero. With probability $\frac{1}{4}$ the true state accords with the preferences of the biased sender and the decision maker observes two agreeing messages and implements the correct decision. Finally, with probability $\frac{1}{4}$ the true state is opposed to the preferences of the biased sender and the decision maker observes conflicting messages and randomises, so that expected payoff is zero. Under delegation, if the honest sender is delegated decision powers, second period decision is made correctly, otherwise, it is correct only when the true state is the one preferred by the biased sender, and this happens with probability $\frac{1}{4}$. In the other cases, the biased sender implements a wrong decision yielding an expected payoff of $-\delta E(A)$. Finally, with probability $(\frac{1-p}{2})^2$ both senders are biased, either left or right. They report the truth in the first period as period importance is lower than B_2^*, while they lie in the second period. Under communication, there can be 2 cases: both senders have the same bias, or they have opposed biases. In the latter case, which occurs with probability $2(\frac{1-p}{2})^2$, the decision maker observes conflicting messages and randomizes. In the former case, which occurs with probability $2(\frac{1-p}{2})^2$, the decision maker observes agreeing messages and implements the decision preferred by senders. That is correct with probability $\frac{1}{4}$ and wrong with probability $\frac{3}{4}$. Under delegation the decision is correct with probability $\frac{1}{4}$ and wrong with probability $\frac{3}{4}$. It is easy to verify that $U_{Del}^{DM} - U_{Comm}^{DM} = \frac{1-p}{2}\delta E(A)(\frac{-1-3p}{2})$, so that communication leads to a larger payoff for the decision maker.

- if $B \in [B_2^*, B_2^{mix}]$ there is truthtelling in pure strategies under delegation, and truthtelling in mixed strategies under communication, unless the true state is zero.

Payoffs for the decision maker are:

$$\begin{aligned}
U^{DM}_{Comm} &= p^2[A+\delta E(A)] + 4p\frac{(1-p)}{2}\{\frac{3}{4}[A+\frac{3}{4}\delta E(A)] + \\
&\frac{1}{4}[q[A+\frac{3}{4}\delta E(A)] + (1-q)\delta E(A)]\} + (\frac{1-p}{2})^2\{2[\frac{1}{2}(A-\frac{\delta E(A)}{2}) + \\
&\frac{1}{4}(A-\frac{\delta E(A)}{2}) + \frac{1}{4}(q^2(A-\frac{\delta E(A)}{2}) + \\
&2q(1-q)(-\frac{\delta E(A)}{2}) + (1-q)^2(-A))] + \\
&2[\frac{1}{2}(qA+(1-q)(-\frac{\delta E(A)}{2})) + \frac{1}{2}A]\} \qquad \text{(A2.36)} \\
U^{DM}_{Del} &= p^2[A+\delta E(A)] + 2p\frac{(1-p)}{2}[A+\delta E(A)] + 2p\frac{(1-p)}{2}[A-\frac{1}{2}\delta E(A)] + \\
&(\frac{1-p}{2})^2[4A - 4\frac{1}{2}\delta E(A))] \qquad \text{(A2.37)}
\end{aligned}$$

The payoff under communication can be illustrated as follows: with probability p^2 both senders are honest, they report the truth in both periods, and the correct decision is implemented, so the payoff is $[A+\delta E(A)]$. Then, with probability $p\frac{(1-p)}{2}$ one sender is honest and the other biased. As the latter can be left or right biased, the total number of such cases is four. With probability $\frac{3}{4}$ the true state is either the status quo, or the state preferred by the biased sender, who reports the truth in both cases. Then the correct decision is implemented and the payoff is A. In the second period when the true state accords with the biased sender preferences, the decision maker receives two agreeing (and correct) messages, when the true state is the status quo she observes two conflicting messages of which one suggests the status quo so that she learns the true state, finally when the true state is the opposite of the biased sender preferences, the decision maker observes conflicting messages and randomizes, so that overall the expected payoff is $\frac{3}{4}\delta E(A)$. When instead in the first period the true state is the opposite of the biased sender preferences, the latter reports the truth with probability q, retains credibility, and reports the truth in the second period only if the true state agrees with his preferences, otherwise the biased sender lies, in which case the decision maker observes conflicting messages and randomizes, and overall the expected payoff is $\frac{3}{4}\delta E(A)$. However, the biased sender reports falsely in the first period with probability $(1-q)$, the decision maker observes conflicting messages and randomizes, but in the second period only the honest sender retains credibility and the correct decision is implemented (and the expected payoff is $\delta E(A)$). Then, with probability $(\frac{1-p}{2})^2$ both senders are biased. When they have the same bias, if the true state is the status quo, or their preferred state, both senders report the truth in the first period and report their preferred state in the second and the decision maker observes agreeing messages (the term

$(A - \frac{\delta E(A)}{2}))$. If the state of the world is neither the status quo, nor their preferred state, they can both report the truth in the first period, retain credibility and influence second period decision when the decision maker observes agreeing messages (this is represented by the term $q^2(A - \frac{\delta E(A)}{2}))$, or they can both lie in the first period and the decision maker observes agreeing messages, but future reputation will be lost (this is represented by the term $(1-q)^2(-A))$, or one sender lies and the other does not, so that the decision maker observes conflicting messages in the current period and randomizes, and only one sender is still credible in the second period and influences that decision (the term $2q(1-q)(-\frac{\delta E(A)}{2}))$. However, senders can have an opposed bias. In such a case, if the true state is different from the status quo, one sender reports the truth, and the other, who has a conflict of interest with the decision maker, randomizes. When the latter reports the truth, first period decision is made correctly (this is represented by the term qA), but in the second period the decision maker observes conflicting messages and randomizes. When the sender who has conflict of interest lies in the first period the decision maker observes conflicting messages, while in the second period only one sender retains credibility and fully influences the decision (this is represented by the term $(1-q)(-\frac{\delta E(A)}{2}))$. When the state of the world in the first period is the status quo, both senders report the truth (this is represented by the term $\frac{1}{2}A$), while they lie in the second period. However, as they have opposed biases, they send conflicting messages and the decision maker randomizes. Then,

$$\begin{aligned}U^{DM}_{Del} - U^{DM}_{Comm} = 2p(1-p)[\frac{1-q}{4}A - \frac{9-q}{16}\delta E(A)]+ \\ (\frac{1-p}{2})^2[(2(1-q)A - \frac{(3+q^2)}{2}\frac{\delta E(A)}{2}] = \\ \frac{1-p}{16}\{8(1-q)A + \delta E(A)(-15p + 2pq - 3 - q^2 + pq^2\}\end{aligned} \tag{A2.38}$$

In order to investigate the sign of this expression, it is necessary to plug q^* in. However, q^* is function of B and $\delta E(B)$, and it is necessary to make assumptions about the correlation between B and A. I assume they are perfectly correlated, so that $B = A$, and $q^* = \frac{2[\delta E(A)(1-\frac{3}{4}p)-A]}{\delta E(A)(1-p)}$ and this expression is positive if and only if the quadratic equation

$$12A^2 - 6pA\delta E(A) + (\delta E(A))^2(\frac{39}{4}p^2 - 2p - 7) > 0 \tag{A2.39}$$

is satisfied. This implies

$$A < \delta E(A)[\frac{1}{4}p - \frac{1}{6}\sqrt{3\,(9p+7)\,(1-p)}] \tag{A2.40}$$

and

$$A > \delta E(A)[\frac{1}{4}p + \frac{1}{6}\sqrt{3\,(9p+7)\,(1-p)}] \tag{A2.41}$$

The term $\delta E(A)[\frac{1}{4}p - \frac{1}{6}\sqrt{3\,(9p+7)\,(1-p)}]$ is positive for $p > 0.956$. When this does not happen, delegation can dominate communication as long as

$$A > \delta E(A)[\frac{1}{2} - \frac{3}{4}p + \sqrt{(1-p)(1+p)}] \tag{A2.42}$$

However, notice that if period importance for the sender and for the decision maker are positively correlated and that $B < B_2^{mix}$ implies that also A will have a bound, in order to satisfy the conditions ensuring there is truthtelling in mixed strategies under communication and in pure strategies under delegation. Therefore, delegation can dominate communication as long as

$$\delta E(A)[\frac{1}{4}p + \frac{1}{6}\sqrt{3\,(9p+7)\,(1-p)}] < A < \frac{\delta E(A)(4-3p)}{4} \equiv B_2^{mix} \tag{A2.43}$$

and it can be seen that there when $p < \frac{5}{9}$ the inequality A2.43 is satisfied. When, instead $p > 0.956$, there is no value of p, such that condition A2.43 is satisfied. However, it is necessary that

$$\frac{\delta E(A)(2-p)}{4} = B_2^* < A < \delta E(A)[\frac{1}{4}p - \frac{1}{6}\sqrt{3\,(9p+7)\,(1-p)}] \tag{A2.44}$$

and it can be seen that this inequality cannot be satisfied. Therefore, delegation can dominates communication when the importance of the decision is intermediate and the probability experts are honest is relatively low, even if the importance of the decision for experts and for the decision maker are perfectly correlated.

- if $B \in [B^{mix}, B^{del}]$ there is truthtelling under delegation, and no truthtelling under communication if the state is not zero. Payoffs for the decision maker then are:

$$\begin{aligned} U_{Comm}^{DM} &= p^2[A + \delta E(A)] + 4p\frac{(1-p)}{2}[\frac{3}{4}(A + \frac{3}{4}\delta E(A)) + \frac{1}{4}\delta E(A)] + \\ &\quad (\frac{1-p}{2})^2[2(\frac{1}{2}A - \frac{1}{2}\frac{\delta E(A)}{2}) + 2(-\frac{A}{2}) + 2\frac{1}{2}(A - \frac{\delta E(A)}{2})] \qquad \text{(A2.45)} \\ U_{Del}^{DM} &= p^2[A + \delta E(A)] + 2p\frac{(1-p)}{2}[A + \delta E(A)] + 2p\frac{(1-p)}{2}[A - \frac{1}{2}\delta E(A)] + \\ &\quad (\frac{1-p}{2})^2[4A - 4\frac{1}{2}\delta E(A)] \qquad \text{(A2.46)} \end{aligned}$$

Where, in the payoff under communication, the term $2p(1-p)[\frac{3}{4}(A + \frac{3}{4}\delta E(A)) + \frac{1}{4}\delta E(A)]$ represents the case when there is one honest and one biased sender. With probability $\frac{1}{2}$ the true state is zero and both senders report the truth. With probability $\frac{1}{4}$ the true state is the one preferred by the biased sender and the decision maker observes agreeing messages and implements the truth, while with probability $\frac{1}{4}$ the true state is the opposite as the biased sender preferences and the decision maker observes two conflicting messages and randomizes. Therefore the correct decision is implemented with probability $\frac{3}{4}$, while with probability $\frac{1}{4}$ the expected payoff is zero. In the second period, when both senders reported the truth in the previous period, the same reasoning applies, and the correct decision is implemented with probability $\frac{3}{4}$. When instead conflicting messages are observed in the first period, the biased sender revealed his type, and the honest sender is left to influence second period decision, thus expected payoff is $\delta E(A)$. When both senders are biased, which occurs with probability $(\frac{1-p}{2})^2$, they can have either the same, or different biases. In the former case if the true state is the status quo (this occurs with probability $\frac{1}{2}$, they both report the truth in the first period and they both report their preferred state in the second (the corresponding payoff is represented by the term $\frac{1}{2}A - \frac{1}{2}\frac{\delta E(A)}{2}$), while when the true state is different from the status quo, they both report their preferred state which is implemented (this is represented by the term $-\frac{A}{2}$). However, in the second period they have no credibility and expected payoff is zero as the decision maker makes an uninformed decision. Finally, when senders have opposed biases and the true state is the status quo, they report the truth in the first period, retain their credibility and report their preferred state in the second period, and the decision maker observes conflicting messages and randomizes. When the true state is different from the status quo, the sender who has a conflict of interest reports his preferred state, the decision maker observes conflicting messages and randomizes, while second period decision is influenced by the biased sender who did not have a conflict of interest in the first period (this is represented in the term $\frac{1}{2}(A - \frac{\delta E(A)}{2})$). Then:

$$U_{Del}^{DM} - U_{Comm}^{DM} = 2p(1-p)[\frac{A}{4} - \frac{9}{16}\delta E(A)] + (\frac{1-p}{2})^2(3A - \delta E(A)) \qquad \text{(A2.47)}$$

it can be seen that this expression is positive as long as

$$A > \delta E(A)\frac{2+7p}{2(3-p)} \qquad \text{(A2.48)}$$

- Finally, if $B \in [B^{del}, \overline{B}]$ biased senders have no incentives for truthtelling neither under delegation, nor under communication unless the state is zero. Payoffs for the decision maker in such a case are

$$\begin{aligned} U^{DM}_{Comm} &= p^2[A+\delta E(A)] + 2p(1-p)[[\frac{3}{4}(A+\frac{3}{4}\delta E(A)) + \frac{1}{4}\delta E(A)] + \\ &\quad (\frac{1-p}{2})^2[2(\frac{1}{2}A - \frac{1}{2}\frac{\delta E(A)}{2}) + 2(-\frac{A}{2}) + 2\frac{1}{2}(A - \frac{\delta E(A)}{2})] \qquad (A2.49) \\ U^{DM}_{Del} &= p^2[A+\delta E(A)] + p(1-p)[A+\delta E(A)] + p(1-p)[-\frac{A}{2}+\delta E(A)] + \\ &\quad (\frac{1-p}{2})^2[-4\frac{A}{2} - 4\frac{1}{2}\delta E(A)] \qquad (A2.50) \end{aligned}$$

The intuition for these expression is analogous to that of the previous cases. The only difference is in the payoff from delegating power, as in this case, a biased sender who is delegated power lies. This occurs either when there is both a honest and a biased sender and this event has probability $p(1-p)$, or when both senders are either left or right biased and this event has probability $4(\frac{1-p}{2})^2$. In both cases, the expected payoff for the decision maker is $-\frac{A}{2}$, because the biased sender induces his preferred action which coincides with the true state with probability $\frac{1}{4}$, leading to a payoff of A, and does not coincide with the true state with probability $\frac{3}{4}$ leading to a payoff of $-A$. Then, it is easy to see that

$$U^{DM}_{Del} - U^{DM}_{Comm} = p(1-p)[\frac{3}{8}\delta E(A) - A] + (\frac{1-p}{2})^2[-3A - \delta E(A)] \qquad (A2.51)$$

This expression is positive as long as

$$A < \delta E(A)\frac{\frac{5}{2}p-1}{3+p} \qquad (A2.52)$$

and this condition can be verified only if period importance for senders and for the decision maker has a strong negative correlation. In fact, it must be that $B \geq B^{del} = \frac{\delta E(B)(1+\frac{p}{2})}{2}$ and $A < \delta E(A)\frac{\frac{5}{2}p-1}{3+p}$

Proof of Proposition 2.9

In the one sender case, the payoff from reporting the truth is

$$V_T = -B^1 + \delta E(B^1) \qquad (A2.53)$$

while that from lying is

$$V_L = B^1 \qquad (A2.54)$$

The gain from lying in the current period is $2B^1$, the expected payoff from exerting influence in the future is $\delta E(B^1)$, the expected future payoff if own reputation is depleted is zero.

In the n senders case, the gain from lying in the current period is

$$B^{n+1} - B^n \tag{A2.55}$$

Thus, competition reduces current influence as long as

$$2B^1 > B^{n+1} - B^n \tag{A2.56}$$

This is likely to happen, especially if the intensity of the action does not "jump" significantly when the consensus becomes more widespread.

The expected future payoff from keeping own reputation is

$$\frac{1}{4}[\sum_{r=0}^{\frac{n}{2}}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}\delta E(B^{n+1-r}) -$$
$$\sum_{r=\frac{n}{2}+1}^{n}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(r+l)}(\frac{1-p}{2})^{(l+r)}\delta E(B^r)]$$
$$+\frac{1}{2}\{\sum_{h=1}^{n}\binom{n}{h}p^h(\frac{1-p}{2})^{n-h}(-\delta E(B^f) +$$
$$(\frac{1-p}{2})^n[\sum_{r=0}^{\frac{n}{2}}\binom{n}{r}(\delta E(B^{n+1-r}) - \sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}(\delta E(B^r)]\} +$$
$$\frac{1}{4}[\sum_{l=\frac{n}{2}}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{l+1})$$
$$-\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{l+r}\delta E(B^{n-l})] \tag{A2.57}$$

Firstly, it should be noticed that when the true state is 0, it is sufficient that there is only one honest sender to influence the decision away from a left biased sender preferences. Furthermore, the decision goes against the interests of a left biased sender when the true state is 1 and there is not a majority of left biased senders, when the true state is one and there is a majority of left biased senders, or when the true state is 0 and there are no honest senders and a majority of right biased senders. This shows the sender will not be able to cash in the benefit of keeping own reputation with probability one, although it is not possible to directly compare those benefits with the payoff in the one sender case because the expected intensity of the action is typically different from the intensity corresponding to that in the one sender case (which would correspond to a majority of one sender). However, again, if the intensity of the action does not jump too much when the consensus increases by one unit, future influence is reduced under competition.

A benefit of keeping own reputation is the ability to move next period decision towards own interests by changing the majority, so that a favourable decision will be "more favourable" and an unfavourable decision will be dampened. When own reputation is lost, in the one sender case expected payoff is zero, while with n senders it is given by

$$\frac{1}{4}[\sum_{r=0}^{\frac{n}{2}-1}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}\delta E(B^{n-r})$$
$$+\sum_{r=\frac{n}{2}+1}^{n}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(r+l)}(\frac{1-p}{2})^{(l+r)}(-\delta E(B^{r}))]$$
$$+\frac{1}{2}\{\sum_{h=1}^{n}\binom{n}{h}p^{h}(\frac{1-p}{2})^{n-h}(-\delta E(B^{f})$$
$$+(\frac{1-p}{2})^{n}[\sum_{r=0}^{\frac{n}{2}-1}\binom{n}{r}(\delta E(B^{n-r})-\sum_{r=\frac{n}{2}+1}^{n}\binom{n}{r}(\delta E(B^{r})]\}$$
$$\frac{1}{4}[\sum_{l=\frac{n}{2}+1}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}\delta E(B^{l})+$$
$$\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}(-\delta E(B^{n-l}))] \tag{A2.58}$$

and again the decision goes against a left biased sender preferences in the same situations as above. An additional difference is that now n is even, so having lost own reputation prevents the left biased sender to be pivotal in those situations. Here it is possible to say something more, as

$$\sum_{l=0}^{\frac{n}{2}-1}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}(-\delta E(B^{n-l}))=$$
$$-\sum_{r=0}^{\frac{n}{2}-1}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}\delta E(B^{n-r}) \tag{A2.59}$$

and

$$\sum_{r=\frac{n}{2}+1}^{n}\sum_{l=0}^{n-r}\frac{n!}{l!r!(n-r-l)!}p^{n-(r+l)}(\frac{1-p}{2})^{(l+r)}(-\delta E(B^{r}))=$$
$$-\sum_{l=\frac{n}{2}+1}^{n}\sum_{r=0}^{n-l}\frac{n!}{l!r!(n-r-l)!}p^{n-(l+r)}(\frac{1-p}{2})^{(l+r)}(+\delta E(B^{l})) \tag{A2.60}$$

furthermore

$$\sum_{r=0}^{\frac{n}{2}-1} \binom{n}{r} (\delta E(B^{n-r}) = \sum_{r=\frac{n}{2}+1}^{n} \binom{n}{r} (\delta E(B^{r}) \tag{A2.61}$$

so that the lost reputation effect is

$$\frac{1}{2}\{\sum_{h=1}^{n} \binom{n}{h} p^{h} (\frac{1-p}{2})^{n-h} (-\delta E(B^{f}) < 0 \tag{A2.62}$$

and it affects truthtelling incentives as in the two senders game.

Chapter 3

Competition and Opportunistic Advice of Financial Analysts: Theory and Evidence

3.1 Introduction

The scandals involving some of the major players on Wall Street in the first half of this decade, cast dark shadows on the conduct of many financial analysts. The prestige and glamour surrounding the profession during the 1990s, which has been dubbed the "Age of the analysts", has been dissipated. The public debate focussed on searching for the causes of the excessive optimism shown by analysts when producing their reports about companies, as well as for appropriate corrective action. The incentive system influencing the analysts has been considered a major suspect and was put under close scrutiny by policy makers in order to restore confidence in financial information. The industry responded by claiming that analysts overoptimism was not driven by distorted incentives but by psychological biases leading analysts to have too positive an impression of the stocks they followed.

An important question in the debate is to what extent market forces help reducing biases in affiliated analysts recommendations, and consequently to what extent regulatory intervention is desirable. This chapter investigates this issue and provides empirical evidence on the effects of competition on the degree of optimism of affiliated analysts. When more analysts cover a stock, more information is available for investors. That can be helpful in reducing biases in recommendations from affiliated analysts. If overly optimistic recommendations are induced by the presence of conflicts of interests, competition can be beneficial as it softens the potential gains from opportunistic behaviour. If overly optimistic recommendations are induced by psychological biases, competition can be beneficial, as affiliated analysts have more chances to revise their beliefs using the information provided by unaffiliated analysts. From now on, for expositional clarity, analysts working for the lead underwriter of the IPO are dubbed "insiders" while analysts working for other broker houses are dubbed "outsiders". Thus, This chapter addresses the following questions:

1. Are insiders less optimistic when other analysts issued (or are likely to issue) a recommendation on the same stock?
2. Are insiders more likely to issue an optimistic recommendation if they observed an optimistic recommendation from outsiders?

A simple univariate analysis suggests that analysts working for the lead underwriter of an IPO behave differently according to whether they face some competition from outsiders or not. Table 3.1 represents the six month average returns in excess of the CRSP value weighted index[1] as a function of whether the IPO is covered by the insider only, or whether also at least an outsider covered the IPO, and as a function of the recommendation issued by the insider[2]. It also shows the percentage of "strong buy" and "buy" recommendations issued by insiders as a function of the strength of competition from other analysts.

The data document that insider analysts appear to be less optimistic when some outsider covers the stock. The average excess return of IPOs for which insiders issued a "Strong Buy" recommendation with no outsider covering the stock is lower than when some outsider competes providing information on the same IPO. The same happens for "Buy" recommendations. On the other hand, strong buy recommendations are issued much more often (about 60 per cent of the times) when the insider faces no competition, than when some outsider provides coverage of the stock, even tough IPOs covered by both insiders and outsiders had a larger six month excess return. Of course this simple univariate analysis must be enriched to control for variables that could be affecting the incentives of analysts, as well as for the possibility that firms not covered by outsiders are much different (also in terms of quality) from those that receive wider coverage. However,

[1]IPO firms are typically quite small, suggesting the equally weighted index would be a better proxy for the returns of IPO firms. However, the value weighted index is a better proxy for the value of the market returns investors face. Results are qualitatively similar if excess returns are computed using the return on the CRSP equally weighted index.

[2]I listed only "Strong Buy" and "Buy" recommendations, but there were also a few "Hold" recommendations. See Table II.

Table 3.1 Recommendations and Returns

The entries in left cells are six months average returns, in US dollars, in excess of returns on the CRSP value weighted index conditional on recommendations ("Strong Buy" or "Buy") from analysts affiliated with the lead underwriter and on whether non affiliated analysts covered the stock (Competition versus No Competition). The entries in right cells are the fraction of "Strong Buy" and "Buy" recommendations issued by insider analysts, again conditional on whether non affiliated analysts covered the stock The left panel labeled as "competition" refers to situations in which some analyst non affiliated with the lead underwriter covered the stock.

	Competition		No Competition	
Strong Buy	Excess Return	% of recomm.	Excess Return	% of recomm.
	0.26	50.6	0.008	60.2
Buy	Excess Return	% of recomm.	Excess Return	% of recomm.
	0.71	47	0.035	38.4

Table 3.1 represents a first sign that insider analysts may change their behaviour when competition from outsiders is stronger.

The behaviour summarized in Table 3.1 could be driven either by distorted incentives, or by psychological biases. In fact, if insiders are psychologically biased in that they observe too positive a signal about the IPO, but are rational in updating their information, they will be less optimistic when observing the unbiased signal contained in recommendations from outsider analysts. Then, I will test whether insiders are influenced by the information provided by outsiders. If that is not the case, their overoptimism cannot be attributed to rational Bayesian updating, providing indirect evidence in favour of the view that attributes affiliated analyst overoptimism to the presence of conflict of interests. Thus, a further important contribution of This chapter is that it provides evidence allowing to distinguish between the main competing explanations for the overoptimism of analysts affiliated with the lead underwriter of the IPO.

The growing interest in the behaviour of financial analysts prompted the appearance of many important papers investigating different dimensions of the issue. Some document overoptimism in forecasts and recommendations from sell-side analysts. Rajan and Servaes (1997) show that analysts forecasts of IPOs future earnings are overoptimistic and they are even more so for more underpriced IPOs and over longer time horizons. Michaely and Womack (1999) show that sell side analysts are systematically more optimistic than other analysts in their recommendations. Michaely and Womack (2004) review the literature and discuss the different theories brought forward to explain overoptimism from sell side analysts. In the context of IPOs that is especially true for analysts affiliated with the bookrunner (lead underwriter) of the IPO. In particular they stress two major hypotheses: the first, which I label the "opportunistic view", maintains that sell side analyst overoptimism is driven by incentives. The bookrunner profits by placing shares of the IPO on the market and from trading commissions. Therefore a positive recommendation boosts both channels. The second hypothesis, which I label the "naive view", suggests that analysts following the company through the due diligence process become truly convinced of the superior quality of the firm just like parents see their kids under an especially positive light.

Other papers point attention on the role of reputation and career concerns in influencing analyst behaviour. Hong and Kubik (2003) focus on analysts career concerns and discuss the effects of earnings forecast precision on job separation. They show that controlling for accuracy, analysts that tend to be more optimistic are more likely to experience favorable job separations. This evidence suggests that career concerns could be a driver for bookrunner analysts overoptimism. Jackson (2005), using Australian data, shows that there is a positive relationship between reputation and performance and also that more accurate analysts acquire a higher reputation. Fang and Yasuda (2006) document, on US data, that there is a positive relationship between reputation and forecast quality. They also show that the relative accuracy of more reputable analysts deteriorates during hot market periods when the gains from opportunistic behaviour are greatest. Fang and Yasuda (2007) investigate the effect of personal reputation on the values of analysts' stock recommendations. They show that recommendations of more reputable analysts working at top-tier banks outperform those of all other analyst subgroups in both buy and sell category. They also provide evidence suggesting that reputation seems to play a disciplinary role in the face of conflicts of interest. Finally, they show that more reputable analysts were faster in downgrading their buy recommendations in the bear market than less reputable analysts. This evidence suggests that reputation can provide important incentives to discipline analyst having possible conflicts of interest with investors. The existing literature provides a starting point for the present work: there is evidence of sell side analysts overoptimism and there is evidence that reputational concerns are important for analysts.

There are some important papers that investigate whether the documented optimism of sell side analysts influences firms and investors. Ljungqvist, Marston and Wilhelm (2005) investigate whether analyst behaviour influences the likelihood of banks winning underwriting mandates. Their results suggest that optimistic behaviour does not increase the chances of winning a mandate. However, they do find that analysts are more optimistic when the fees at stake are larger. Blanes-i-Vidal (2004) provides evidence that investors react more to unfavourable earnings forecast than to favourable ones, and that the difference in this reaction is higher when the investor has a greater prior suspicion that the analyst is a biased type. Agrawal and Chen (2007) confirm that sell side analysts tend to issue overly optimistic recommendations, but that investors are able to discount analysts opinions. The last two papers seem to suggest that it might not be necessary to worry much about analysts providing biased information, as investors are able to discount the bias embedded in analysts recommendations and forecasts. However, analysts overoptimism can harm investors if analysts provide favourable information when they should have provided unfavourable information instead. Furthermore, the evidence does not allow to conclude that investors are able to fully discount the bias contained in analysts information, and thus analysts may still be able to influence investors, although not fully. Finally, the information provided by sell side analysts is especially important in the case of IPOs, as relatively little information on such companies is available to investors and to other non affiliated analysts. Thus even if some sophisticated investors may be able to discount, at least in part, the biases contained in analyst opinions, such biases can still harm market players especially in the case of recently listed companies. Therefore, it is interesting to investigate to what extent competition in the production of information from non affiliated analysts helps disciplining affiliated analysts.

The theoretical model formalizes the interaction among analysts and investors as a dynamic cheap talk game. This is related to the contributions of Sobel (1985), Benabou and Laroque (1992), Morris (2001). The main step ahead from these papers is that multiple sources of information are introduced and their influence is studied in detail. The focus on the effects of competition is shared with Horner (2002). The main difference is that Horner (2002) do not deal with a cheap talk model and the uninformed party can interact with only one informed agent in each period. Finally, Morgan and Stocken (2003) propose a theoretical model showing the existence of equilibria where information from analysts is transmitted using categorical ranking systems. However they do not analyze the effect of competition.

The chapter proceeds as follows: section 3.2 outlines the theoretical model, section 3.3 discusses the testable predictions, section 3.4 outlines the identification strategy, section 3.5 describes the dataset, section 3.6 presents the empirical results, section 3.7 discusses the effect of selection, section 3.8 discusses assumptions and results, section 3.9 concludes, the appendix contains proofs of propositions and tables with estimation results.

3.2 A Model of Analyst Behaviour

The interaction among analysts and investors is modelled as a dynamic cheap talk game: analysts privately observe the realization of a random variable that provides information about the quality of the firm and send a recommendation to investors. The latter adjust their portfolios possibly using the information provided by analysts. Insider analysts have a conflict of interest: they would like to report favorable information, so as to induce investors to purchase the stock, even when they observe a negative signal, because they are incentivized to do so by their employer. Each analyst is characterized by a type (careerist, not careerist) which is constant over time and across firms, and a condition (insider, outsider) which is constant over time for a given firm. The type of analysts is modelled as follows: the careerist type is willing to enjoy the current profit as he cares both about his future reputation, and about conforming to the interests of the bank he works for. On the contrary, a non - careerist type wishes to report the truth anyway, because of, say, strong moral characteristics that induce very large costs from behaving opportunistically[3]. The market appreciates non - careerist analysts because their incentives are aligned to those of investors.

Players: there are one insider (he), one outsider (he) and one investor (she).

Timing: Agents interact over time repeating the same stage game (evaluation of an IPO and portfolio investment decision). The timing of the stage game is as follows:

1. Analysts receive a signal about the quality of the IPO and report it (issue a recommendation) immediately as soon as they observe it. Hence, no strategic delay is allowed. The outsider analyst might not cover the stock. In that case he receives no information and issues no recommendation. The insider does not know whether an outsider covers the stock. Recommendations are publicly observed.

2. The investor adjusts her portfolio each time she observes a recommendation, provided the recommendation has enough credibility (notice that it is optimal for her to do so as I am assuming no adjustment costs).

3. Payoffs are realized and all players observe whether the recommendation was correct. Therefore the reputation of an analyst is public information.

Information Structure: agents can be of two types, careerist and non - careerist. The prior probability of the latter event is λ. An analyst's type is drawn at the very beginning

[3] Notice that even a small fraction of such analysts is sufficient to generate the results.

of the game and is private information. The investor and the other analyst share the same beliefs about an analyst's type. Analysts also privately observe a signal s about the realization of a binary random variable $\Theta = \{L, H\}$ representing the quality of the firm. The precision of the signal depends upon whether the analyst is an insider as insiders get more informative signals than outsiders. Formally,

$$\begin{array}{l} Prob(\theta = Y \mid s = Y, \, Insider) = a \\ Prob(\theta = Y \mid s = Y, \, Outsider) = b \end{array}, \; Y = L, H, \; where \; a > b > \frac{1}{2}$$

ensures that insider agents get a more informative signal than outsiders. The probability the signal of the insider is correct does not affect the probability the signal of outsiders is correct, and vice versa. Formally,

$$\begin{array}{rl} Prob(Outsider\ correct & \mid \; Insider\ correct) = b \\ Prob(Insider\ correct & \mid \; Outsider\ correct) = a \end{array}$$

This assumption implies that no information about the true signal observed by an analyst can be extracted from the observation of the correctness of the recommendations issued by other analysts on the same stock. Notice that this assumption implies that the presence of outsider analysts does not impact the reputation of the insider analyst[4], and only affects his chances to fully enjoy current profit if he lies. Without this assumption, the presence of outsiders will also affect the updating about the insider reputation.

Contracts: monetary transfers contingent on the correctness of the recommendation are not feasible.

Analyst Strategies: analyst's actions in each period are $m : S \to M$; where m is a mapping from the set of signals $S = \{L, Y\}$ to the set of recommendations $M = \{sell, buy\}$. Attention is limited to Markovian strategies, i.e. strategies that depend upon history at time $t-1$ only. Strategies are probabilities of truthful reporting $q_t^{i,j}$, where i denotes an agent type, j denotes the state observed, and t the time period.

Analyst Payoffs: the payoff of analysts is comprised of a wage which is increasing in his reputation and, when he is an insider, of a term which depends upon his ability to induce investors to purchase shares of the IPO. Formally, the payoff of a careerist insider

[4]There exists a relatively large literature on herd behaviour of financial analysts. That does not arise in this model as outsider analysts essentially are "committed types" and insider analysts do not observe the signal of outsiders. In the latter case, insiders may disregard their more precise information and report favourable information upon observing a favourable report from outsiders as this would entail a lower reputational loss. In this case, we should observe that insider analysts are more optimistic following an optimistic recommendation from outsiders. This possibility is further investigated empirically in section V-B.

is $U = w(\lambda_t) + g\alpha^+ + \delta V(\lambda_{t+1})$ where w is a wage increasing in the reputation of the analyst for being non - careerist (the intuition is that these are the analysts most valued by investors, though not necessarily by investment banks)[5]. This assumption is motivated by the fact that analysts are nominated in the All American League by institutional investors and there is evidence that such analysts earn higher wages. The term $g\alpha^+$ represents the payoff from inducing investors to purchase the stock, g is a positive constant and α^+ represents the amount of shares bought by the investor[6]. Thus, I am assuming the analyst gains if investors purchase the stock, while he does not gain anything if investors do not purchase, or sell, the stock. Those gains can derive both from trading commissions[7], and from the fact that stronger demand for the stock raises its price[8]. Finally, the term $\delta V(\lambda_{t+1})$ represents the future gains from having reputation λ_{t+1}, V is continuous and increasing in λ, and $\delta < 1$ is a discount factor. The function U is continuous and maps the set of non negative real numbers ($\mathbb{R}_0^+$) into itself. Non - careerist insiders payoff features a cost of lying, high enough so that they will always find it optimal to report information truthfully, setting $q = 1$. Outsiders, either careerists, or not, have a payoff $U = w(\lambda_t) + \delta V(\lambda_{t+1})$ and they do not gain anything by misreporting information, so that they always report the truth. Finally, to ease the analysis, it is assumed that insiders face the risk of getting a punishment from their employer if they are discovered reporting low prospects after having observed good prospects for the firm. The employer can go to court and bring verifiable evidence. Such punishment is large enough so that insiders always report the truth if they observe a good signal (notice that this might not be necessarily the case, in equilibrium, for careerist insiders[9]). Therefore it follows that

$$q_t^{NC,H} = 1$$

$$q_t^{NC,L} = 1$$

[5]Therefore investment banks are forced to link wage to the chances the analyst is non careerist because such analysts increase the appeal of the bank to investors, even if banks would prefer careerist types. The wage function could also include a component linked to the chances of internal career (which could then be decreasing in the probability the analyst is non careerist) without altering the basic insight of the model. However, if the internal career motive becomes too strong, insiders will have stronger incentives to misreport information and in equilibrium their credibility could be compromised.

[6]Technically this is the positive part of the optimal demand of the investor. Such demand can be negative, as the investor may sell (or short sell) the stock. In that case, the analyst gains nothing.

[7]Trading commissions could also be generated by sales of the stock. However investors often face short selling constraints which reduce that possibility so that trading commissions are mostly generated by investors purchasing the stock. See Jackson (2005) on the latter point.

[8]A higher price for the stocks of the company can benefit both the broker house, which is perceived as one that is willing to provide favourable coverage of the stock by its analysts, and the investors that acquired the IPO in the first day of trade, which often are among the best clients of the broker house.

[9]This follows because if in equilibrium careerist types find it optimal to report optimistically when observing that the state is low, they can also have incentives to "pool" with non careerist and report a low state more often than what own information would dictate. This is essentially the "political correctness" effect highlighted in Morris (2001).

$$q_t^{C,H} = 1$$

where NC refers to *non - careerist* and C to *careerist.* Hence, non - careerist analysts always report truthfully, while careerist analysts always report truthfully if they observe the firm prospects are good. It remains to determine $q_t^{C,L}$, the probability a careerist analyst reports the truth when he observes the firm has bad prospects, and this will be determined in equilibrium. To ease notation, from now on, $q_t^{C,L} = q_t$.

Investor Payoff: The stock provides a return R_H in the high state, and R_L in the low state. The investor can put her money (normalized to one unit of wealth) either in the stock, or in a riskless asset that yields a return R_f. I assume that $R_L < R_f < R_H$. Thus the payoff of the investor is given by

$$\frac{1}{2}\Pi(\alpha R_H + (1-\alpha)R_f) + \frac{1}{2}\Pi(\alpha R_L + (1-\alpha)R_f) \tag{3.1}$$

as the good and bad states are equally likely. The term α is the holding of the stock by the investor. The utility function Π is continuous and differentiable at least twice. Moreover, $\Pi_\alpha > 0$, $\Pi_{\alpha\alpha} < 0$ (so as to ensure a unique interior solution). I assume the investor starts with no stocks in her portfolio[10]. The investor sets α as a function of the likelihood the messages received are correct. An insider analyst is credible as long as $\lambda_t a + (1-\lambda_t)[a + (1-a)(1-q_t)] > \frac{1}{2}$. If this is not verified, the investor ignores the recommendation from the insider. When recommendations are credible, and only the message of the insider is available, the probability that buy is the true state conditional on a buy recommendation from the insider is given by

$$p = \frac{\lambda_t a + (1-\lambda_t)[a + (1-a)(1-q_t)]}{\lambda_t a + (1-\lambda_t)[a + (1-a)(1-q_t)] + \lambda_t(1-a) + (1-\lambda)[(1-a) + a(1-q_t)]} =$$
$$\frac{\lambda_t a + (1-\lambda_t)[a + (1-a)(1-q_t)]}{1 + (1-\lambda_t)(1-q_t)} \tag{3.2}$$

and the investor sets the optimal α as the solution of the program

$$Max_\alpha \;\; p\Pi(\alpha R_H + (1-\alpha)R_f) + (1-p)\Pi(\alpha R_L + (1-\alpha)R_f) \tag{3.3}$$

It is easy to see that α is increasing in p, which in turn increases in q. In fact the first order condition yields

$$[p\Pi_\alpha(\alpha R_H + (1-\alpha)R_f)(R_H - R_f) + (1-p)\Pi_\alpha(\alpha R_L + (1-\alpha)R_f)(R_L - R_f)] = 0 \tag{3.4}$$

[10] This assumption is motivated both by the fact that the stock began trading recently and by the desire to avoid introducing additional notation to denote the initial stock holdings. All results are essentially unchanged if it is assumed that agents starts with positive holdings of the stock.

and the implicit function theorem yields

$$\frac{d\alpha}{dp} = \frac{-[\Pi_\alpha(\alpha R_H + (1-\alpha)R_f)(R_H - R_f) - \Pi_\alpha(\alpha R_L + (1-\alpha)R_f)(R_L - R_f)]}{[p\Pi_{\alpha\alpha}(\alpha R_H + (1-\alpha)R_f)(R_H - R_f)^2 + (1-p)\Pi_{\alpha\alpha}(\alpha R_L + (1-\alpha)R_f)(R_L - R_f)^2]} \tag{3.5}$$

which is positive as $\Pi_{\alpha\alpha} < 0$. Notice that a sell recommendation will be taken at face value because careerist types never report a negative recommendation when observing a good signal as they could be punished by their employer. Therefore, following a sell recommendation from the insider, α is set independently of λ, the probability the insider is non - careerist. This implies that $p = 1 - a$ and α is set optimally independently of the analyst reputation[11].

When outsiders issue their recommendation, they might be influenced by the signal reported by insiders. However, as the recommendation reported by insiders does not provide any information about the type of the outsiders, the latter has no reason to report a recommendation different from the signal he observed[12]. Hence, if the investor also observes the recommendation of the outsider, the probability that buy is the correct action is represented by:

$$p_o^{b,b} = \Pr(buy \mid buy, buy) = \frac{bp}{bp + (1-b)(1-p)} \tag{3.6}$$

where the notation indicates that a recommendation from the outsider has also been issued, and that the recommendation was a buy. As $p_o^{b,b} > p$, a buy recommendation from an insider is reinforced by a buy recommendation from the outsider. On the contrary, a sell recommendation from an outsider reduces the probability that buy is the true state when the investor observes a buy message from an insider and a sell message from the outsider. In fact:

$$p_o^{b,s} = \Pr(buy \mid buy, sell) = \frac{(1-b)p}{(1-b)p + b(1-p)} \tag{3.7}$$

it is easy to see that $p_o^{b,s} < p$, so that now the investor will buy less shares of the company, as α is increasing in p. Notice that if the probability the insider is non - careerist is not

[11] Allowing insiders to strategically report a sell recommendation when observing a good signal about the company, an effect similar to Morris (2001), would imply that the more reputable the insider, the more it hurts him to issue a sell recommendation as in that case $\frac{\partial\alpha}{\partial p} < 0$ and the sensitivity of α to p will be increasing in the reputation of the insider, so that a sell recommendation by a more reputable insider induces the investor to invest less than if the recommendation was issued by an insider with lower reputation. This is not the case here as a sell recommendation surely means the insider observed a negative signal on the company and the probability the signal is correct is just a.

[12] In fact the payoff of the outsider depends upon his present and future reputation, and inference about the latter is not affected by the recommendation reported by the insider, due to the assumption that *Prob(Outsider correct | Insider correct) = Prob(Outsider correct) = b*.

large enough to ensure his recommendation is credible, then the message of the insider will be ignored and the only equilibrium involves babbling from the insider. I assume that returns are such that $\alpha > 0$ even when the investor observes two sell recommendations. That is the most general case. Situations when the investor (short) sells the stock after observing one or two "sell" recommendations are essentially analogous[13].

Beliefs: First of all, there is no updating on the type of the outsider, as outsiders are committed types and report the truth. The market updates the reputation of an insider analyst for being non - careerist according to Bayes rule, so that:

$$\begin{aligned}
\Pr(non - careerist \mid Buy, True) &= \lambda^{B,+} = \frac{a\lambda_t}{a\lambda_t + (1-\lambda_t)[a + (1-a)(1-q_t)]} \\
\Pr(non - careerist \mid Buy, Wrong) &= \lambda^{B,-} = \frac{(1-a)\lambda_t}{(1-a)\lambda_t + (1-\lambda_t)[(1-a) + a(1-q_t)]} \\
\Pr(non - careerist \mid Sell, True) &= \lambda^{S,+}_{t+1} = \frac{\lambda_t}{\lambda_t + (1-\lambda_t)q_t} \\
\Pr(non - careerist \mid Sell, Wrong) &= \lambda^{S,-}_{t+1} = \frac{\lambda_t}{\lambda_t + (1-\lambda_t)q_t}
\end{aligned}$$

It is useful to state a preliminary result.

Remark 3.1 *A careerist insider never reports information truthfully with probability 1.*

In fact in such a case, $\lambda^{S,+}_{t+1} = \lambda^{S,-}_{t+1} = \lambda^{B,+}_{t+1} = \lambda^{B,-}_{t+1} = \lambda_t$. Then, there is no reputational gain from reporting the truth, and thus lying is always optimal. This, however, contradicts the fact that $q = 1$.

Equilibrium: the equilibrium concept is Perfect Bayesian Equilibrium. The game can be reduced essentially to a static game[14]. The equilibrium is a set of beliefs L about the insider analyst type, probability of truthtelling $0 \leq q_t < 1$ and an optimal investment strategy α for the investor so that

$$\alpha \in \arg\max E\Pi$$

the insider behaves optimally and beliefs are confirmed in equilibrium and evolve according to Bayes rule. The payoff of the insider from reporting the truth, when observing the true state is low is given by

$$U_T = gE[\alpha \mid s, z] + \delta[aV(\lambda^{S,+}) + (1-a)V(\lambda^{S,-})] \tag{3.8}$$

[13]In those situations the analyst does not gain anything.

[14]I assumed that the analyst cares about his reputation as represented by the term $V(\lambda)$ in the payoff function. In a previous version of the model, I proved the existence of a unique equilibrium in which reputation has value in an infinite horizon game, along the lines of Benabou and Laroque (1992).

while that from lying is

$$U_L = gE[\alpha \mid b, z] + \delta[aV(\lambda^{B,-}) + (1-a)V(\lambda^{B,+})] \tag{3.9}$$

and the insider decides whether to lie or to randomize[15], so that

$$U_T \leq U_L$$

In both expressions, $V(.)$ is the continuation value. This formulation implies that the payoff of the insider depends upon the effectiveness of his recommendation: if the investor has more trust in the analyst, then α will be larger and the current gain amplified. The term $gE[\alpha \mid j, z]$, where $j = s, b$, represents the expected gains for the analyst which in turn depend upon the optimal strategy of the investor. The expected gain for the analyst is function of the probability z the outsider issues a recommendation on the company. This in turn can depend upon company observable characteristics, such as industry, size, upon how hot the IPO market is and upon the general conditions of the market. The expectation is conditional upon whether the recommendation issued by the insider was a buy or a sell, and of course $gE[\alpha \mid b, z] > gE[\alpha \mid s, z]$. I firstly prove there is a unique equilibrium probability of truthtelling, then I turn to analyze the effect of competition.

Proposition 3.1 *The game has a unique equilibrium probability of truthtelling q_t.*

Proof. See Appendix 1 ∎

Now, it is possible to analyse the effects of competition on truthtelling incentives. The answer can be found by inspecting $gE[\alpha \mid b, z]$ and $gE[\alpha \mid s, z]$. These are equal to

$$\begin{aligned} gE[\alpha \quad | \quad b, z] = zg\{a[(1-b)\alpha(p_o^{b,b}) + b\alpha(p_o^{b,s})] + (1-a)[b\alpha(p_o^{b,b}) + \\ (1-b)\alpha(p_o^{b,s})]\} + (1-z)g\alpha(p) \end{aligned} \tag{3.10}$$

and

$$\begin{aligned} gE[\alpha \mid s, z] = \quad & zg\{a[(1-b)\alpha(p_o^{s,b}) + b\alpha(p_o^{s,s})] + (1-a)[b\alpha(p_o^{s,b}) + \\ & (1-b)\alpha(p_o^{s,s})]\} + (1-z)g\alpha(1-a) \end{aligned} \tag{3.11}$$

The continuation value does not depend upon the probability outsiders issue a recommendation, while the expected gains do.

Before deriving the effect of competition, I add the following simplifying assumption

[15] Remark 1 shows that $q = 1$ implying $V_T > V_L$, cannot occur in equilibrium.

Assumption 3.1: the function α is linear in the probability the stock is good (conditional on observed recommendations).

Then, it is possible to prove the following

Proposition 3.2 *Competition increases truthtelling incentives.*

Proof. See Appendix 1. ■

This proposition shows that competition increases truthtelling incentives. The intuition is that when outsiders are likely to issue a recommendation, the short run gains for insiders by misreporting information are smaller. In fact, when the insider observes a negative signal on the stock, outsiders are relatively more likely to observe a negative signal and report a sell recommendation. Then, the investor will reduce the amount of shares purchased, and this impacts negatively on the gains from misreporting information. Assumption 3.1 is quite important for this result. In fact, if the function α is very convex, it could be that investors sensibly increase their demand for the asset upon observing a buy recommendation from both the insider and the outsider. Then, the insider may gain very much from reporting a buy recommendation when it is more likely that outsiders issue a recommendation on the stock. In fact, outsiders may observe a wrong signal and issue a buy recommendation. Even if this happens with a low probability, it can lead to large gains if investors react sharply[16]. This situation, however, seems quite special, and unlikely to be occur in practice.

Finally, it is left to discuss how results are affected if outsiders issue a recommendation before the insider does. All results are similar. If the insider observes the outsider reports a buy recommendation, she will be more willing to misreport information. However, on average, when the true state of the company is poor, outsiders will issue a sell recommendation, and, in this case, the insider has weaker incentives to misreport information. The model predicts that the insider is relatively more willing to report a buy recommendation, independently of the recommendation of the outsider. Furthermore, even when the outsider issues a buy recommendation the insider is willing to randomize between reporting information truthfully and lying. Thus, the model predicts that the correlation between the probability the insider issues a positive recommendation and the probability

[16]Notice that the same logic would hold in a model where short run gains for insiders are not affected by the presence of outsiders, but recommendations from outsiders provide information about the signal observed by the insider. In fact, even if reputational losses of reporting a wrong buy recommendation when outsiders reported a sell recommendation increase, the gains from reporting a buy recommendation when outsiders report a buy recommendation can be quite large. That depends upon the shape of the continuation value function V.

the outsider issues a positive recommendation can be quite low. That would not be the case if insiders were optimistically biased and updated their beliefs according to the recommendation issued by the outsider. This point will be exploited to distinguish between the opportunistic view and the naive view.

3.3 Testable Hypotheses

The model underlines that competition is expected to increase truthtelling incentives. The model assumes that insider analysts are rational and driven by incentives. This is the view taken by the New York attorney - general, Eliot Spitzer, as well as by a large part of the press, about the financial scandals of 2002-2003. An alternative hypothesis suggests that analysts are truly convinced of the superior quality of the stocks they follow, so that they receive an optimistically biased signal but do not realize it. Then there can be two possibilities: the first is that analysts are totally naive and ignore the information that could be conveyed by recommendations issued by outsiders. In such a case, insider analysts should be more optimistic independently of whether they observe information provided by other analysts. The second possibility is that analysts, though optimistically biased, are rational in updating their beliefs. Then, if they are the first to issue a recommendation, they report their biased signal at face value. On the contrary, when an outsider issues a recommendation they update their signal and make a less optimistic, though positively biased, recommendation. Then the "naive view" predicts the same empirical behaviour as the "opportunistic view".

However, it is possible to distinguish between these hypotheses by testing whether the behaviour of insider analysts is affected by that of outsiders. This is a possibility suggested by the theoretical model. In fact the model predicts that the insider is willing to randomize between reporting information truthfully and lying even after observing the outsider reported a positive recommendation. Thus, the model predicts that the correlation between the probability the insider issues a positive recommendation and the probability the outsider issues a positive recommendation can be quite low. This would not be the case if insiders were optimistically biased and updated their beliefs according to the information contained in the recommendations issued by outsiders. This point will be exploited to distinguish between the "opportunistic" and the "naive view".

To sum up, the following hypotheses are brought to empirical test:

- H1: Insiders are more optimistic when it is more likely that outsiders issue a recommendation about the stock, so that insiders face more competition.

- H2: The extent to which insiders issue an optimistic recommendation is not influenced by the observation of previous optimistic recommendations by outsiders.

The next section discusses the identification strategy where these hypothesis are developed and made operational.

3.4 Identification Strategy

3.4.1 Estimation

The theoretical model suggests that analysts observe a signal about an IPO. This can be formalized as follows

$$recc_i^{outsider} = s_i^{outsider} \quad (3.12)$$
$$recc_i^{insider} = s_i^{insider} + g + h \quad (3.13)$$

where $recc_i^{insider}$, $recc_i^{outsider}$ are the recommendations issued by the insider and by an outsider on IPO i, respectively; $s_i^{insider}$, $s_i^{outsider}$ are the signals received by the insider and by an outsider on IPO i. The terms g and h are the components in insiders recommendation stemming from the presence of conflicts of interest. Similarly to the assumptions of the model, signals can take the following form:

$$s_i^{insider} = s_i + \omega_i^{insider} \quad (3.14)$$
$$s_i^{outsider} = s_i + \omega_i^{outsider} \quad (3.15)$$

where $\omega^{insider}$, $\omega^{outsider}$ represents noise terms. I assume these noise terms come from distributions from the same family, have zero mean, but differ in their variance and are independent. The insider decides whether to inflate the recommendation as a function of his optimal trade off between short run gains and reputation. I denote this term as g. Furthermore, the insider decides to inflate the recommendation as a function of his assessment of the presence of outsiders. I denote this term as h. The goal of the empirical analysis is to estimate h, which represents the effect of lack of (or weaker) competition[17], and g, which represents the inflation term due to being an insider and having a conflict of interest with investors[18]. A possible empirical specification suggested by the model

[17] In the interpretation suggested by the naive view the term h would capture the lack of reduction in the optimistic bias in the beliefs of insiders due to not observing the information provided by outsiders.

[18] In the interpretation suggested by the naive view the term g would capture the optimistic bias in the beliefs of insiders.

has the probability of observing the most optimistic recommendation as the dependent variable. This is an especially interesting possibility as recommendations are coded on a discrete scale[19]. The idea is that analysts issue a "Strong Buy" recommendation only if the signal they receive is above a given threshold. For outsiders that can be formalized as

$$recc^{outsider} = \text{"Strong Buy"} \ if \ s_i > s^* \tag{3.16}$$

for insider as

$$recc^{insider} = \text{"Strong Buy"} \ if \ s_i > s^* - g - h \tag{3.17}$$

then the probability a "Strong Buy" recommendation is issued by an outsider is given by the probability that $s_i > s^*$, or that $s_i + \omega_i^{outsider} > s^*$, implying $\omega_i^{outsider} > s^* - s_i$. In the case of insiders, the probability a "Strong Buy" recommendation is issued, is given by the probability that $\omega_i^{insider} > s^* - s_i - g - h$. Therefore:

$$\begin{aligned} Prob(recc_i^{insider} &= \text{"Strong Buy"} \mid no\ competition) = G(s_i + g + h) && (3.18) \\ Prob(recc_i^{insider} &= \text{"Strong Buy"} \mid competition) = G(s_i + g) && (3.19) \\ Prob(recc_i^{outsider} &= \text{"Strong Buy"}) = G(s_i) && (3.20) \end{aligned}$$

where G is the probability distribution for the noise term in the signal[20]. Operationally, estimates of g and h can be obtained by including dummy variables for being an insider, and for being an insider facing no competition. The latter is observed ex post and a critical assumption is that insiders have rational expectations on the likelihood outsiders issue a recommendation on each stock.

An important problem is that the signal s is not observed. However, the signal can be proxied by observable variables. In fact, s represents the signal about the perspective of the company, therefore returns (the one day return which is observed by analysts when issuing recommendations and medium term returns in excess of some benchmark), time effects and industry, represent information about the signal observed by analysts. If IPOs of different quality are assigned to analysts according to analyst talent or willingness to trade off reputation for current gains, etc., then it will be necessary to include an analyst fixed effect. Size, captured by the proceeds amount of the IPO may also influence the signal received as it can signal how successful the IPO was, and it can be an important

[19] An alternative would be to analyze analyst forecasts. However, earnings forecasts for IPOs are typically not available in the first period after the company stocks began trading. That period is, however, the most suited to identify what analysts have a stronger conflict of interest with investors.

[20] The fact that the noise term has different variance across analysts is taken care in the estimation by allowing for errors to be clustered at the analyst level.

variable to include. In practice, I approximate the signal on the IPO as a linear function, as follows:

$$s_i = \theta_1 size_i + \theta_2 returns_i + industry_i + time_i \tag{3.21}$$

Then, in order to identify the terms g and h, it is needed that the dummies for being an insider and those for being an insider facing no competition are non linear functions of the same controls (or of a subset of them). In such a case, it is possible to get

$$Prob(recc_{i,j} = \text{“Strong Buy”}) = \tag{3.22}$$

$$G[\psi + \theta_1 size_i + \theta_2 returns_i + industry_i + time_i + g * dumins_{i,j} + h * (no\ competition_{i,j})]$$

where $recc_{i,j}$ is the recommendation issued by analyst j on IPO i, G is a distribution function, ψ is a constant term, $dumins_{i,j}$ is a dummy taking the value 1 if analyst j is an insider for IPO i and $no\ competition_{i,j}$ is a dummy variable taking the value 1 if analyst j is an insider facing no competition for IPO i, and both dummies are non linear functions of the controls (size, returns, etc.). That is a reasonable assumption as both dummies can be intended as probabilities that the insider issues a recommendation and that the insider issues a recommendation facing no competition[21]. The critical identifying assumption is that the dummies for being an insider and for facing less competition should not be correlated with firm unobservable quality. I further discuss this issue in sections 3.6, 3.7 and 3.8.

Another possibility is to use the strength of coverage from outsiders to capture the effect of stronger versus weaker competition. This implies assuming that h depends upon the number of outsiders covering the IPO. To get an estimable equation, I assume that h is a linear function of n. Again, I use the probability of observing the most optimistic recommendation as the dependent variable. I also introduce an interaction term between the number of outsiders and size, in order to allow for the possibility that competition affects the degree of opportunism of insiders differently as a function of the size of the deal, and thus of the importance of the deal for the employer of the analyst. Formally:

$$Prob(recc_i^{insider} = \text{“Strong Buy”}) = \tag{3.23}$$

$$G[\psi + \theta_1 size_i + \theta_2 returns_i + industry_i + time_i + \beta n_i + \phi(n_i * size_i)]$$

where ψ is a constant, n_i is the number of outsiders issuing a recommendation on firm i, and the main parameters of interest are β and ϕ. The key identifying assumption in this

[21] If, on the contrary g and h were linear functions of the controls, the term g can identify the part of conflict of interest that does not depend upon size, and the term h can identify the assessment of the insider about the extent of coverage from outsiders that is based on his unobservable information.

case is that the number of outsiders covering the IPO is uncorrelated with unobservable firm quality, conditional on the included controls. I discuss this point in greater depth in section 3.6, 3.7 and 3.8.

3.4.2 Issues

The first issue is to define which agents have a stronger conflict of interest with investors. I limit attention to recommendations about IPOs issued in the first days after the company went public so as to define clearly who is the insider. This can be achieved by gathering information on the identity of investment banks underwriting the IPO, as they will have the strongest conflicts of interest with investors. However, IPOs typically involve other intermediaries acting as co-managers. I believe this is not a great problem for two reasons. Firstly, the lead underwriter has a stronger conflict of interest with investors than all other co-underwriter involved. Secondly, this would weaken the differences between insiders and outsiders, increasing the difficulty to identify any effect. Therefore, if any difference in the behaviour of insiders and outsiders is found in the data, it could be argued that it is underestimated.

The second issue is to define when an insider analyst faces more or less competition. I take two approaches. The first considers the insider as facing less competition if no outsider analyst issued a recommendation on the stock during the first 45 days of trade, defining a dummy variable taking the value one when the insider is the only analyst to issue a recommendation on the IPO, as in equation 3.22. The second employs coverage of the stock from outsider analysts, including the number of outsiders issuing a recommendation on the IPO as a regressor to capture competitive pressure on insider analysts, as in equation 3.23.

The third issue is that insiders form expectations to assess whether outsiders cover the stock. Such expectations are based upon variables such as the size of the IPO, the industry the firm operates in, how "hot" the market is. The fact that insiders can make mistakes raises the difficulty to identify the effect of competition, because insiders might report the truth attaching a large probability outsiders issue a (truthful) recommendation, while this might not happen in the data. On the other hand, insiders may have private information about whether outsider analysts issue a recommendation. I observe (ex - post) that insider analysts are facing less competition. When this happens, the measure of competition from outsiders captures also the private information the insider may have on the strength of coverage on the stock from outsiders.

The fourth issue concerns the evaluation of whether the behaviour of analysts could be determined by psychological biases as suggested by the naive view or not. The analysis of the effect of competition does not allow to answer this question. Therefore, I try to establish whether an analyst updates his beliefs about the stock after observing a recommendation from other analysts (this could be due to rational Bayesian updating or to herd behaviour) by testing directly whether insiders seem to use the information contained in recommendations from outsiders (and vice versa). This is done by running a Probit regression to check whether the fact that outsiders issued a positive recommendation before the insider, raises the chances the latter issues a positive recommendation. A rejection of this hypothesis suggests insiders are optimistic independently of whether they observed an optimistic recommendation from outsiders. That would provide indirect evidence in favour of the "opportunistic view" for insider analysts overoptimism. Of course, if the hypothesis is not rejected that could also be due to the intrinsic quality of the firm.

3.5 Data

Information about IPO deals have been collected from the SDC-Platinum database. The dataset I obtained lists IPOs in the period 1995 to 2002 providing information about the identity of the bookrunner(s), the date of the IPO, the size of the issue, the offer price, the one day, three and six months returns, the industry, the nationality of the company, the market on which it trades, the type of shares issued. There are 3707 IPOs in the dataset[22]. Data on analysts recommendations come from I/B/E/S. Recommendations are coded in a scale from 1 (the most favorable to the company, "Strong Buy") to 5 (the least favorable to the company, "Strong Sell"). Following the existing literature, I recode recommendations so that 5 corresponds to "Strong Buy" and 1 to "Strong Sell". The database also provides information about the analyst issuing the recommendation, the date of the recommendation, the broker the analyst is working for. The two dataset are matched in order to identify who is the analyst issuing the recommendation and whether this analyst is working for the bookrunner and is thus an "insider", or not. I also include information on returns. These come from the CRSP database.

The main data issue is dealing with IPOs with more than one bookrunner. In such cases the game changes: one insider knows that there are chances that other insiders as well as outsiders issue a recommendation and this can modify his incentives. My strategy is to exclude the company when multiple insiders are issuing a recommendation in the same time window. The fact that brokers engaged in extensive M&A activities is not an

[22]This is consistent with the information provided by Jay Ritter on the number of IPOs per year in the US.

important problem for this work as the analysis is limited to the recommendations issued in the first days after the IPO.

Insiders are prevented to release recommendations about the company before the end of the "quiet period". This was set at 25 days until July 2002, and later extended to 40 days. For this reason, data on IPOs that begun trading after the second quarter of 2002 have been excluded from the analysis[23]. Therefore the sample includes recommendations issued in the first 45 days after the IPO begun trading (end of the quiet period plus 20 days). This choice is motivated by the desire to have a clear definition of "competition", and by the desire to minimize distortions coming from the possibility that new information about the company becomes public in the meanwhile. A longer interval would add noise as it is more likely that new information gets revealed in the meanwhile. A shorter interval raises the risk of misclassifying the degree of competition, as outsiders may issue a recommendation 35 or 40 days after the IPO. I am including in the analysis ordinary (or common) shares only, as comparing different financial instruments can be misleading as the degree of "competition" among analysts could differ for very specialized financial instruments. Also, including issues of shares with limited (or extra) voting rights could affect the recommendation. I also exclude those recommendations for which the identity of the analyst is not reported, though the identity of the bookrunner is. When this happens, recommendations are excluded in order to be able to use information about analysts. I identified a few errors, such as repeated recommendations, and I excluded them. There are a few cases (38 observations) where an insider issues more than one recommendation in the 45 days sample. These observations are not excluded from the analysis, but the estimation has been performed also on the sample excluding such observations as a further robustness check and results hold. There is no information about the first day return of some firms. Analogously the six month excess return is missing for some firms. The sample also includes a few (78) non-US firms. Most of these are those firms for which informations about returns are missing. Their inclusion do not alter results, so such IPOs are left in the sample. Thus, in the end, the analysis is carried out on a sample including 3164 recommendations from 1275 analysts about 1416 IPOs.

It is important to review the summary statistics of the sample. Table 3.2 summarizes the distribution and the mean of recommendations according to the type of analyst that issued them.

A preliminary inspection of Table 3.2 suggests that insiders issue more optimistic rec-

[23] These could be included adding other 20 days after the quiet period. Results are unchanged. However, recommendations issued 60 days after the IPO date might incorporate a great deal of new information and the comparison with recommendations issued when the quiet period ended on the 25th day after the IPO might be debatable.

Table 3.2 Distribution of Recommendations by type of Analyst

This table displays the distribution of recommendations by type of analyst. The first column shows the percentage of occurrence of each recommendation issued by all the analysts in the sample. The second column shows the percentage of occurrence of each recommendation issued by analysts non affiliated with the lead underwriter of the IPO (outsiders). The third column shows the percentage of occurrence of each recommendation issued by analysts affiliated with the lead underwriter of the IPO (insiders). The fourth column shows the percentage of occurrence of each recommendation issued by analysts affiliated with the lead underwriter of the IPO issuing a recommendation on a company that received no coverage from non affiliated analysts (insiders with no competition). The last line represents the average recommendation issued by each type of analyst. Recommendations are from the I/B/E/S dataset, recoded on a scale from 5 (Strong Buy) to 1 (Strong Sell).

	All analysts	Outsiders	Insiders	Insiders with no competition
Strong Buy	46.11	43.88	50.62	60.19
Buy	49.59	50.83	47.09	38.39
Hold	4.20	5.15	2.29	1.42
Sell	0.09	0.14	0	0
Strong Sell	0	0	0	0
Average	4.41	4.38	4.48	4.58

ommendations than outsiders, and furthermore that insiders issue even more optimistic recommendations when they face less competition. In fact outsiders issue a far larger proportion of "Hold" recommendations than insiders, and a far lower proportion of "Strong Buy" recommendations. Finally, insiders issue a larger fraction of "Strong Buy" recommendations when they face no competition from outsiders (this information was already provided in Table 3.1).

It is also interesting to examine firm characteristics. Table 3.3 shows descriptive statistics about the size and returns of the IPOs.

These statistics show that companies recommended only from insiders are on average smaller. It seems obvious that outsiders are more likely to issue a recommendation about "larger" issues. This can constitute a problem if size is related to firm unobservable quality. On the contrary, as long as size is a measure of firm visibility[24], it will be a crucial factor in determining the incentives of outsiders to acquire information about the company and issue a recommendation. IPOs receiving less coverage from outsider

[24]This expression refers to the degree investors are interested in getting information about the company.

Table 3.3 Descriptive Statistics of IPOs

Panel A contains summary statistics of size, first day return and six month excess return for the whole sample of IPOs. The first column represents the main statistics of the size of the IPO (proceeds amount in million US Dollars) for the whole sample under analysis, the second column represents the main statistics of the first day return, the third column contains the main statistics of six month returns in excess of the CRSP value weighted index. Returns are measured in US dollars. Panel B represents the same information for those IPOs for which insider analysts are the only analyst issuing a recommendation in the first 45 days after the stock began trading.

	Panel A	Full sample	1416 Observations
	Size	First Day Return	Six Month Excess Return
Mean	78.37	0.412	0.487
Median	45.5	0.191	0.091
Std. Dev	159.5	0.665	1.804
Skewness	10.83	3.206	7.677
	Panel B	IPOs with no coverage from outsiders	208 Observations
	Size	First Day Return	Six Month Excess Return
Mean	45.51	0.167	0.0710
Median	35.65	0.115	−0.077
Std. Dev	43.53	0.222	0.701
Skewness	5.58	1.668	3.069

analysts also have lower returns, both first day and six month excess returns[25]. This suggests that IPOs that receive wider coverage from outsiders have higher returns, and are thus probably "better companies" for investors.

Finally, IPOs are classified in different industries according to the SIC-4 digit classification system. There is a relatively large fraction of IPOs operating in the information technology and biotechnology reflecting the "Hi - Tech" boom of the nineties.

[25]The mean six month excess return is especially large for three observations for which insider analysts facing no competition from outsiders issued a "hold" recommendation. That explains why the average six month excess returns for IPOs in table III is larger than the average six month excess returns for IPOs for which insider analysts facing no competition issued "Strong Buy" or "Buy" recommendations displayed in Table I.

3.6 Results

3.6.1 Testing the Effect of Competition

In this subsection, I test whether and how competition affects the recommendation issued by insider analysts. Recommendations are a discrete and ordered dependent variable. This suggests estimating a multinomial ordered Logit or Probit model. However, it can be important to take into account that analyst unobserved characteristics may be correlated with the regressors. Estimating an ordered Logit with fixed effects is not feasible, due to the incidental parameters problem. As shown in section 3.4, the theoretical model suggests that it is possible to focus attention on the probability that an analyst issues the highest recommendation "Strong Buy", thus obtaining a binary dependent variable. Then, it is possible to estimate a conditional fixed effect Logit model to take into account the influence of analyst unobserved heterogeneity[26]. Then, I estimate a model based upon equation 3.22:

$$\begin{aligned} Prob(recc_{i,j,t} &= \text{"}Strong\ Buy\text{"}) = \\ & \Lambda[\psi + \gamma * dumins_{i,j} + \eta * nocompetition_{i,j} + \theta * X_{i,t} + \zeta_j] \end{aligned} \quad (3.24)$$

where Λ is the logistic distribution, $recc_{i,j,t}$ is the recommendation about firm i from analyst j at time t, ψ is a constant, $dumins_{i,j}$ is a dummy variable taking the value 1 when the recommendation from analyst j about firm i is issued by an insider, $nocompetiton_{i,j}$ is a dummy variable taking the value 1 when the recommendation on firm i is issued by an analyst j being an insider facing no competition from outsiders. The parameters γ and η are the estimates for the parameters g and h in equation 3.22. The matrix $X_{i,t}$ includes industry fixed effects, quarterly dummies to capture the effect of the business cycle and of market conditions, the size of the issue (measured as the logarithm of the proceeds amount of the issue, the name of the variable is *Size*), the return in the first day of trading (the name of the variable is *First Day*) and the six month excess returns on the stock computed as difference from returns on the CRSP value weighted index (the name of the variable is *Six Month Excess Return),* as a control for the quality of the firm. I run regressions including both the three and the six month return from the issue date. Results are not affected by the choice of this time span. The three months (excess) return could be more directly affected by recommendations, therefore, I present results including the six-months returns[27]. The term $\theta * X_{i,t}$ aims at capturing the signal observed by the analyst.

[26]In a previous version of this paper, I estimated an ordered Logit model (without analyst fixed effects), and a linear model. Results are very similar and are available upon request.

[27]Another possibility is to compute excess returns on the CRSP equally weighted index. Results are both qualitatively and quantitatively very similar.

However, the size of the issue can also capture the effects of the incentives as insiders are subjected to stronger pressure to issue a favourable recommendation on larger clients. Finally, the term ζ_j represents an analyst time invariant component. It can be especially important to control for analyst unobserved heterogeneity as firms can be allocated to analysts as a function of analyst unobservable (and time invariant) characteristics, such as ability or willingness to trade off reputation for current gains.

The main hypothesis to be tested concerns the behaviour of insider analysts as a function of whether other analysts are transmitting information about the same company in a given time window. This is:

- $\eta = 0$ versus an alternative $\eta > 0$.

If $\eta > 0$, then

$$\begin{aligned} Prob(recc &= \text{"}StrongBuy\text{"} \mid X, insidernocompetition) > \\ Prob(recc &= \text{"}StrongBuy\text{"} \mid X, insider) \end{aligned} \tag{3.25}$$

and insiders are more likely to issue the most optimistic recommendation when there is no coverage of the stock from outsiders.

Another hypothesis to be tested is:

- $\gamma = 0$ versus an alternative $\gamma \neq 0$.

and the model also suggests testing the one - sided hypothesis:

- $\gamma = 0$ versus an alternative $\gamma > 0$

so that insider analysts are more likely to issue the most optimistic recommendation than outsiders independently from the strength of competition from outsider analysts. In fact, if $\gamma > 0$,

$$\begin{aligned} Prob(recc &= \text{"}StrongBuy\text{"} \mid X, insider) > \\ Prob(recc &= \text{"}StrongBuy\text{"} \mid X, outsider) \end{aligned} \tag{3.26}$$

Table 3.5 in Appendix 2 reports results. The first column displays results from a logit model estimated by maximum likelihood that does not control for analyst unobserved heterogeneity. It can be seen that the dummy for the insider facing no competition from outsiders is positive and significant at the five percent level. The dummy for being an insider is positive but not significant in a two sided test (but it is, at the 6 per cent level, in a one sided test). The size of the issue is negative and significant, at the ten percent level. The first day return is negative and highly significant. The fact that the first day return is negative, suggests that analysts tend to be less optimistic about those IPOs that experienced a very pronounced increase in price during the first day of trade. Finally, the six month excess return is negative but not significant. The negative sign is a bit puzzling, although this may be due to the fact that this regression does not control for analyst characteristics that may be correlated with the quality of the IPO. In fact, IPOs may be assigned to analysts according to their ability or talent, or maybe according to their willingness to sacrifice their reputation to please their employers. The second column of Table 3.5 reports results from a conditional fixed effects Logit model. Some observations are lost, as this model does not use those observations for which the dependent variable does not change within individuals. Therefore recommendations from those analysts always issuing a "Strong Buy", or never issuing a "Strong Buy" are not used in the estimation. It can be seen that when analyst fixed effects are included, the dummy for the insider facing no competition is still positive and significant, although now at the 10 per cent level (p-value is 0.07). The dummy for being an insider is positive and now strongly significant, suggesting that insiders are more likely to issue "Strong Buy" recommendations than outsiders. An interesting change occurs to the parameter of size. The coefficient becomes positive, and significant. This seems to suggest that analyst characteristics influence the kind of IPOs they are assigned to cover. Finally, the first day return is again negative and highly significant, while the six month excess return is not significant but has now the expected sign (positive). Results are similar when analyst effects are treated as random, and the dummy for the insider facing no competition is now significant at the 2 per cent level. The main difference concerns the coefficient for the size of the IPO which is now quite small and not significant.

As a second approach to capture the effect of competition, I include the number of outsiders, an explicit measure of coverage of the stock, as a regressor in a model including only recommendations issued by insider analysts. If the insider has rational expectations, he will be able to forecast correctly the number of outsiders issuing a recommendation on the same company, and thus the degree of competition. Having a measure of the strength of analyst coverage allows to take care of the possibility that competition and size also have an interaction effect, so that competition affects the degree of opportunism of insiders differently as a function of the size of the deal, and thus of the importance of the deal for the employer of the analyst. As discussed above, recommendations are discrete and ordered, calling for the use of an ordered Logit or Probit model to estimate parameters, which however, is not tractable if analyst fixed effects are included. Therefore, as above, I estimate a Logit model for the probability the insider issues a "Strong Buy" recommendation. The model, based upon equation 3.23, is:

$$Prob(recc^{insider}_{i,j,t} = \text{“}StrongBuy\text{”}) = \qquad (3.27)$$
$$\Lambda[\psi + \beta numbout_i + \rho size_i + \phi(size_i * numbout_i) + \psi X_{i,t} + \zeta_j]$$

where, again, Λ is the logistic distribution, $recc^{insider}_{i,j,t}$ is the recommendation by analyst j being an insider on company i, ψ is a constant, $numbout_i$ is the logarithm of the number of outsiders issuing a recommendation on company i[28], $size_i$ is again the logarithm of the proceeds amount in million dollars on IPO i, $size_i * numbout_i$ is an interaction between size and number of outsiders, and $X_{i,t}$ includes the remaining controls: the six month excess return on the IPO, the return in the first day of trade, quarterly and industry dummies. The term ζ_j represents an analyst specific time invariant component. The main hypotheses to be tested in this case are:

- $\beta = 0$ versus an alternative $\beta < 0$
- $\phi = 0$ versus an alternative $\phi > 0$

The first hypothesis suggests that when coverage from outsider analysts is stronger, insider analysts display a larger degree of optimism. The second hypothesis implies that such effect is weaker for larger deals, exactly those for which the incentives of insider analysts to report favourable information would be stronger.

Table 3.6 in Appendix 2 shows results. Column 1 reports estimates from a Logit model that does not control for analyst unobserved heterogeneity. The coefficient of the number of outsiders issuing a recommendation is negative and highly significant (at the one per cent level), suggesting that the more outsiders cover the stock, the less optimistic the insider analyst, when the effect of size is ignored[29]. The coefficient for size is negative but not significant (although it will be significant in a one-sided test at the 6 per cent level). The marginal effect of the interaction term is positive and significant (at the 1 per cent level)[30] suggesting that the effect of competition is weaker for larger deals. In fact the partial effect of the number of outsiders on the probability the recommendation

[28] I rescaled the number of outsiders adding one, so as to include the cases when no outsider issued a recommendation, which would turn as missing values, being the log of zero.

[29] The partial effect of the number of outsiders on the probability the recommendation is a "Strong Buy" is given by $\beta + \phi size$

[30] The $z - statistic$ refers to the significance of the coefficient of the interaction term. However, in order to test the significance of the interaction effect, it is necessary to test for the significance of the whole interaction effect which is given by $\beta\Lambda^{'}(\cdot) + (\beta + \phi size)(\rho + \phi numbout)\Lambda^{''}(\cdot)$.

is a "Strong Buy" is given by $\beta + \phi size$ and as $\beta < 0$ and $\phi > 0$, the mitigating effect of competition from outsiders is weaker for larger IPOs. The coefficient for the first day return is again negative and significant. Finally, the coefficient for the six month excess return is negative but very small and not significant. Again, it could be important to control for analyst unobserved heterogeneity. However, as discussed above, the conditional fixed effect Logit discards quite a lot of observations, and the model is estimated using only 310 recommendations. Results are reported in the second column of Table 3.6. The coefficient for the (log) number of outsiders is negative, but not significant. The coefficient of the interaction term is positive but again not significant, as it is the coefficient for Size. Only the coefficient for the first day return is significant, and negative. The fact that most coefficients are not significant is not very surprising due to the small number of observations on which the model is estimated, and the relatively large number of dummy variables included. However, at least the sign of the coefficient for the number of outsiders and for the interaction term, is the one expected on the basis of the model. The third column of Table 3.6 reports results for the Logit model with random effects. The coefficient for the number of outsiders is negative and significant (at the 2 per cent level), the coefficient for size is negative but not significant while the interaction term is positive and significant at the three per cent level. Returns on the first day of trade are negative and highly significant, while six month excess returns are, again, not significant.

3.6.2 Discriminating between the Opportunistic and the Naive View: Testing for Bayesian Updating

The results presented up to this point leave the question on the origin of insider analyst overoptimism open. Insiders could be less optimistic when there is wider coverage of the stock from outsider analysts due to "simple" rational Bayesian updating. When insiders are the first to issue a recommendation they do not have any other information but their private signals, while if they can observe a report from an outsider, they might decide to use this information when issuing a recommendation on the company. Thus, it is important to understand whether some learning takes place, in order to distinguish the "opportunistic" versus the "naive" view to explain overoptimism. To this end, I examine whether insiders are influenced by outsiders when issuing their recommendation. This is done by checking whether the chances the insider issues a positive recommendation increase after observing a positive recommendation from outsiders. This requires defining situations in which outsiders issued an optimistic recommendation on the IPO. The average recommendation from outsiders issued before the insider issues a recommendation is distributed as summarised in Table 3.4.

Table 3.4 Distribution of the Average of Recommendations by Non-Affiliated Analysts Issued before an Affiliated Analyst Issued a Recommendation

The table reports the distribution of the average recommendation issued by analysts non affiliated with the lead underwriter of the IPO in the three days before an analyst affiliated with the lead underwriter of the IPO issued a recommendation. Recommendations are from the I/B/E/S dataset recoded on a scale from 5 (Strong Buy) to 1 (Strong Sell). The column labelled as *recc* contains the recommendation, the column labelled as *obs* the number of observation for each recommendation, the column labelled as *freq* the relative frequency of the recommendation and the column labelled as *cum* contains the cumulative frequency.

recc	*obs*	*freq*	*cum*
5	40	27.4	27.4
4.5	22	15.07	42.47
4.333	6	4.11	46.58
4	69	47.26	93.84
3.5	4	2.74	96.58
3	5	3.42	100
Total	146		

It can be seen that half of the times the average recommendation is larger than 4.333. Thus, in order to build a measure of outsider analyst optimism, I define a dummy variable taking the value 1 if the average recommendation is greater or equal than 4.333. Essentially, I define a case when the average recommendation from outsiders is above the median average recommendation as a situation where outsiders issued an optimistic recommendation. As a second measure for outsider analyst optimism, I consider the most optimistic recommendation issued by outsiders, and I define a dummy variable taking the value 1 when at least an outsider issued a "strong buy". This strategy is formalized as follows

$$Prob(recc_{i,t}^{insider} = strong\ buy) = \Phi(\psi + \beta outopt_i + \gamma X_{i,t} + \varepsilon_{i,t}) \tag{3.28}$$

where $recc_{i,t}^{insider}$ represents the recommendation issued by the insider on company i at time t, Φ is the Normal distribution, ψ is a constant, $outopt_i$ is a dummy taking the value 1 if the average of outsider recommendations on company i is larger than 4.333 (the median average recommendation from outsiders). Then in a second regression the dummy $outopt_i$ takes the value 1 if at least one outsider issued a "Strong Buy", and $X_{i,t}$ is a vector of controls including size, the first day and the six month excess return on the stock. Quarterly and industry dummies are not included as the number of observations is small, in order not to reduce the precision of inference too much. The main hypothesis to be tested is whether $\beta \neq 0$, and in particular whether $\beta > 0$. Table 3.7 in Appendix 2 presents results for the sample including only recommendations issued in the three days prior to the date the insider issued his recommendation[31]. Results show clearly that *outopt*, the measure for outsider optimism, is not significant. Notice that finding a significant coefficient of the dummy for an optimistic report from outsiders would not signal that insiders use the information of outsiders, it could just be that the company is of intrinsically good quality. In fact, if controls are not enough to capture the unobserved quality of the IPO, the measure of outsider optimism would be endogenious, as it is correlated with the unobserved quality of the firm that also affects the recommendation from the insider (the dependent variable). However, if this is the case, the bias should clearly be positive, because if the IPO is good, both the insider and the outsiders are relatively more likely to have observed favourable signals about the IPO. This implies that finding the coefficient is not significant is clearly inconsistent with the hypothesis that insiders update their information observing the information provided by outsiders.

3.6.3 Summary of Results

The evidence provided so far suggests the following:

1. Insiders are more likely to issue "Strong Buy" recommendations than outsiders. Such optimism is more pronounced when competition, measured in various ways referring to the extent of coverage from outsider analysts, is less intense.

2. The effect of competition is weaker for larger IPOs, those for which conflicts of interest are likely to be stronger.

3. Insiders do not seem to update their beliefs when observing recommendations from outsiders, as the probability they issue the highest possible recommendation is not affected by whether they observed a positive recommendation by outsiders.

These findings suggest that competition disciplines insider analysts. In principle, this result is consistent both with an incentive based theory (opportunistic view), and with an irrationality based theory (naive view) where insiders are optimistically biased but update their information rationally, so that they learn about the true distribution of firm quality when observing recommendations from outsiders. The second result is clearly

[31] Results are essentially unchanged if all recommendations issued before the one issued by the insider are included. Of course there can be noise in these results, as new information about the company may become available over time. Similar results are also obtained if the regression includes all recommendations issued in the 10 or 5 days prior to the recommendation issued by the insider.

consistent with the "opportunistic view", and it could also be consistent with the "naive view" if one is ready to assume that psychological biases are stronger for more important deals. The third finding can be consistent with the "opportunistic view", but not with the "naive view". In the latter case, insiders should be more optimistic when observing an optimistic message and less optimistic otherwise. On the contrary, the fact that they tend to maintain the same degree of optimism independently of whether they observed positive recommendations from outsiders, suggests insiders behave opportunistically, trying to induce investors to have a positive perception of the quality of the IPO.

Thus far, the analysis maintained the assumption that the degree of competition from outsiders is independent of intrinsic firm quality, once observable characteristics of the IPO are controlled for. The analysis also controlled for the influence of analyst fixed effects, and this seems to be sufficient to conclude that the measure of competition used in the analysis is exogenous conditional on firm characteristics and analyst identity. However, the next section explicitly addresses the possibility that some form of selection takes place, so that the degree of competition (stock coverage from outsider analysts) is lower exactly when the IPO is of better quality.

3.7 Addressing Selection

One potential problem of this analysis is the possible presence of selection bias: if it happens that insider analysts face less competition exactly when firms are better, then there would be no strategic behaviour from insiders who would just be reporting what they observe. There are three answers to this important point. The first is that it is hard to imagine that outsiders issue recommendations about worse firms: if they have some freedom about which firm to analyse, then it is unlikely that they on average choose to cover the less promising IPOs. On the contrary, it seems more reasonable that outsiders do not issue recommendations about the worst companies. Therefore, selection bias, if present, should lead to an underestimation of the effect of competition on the degree of optimism of insider analysts. The second answer is that including as regressors industry and quarterly dummies, the six month excess return on the stock, and the return in the first day of trade, which can proxy for quality, the size of the issue and analyst fixed effects, should be enough to control for the effect of selection. The third answer is to further exploit the role of these observable variables and estimate the average effect of competition from outsiders through propensity score matching. I estimate a sort of average treatment effect, where the "treatment" is represented by lack of coverage of the IPO from outsiders[32]. In this setting matching estimates the "correct assessment" of insiders about the degree of competition from outsiders on a given IPO. As discussed in section 3.4, insiders inflate or deflate their recommendation as a function of their assessment of the degree of competition from outsiders. That can depend upon observable information, but also upon private information of the insider. Matching methods try to identify observations such that the coverage from outsider analysts can be considered as random conditional on observable variables[33]. Then, matching compares two IPOs that, given their characteristics, have similar chances of being covered by outsiders, and have similar chances to be given the same recommendation by the insider. If the insider has no further information, he should inflate his recommendation in the same way on both IPOs, and "competition" would have no effect. If, on the other hand, the insider is able to correctly assess the extent of coverage from outsiders on the IPO, that should be fully captured by matching. In other terms, matching compares two IPOs with the same characteristics, but for one IPO the insider attaches larger chances that outsiders provide coverage, and thus inflates less his recommendation.

It is important to stress that if the strength of coverage from outsiders depends upon unobservables, matching methods would be of no help. In that case, it would be necessary to estimate an Heckman selection model. That requires finding a valid instrument and thus imposing a reasonable exclusion restriction. In This work I can control for size, returns, industry and for the time period in which the IPO takes place. All such variables are both likely to affect the coverage of the stock from outsider analysts, and likely to affect the recommendation. Therefore, there is no obvious exclusion restriction that can be imposed. On the other hand, it seems that conditioning on size, returns, industry, the period in which the IPO occurred, is enough to control for factors affecting the strength of coverage from outsider analysts. If this is the case, matching may represent a cleaner way to estimate the effect of competition than the regressions run in section 3.6.

Thus, I firstly estimate the propensity score, in order to capture the likelihood that the insider faces less competition, as follows:

$$Prob(No\ Competition_{i,t} = 1) = \Phi(\psi + \beta X_{i,t} + \varepsilon_{i,t}) \tag{3.29}$$

where $Prob(No\ Competition_{i,t} = 1)$ is the probability there is no coverage from outsiders on company i, Φ is the Normal distribution, ψ is a constant term, $X_{i,t}$ includes size (proceeds amount in million dollars), six month excess return, industry and quarterly dummies. I only include those IPOs for which there is a recommendation from insid-

[32] As potentially all firms covered by insiders can also be covered by outsiders, it is interesting to estimate the effect of lack of coverage by outsiders on all IPOs, thus estimating the average treatment effect.

[33] Or conditional on the propensity score, which is estimated using such observable variables.

ers. Then, I estimate the average effect of not having coverage from outsiders, on the recommendation issued by the insider, by matching IPOs according to the probability that outsiders do not issue a recommendation, so as to create a sample of IPOs that are covered by both insiders and outsiders, but that have characteristics similar to those of IPOs covered by insider analysts only[34]. Formally I estimate the following:

$$\begin{aligned} \tau = & \; Prob(recc_i = \text{``}Strong\ Buy\text{''} \mid P(X_i), No\ Competition = 1) \\ & -Prob(recc_i = \text{``}Strong\ Buy\text{''} \mid P(X_i), No\ Competition = 0) \end{aligned} \tag{3.30}$$

where τ is the effect of exposing insider analysts to no competition from outsider analysts on the probability an insider analyst issues a "Strong Buy" recommendation, $recc_i$ is the recommendation on company i, $P(X_i)$ is the propensity score and units (companies) i are matched according to their propensity score. The term τ is different from zero if insider analysts are able to assess whether outsiders cover the stock or not, and modify their behaviour accordingly.

Table 3.8 in Appendix 2 reports results for the estimation of the propensity score. It can be seen that size is negative and highly significant, and both the six month excess return and the return in the first day of trade are negative and significant, suggesting that outsider analysts tend to cover stocks that have larger returns[35]. Table 3.9 in Appendix 2 shows summary statistics of the propensity score. The estimated propensity score satisfies the balancing property, meaning that for the estimated propensity score, IPOs for which there is coverage from outsiders have the same distribution in terms of size, returns, industry and time of the IPO, as IPOs for which there is no coverage from outsider analysts. Finally, I estimate the average effect of no coverage from outsiders, on the recommendation issued by insiders, matching observations on the basis of propensity scores, using the method of nearest neighbour. Table 3.10 in Appendix 2 reports results. The first line reports the average treatment effect estimated as in Abadie and Imbens (2002), while the second line reports the bias adjusted estimator of the average treatment effect[36], where the adjustment is performed on size and excess returns. In both cases,

[34] Ideally the effect should be estimated by comparing, for the same IPO, the recommendation provided by the insider analyst facing no competition with the recommendation provided by the insider analyst facing competition. However, the recommendation issued by the insider analyst on each IPO is either under competition from outsiders, or under no competition. Then, the counterfactual is obtained by matching each IPO for which there is a recommendation by the insider and no coverage from outsiders, with an IPO for which there is a recommendation by the insider and coverage from outsiders. Matching is implemented by using the IPO which has the closest propensity score, i.e. the closest probability that the outsiders provide coverage. Again a critical assumption is that insiders should have rational expectations about outsider analysts coverage. In fact, it is needed that insiders know that taken two firms with similar propensity score, on one there will be coverage from outsiders, while on the other there will be no coverage.

[35] I tried other more parsimonious specifications for the propensity score, excluding quarterly or industry dummies, and including a coarser definition of industry and results (available upon request) are robust.

[36] See Abadie and Imbens (2002).

the effect is negative and statistically significant at about the 5 per cent level. The effect is also quite large. Using different matching algorithm (caliper or radius matching) does not affect results.

3.8 Discussion

3.8.1 Empirical evidence

The evidence provided suggests that insider analysts behave differently according to whether there are other analysts providing information about a firm. The effect of competition could act either on incentives for opportunistic behaviour, or on favouring the updating of optimistically biased beliefs on part of insider analysts. Updating is not found in the data as shown in section 3.6.2. An important implication of these results is that the "psychological" explanation for insider overoptimism is inconsistent with the evidence documented in This chapter. On the contrary, the empirical evidence is consistent with the "opportunistic view" for analyst overoptimism. This conclusion has important policy implications: if insiders overoptimism was caused by a psychological bias, changing insiders incentives might have a limited effect on the information they provide. On the contrary, if their behaviour is driven by existing incentives, then that should be the focus of policy makers.

It is useful to discuss further the possible role of selection by thinking about what the results are suggesting. If insiders are more optimistic when no outsiders are issuing a recommendation because the firm is intrinsically better when they face less competition, then outsider analysts would tend to cover firms that have worse perspectives ex-ante. This hypothesis is difficult to defend: financial information can be thought of as an experience good. An investor appreciates the quality of an analyst recommendation if she invests in the company recommended. She would not do so if the recommendation is not very positive. It is difficult to think that investors track a stock they did not purchase in order to evaluate whether the negative recommendation of the analyst was correct. Thus, if anything, outsiders should, on average, cover a company with better ex-ante prospects. Then the fact the insider faces less competition would be negatively correlated with the quality of the company. In such a case the results of this chapter would even more strongly suggest that insiders behave opportunistically and that competition has a beneficial role in disciplining insider analysts. This is what is suggested in Table 3.1. Six month excess returns are lower for IPOs that receive no coverage from outsiders. However, insider analysts tend to issue especially optimistic recommendations for such IPOs.

A last point concerns the decision to issue a recommendation: this has not been modelled formally, and it was assumed that insiders always issue a recommendation. However, this is not necessarily the case. It is not clear what the incentives of the insider are in such situation: he might prefer to say nothing rather than issue a bad recommendation. Then, the market should discount this fact and interpret no recommendation as a bad recommendation, thus reducing the incentives to keep silent. Under an empirical point of view, this means there is no recommendation by insiders about the worst companies. This can justify why insider recommendations are, on average, more optimistic than those of outsiders, but has no effect on the differential behaviour of insiders as a function of whether outsiders issue a recommendation. A possibility is that insiders decide not to issue a recommendation because they know there will be competition from outsiders and the cost of lying, in terms of reputation, will be larger. In such a case, we would observe insiders issuing a recommendation when outsiders provide coverage, for better companies only, and for both good and bad companies when there is less competition. Then, again the larger degree of optimism of insiders when they face less competition, would be underestimated.

3.8.2 Theoretical model

This subsection provides a discussion of the main assumptions of the theoretical model. The model assumes that the insider moves first. Removing this assumption does not harm the results in this version of the model, but may create interesting effects if also outsiders may have conflict of interests with investors. In this case an outsider may have incentives to wait for the recommendation of the insider. On the other hand, if he has reputational concerns, he might want to pool with non - careerist and issue a recommendation before the insider to show the market he just cares about reporting his information. This is an interesting problem that, however, does not seem to alter the main mechanism highlighted in this chapter.

The model would also yield predictions about the effect of reputation on incentives. For example, as in other models of reputational incentives, truthtelling incentives decrease as more information about an analyst type has been revealed, because much learning about the analyst type has occurred and further reputational gains are low[37]. These aspects have not been emphasized in the discussion as I could not gather information about analysts' reputation.

In order to clarify the modelling strategy, the role of the main assumptions is summarized

[37]See, among others, Holmstrom (1982 - II).

below:

- The greater precision of insider signals is introduced for the sake of realism, but plays no specific role for the results and could be dispensed with.

- The assumption that insiders do not issue a bad report when observing a good signal, determines the fact that the investor decision does not depend upon analyst reputation when observing an unfavourable report because the signal is fully credible. The assumption considerably simplifies the analysis and its removal would modify the equilibrium of the game. However, the effects of competition highlighted in the model will still hold, although further effects may arise.

- The assumption about the timing of the game is needed to simplify the analysis. Without this assumption each analyst would choose optimally the timing to issue a recommendation. However, assuming this does not happen does not seem unrealistic as the data do not show any specific pattern. Furthermore, insider analysts cannot issue a recommendation earlier than 25 days from the IPO (this was extended to 40 days since July 2002), so they have a relatively limited choice. Even allowing for strategic timing of information transmission, the basic insight about the role of competition would remain valid.

- The assumption that analysts always issue a recommendation when they receive information about a company is made to simplify the solution of the model. Allowing for strategic "silence" would not alter the basic insight of the model, it would add a further strategic choice to careerist insiders. This assumption, however, might have consequences for the empirical work: if analysts strategically choose to avoid sending a recommendation, the sample might be biased. This possibility was discussed further in sections 3.7 and 3.8.1.

- The model assumes that recommendations take a binary form. In practice, however, recommendations can be considered as partitions over the space of company states. The dataset used in the empirical analysis codifies recommendations in 5 intervals. The assumption of binary recommendation allows to improve the tractability of the analysis, without a great loss of generality.

- The model assumes there is one outsider only. This is not restrictive at all. It just helps reducing the computational and notational burden. In a more general set up, the insider and the outsiders will form beliefs about the likelihood other outsiders issue a recommendation, and how many of them are likely to do so. Hence the predictions of the model are suitable to be tested on data where more than one outsider issues a recommendation.

- The presence of only one insider is slightly more restrictive. The presence of multiple insiders complicates the analysis, but not the conclusion: in fact, insiders will now form beliefs about the chances other insiders issue a recommendation, but the intuition of the model will not be overturned.

- Career concerns in this model are not related to talent, but to some moral characteristics. A talent model, in which more talented analysts observe a more precise signal of the state of the world, can yield similar predictions. An important difference, however, will be in the behaviour of outsiders: the latter would always use the information contained in previous recommendations of insiders (as long as these are credible) because they will try to guess the true value of the firm using all available information. In fact a talent model would assume that talented types are more likely to observe a correct signal. Then, the reputation of outsiders for being talented raises if they issue a correct recommendation. Therefore outsiders will use all the available information (including the recommendation issued by insiders) to guess the correct realization of the quality of the company.

3.9 Conclusion

This work investigates whether competition helps mitigating biases in recommendations issued by affiliated analysts. Competition is measured as the strength of coverage of a stock from unaffiliated analysts. I develop a theoretical model to assess the effect of competition on the incentives of affiliated analysts who are motivated by reputational concerns. The theoretical model shows that coverage from non affiliated analysts is expected to increase truthtelling incentives. This hypothesis is tested empirically using data on recommendations about IPOs on the US market. The main result is that analysts working for the bookrunner of the IPO tend to be more optimistic when there is less coverage of the stock from other analysts. Moreover, the disciplining effect of competition is weaker for larger IPOs for which conflicts of interests are likely to be larger. Even when competition is stronger, affiliated analysts tend to issue too optimistic recommendations, suggesting that competition mitigates, but does not fully solve, the problem and that policy intervention may be warranted.

These results are consistent both with the possibility that affiliated analysts overoptimism is induced by incentives and with the possibility that affiliated analysts overoptimism is induced by psychological biases. In the first case competition would be reducing the short run gains from issuing an overoptimistic report making reputational incentives more effective. The evidence on the weaker effect of competition for larger deals seems to confirm this hypothesis. In the second case, competition would provide affiliated analysts with more unbiased information useful to update their optimistically biased prior beliefs on the company. Exploiting the presence of competition from non affiliated analysts can help devising a test to distinguish between these competing hypotheses to explain affiliated analysts overoptimism. In fact, it is possible to test whether affiliated analysts use the information contained in recommendations from non affiliated analysts. The empirical results suggest this is not the case, providing evidence against the psychological bias hypothesis to explain affiliated analysts overoptimism. Hence, these results provide indirect evidence in favour of the hypothesis that affiliated analysts overoptimism is driven by incentives, and therefore have important implications for the design of appropriate regulatory intervention.

3.10 Appendix to Chapter 3 - Proofs

Proof of Proposition 3.1. As argued in the text, in equilibrium either $U_T < U_L$ and $q^* = 0$, or $U_T = U_L$ and $q^* \in (0,1)$. Define the function $S(q) = U_T - U_L$. The analyst is indifferent between reporting the truth and lying when $U_T = U_L$, or $S(q) = 0$. Then, for a unique equilibrium to exist, it is necessary that the function $S(q)$ be monotonic in q. It is possible to show that the function $S(q)$ is monotonically decreasing in q. In fact,

$$\begin{aligned} U_T - U_L &= \\ gE[\alpha &\mid s, z] + \delta[aV(\lambda^{S,+}) + (1-a)V(\lambda^{S,-})] - \\ \{gE[\alpha &\mid b, z] + \delta[aV(\lambda^{B,-}) + (1-a)V(\lambda^{B,+})]\} \end{aligned} \tag{A3.1}$$

the term $gE[\alpha \mid s, z]$ is independent of q, as a sell recommendation is taken at face value. Then, as $\frac{\partial \lambda^{S,+}}{\partial q} < 0$, $\frac{\partial \lambda^{S,-}}{\partial q} < 0$, $V(\lambda^{S,+})$ and $V(\lambda^{S,-})$ are monotonically decreasing in q, as V is a continuous and increasing function of λ. As $\frac{\partial \lambda^{B,-}}{\partial q} > 0$, $\frac{\partial \lambda^{B,+}}{\partial q} > 0$, $V(\lambda^{B,-})$ and $V(\lambda^{B,+})$ are increasing in q, but have a negative sign in $S(q)$. Furthermore, $\frac{\partial E(\alpha \mid b, z)}{\partial q} > 0$ as $\frac{\partial \alpha}{\partial p} > 0$ and the derivative

$$\frac{\partial p}{\partial q} = \frac{(1-\lambda_t)(2a-1)}{[1+(1-\lambda_t)(1-q_t)]^2} > 0 \tag{A3.2}$$

as $a > \frac{1}{2}$. Therefore, the function $S(q)$ is monotonically decreasing in q. Thus the function attains its maximum when $q = 0$ and its minimum when $q = 1$. It can be seen that $S(1) < 0$. This follows because in such a case, there is perfect pooling of types and $\lambda_{t+1}^{S,+} = \lambda_{t+1}^{S,-} = \lambda_{t+1}^{B,+} = \lambda_{t+1}^{B,-} = \lambda_t$, so that

$$S(1) = gE[\alpha \mid s, z] - gE[\alpha \mid b, z] < 0 \tag{A3.3}$$

Then, there are two cases: if $S(0) < 0$, then $q = 0$ is the unique equilibrium because by raising q, the function S decreases even further and there is no value of $q \in (0,1)$ ensuring that $S(q) = 0$, or $U_T = U_L$ so that the analyst is willing to randomize. On the contrary, if $S(0) > 0$, there will be a unique $q \in (0,1)$ such that $S(q) = 0$, because $S(1) < 0$ and S is continuous because of the continuity of $E(\alpha)$ and V, and monotonically decreasing in q. Notice that the same result holds if the investor (short) sells the stock after observing one or two sell recommendations. In such cases either $\alpha(p^{s,s})$, or $\alpha(p^{s,s})$, and possibly $\alpha(p^{s,b})$ or $\alpha(p^{b,s})$ are negative and the gains for the analyst are nil.

Proof of Proposition 3.2. Insider analysts randomize in equilibrium as long as $U_T =$

U_L, or

$$gE[\alpha \mid b, z] - gE[\alpha \mid s, z] = \delta[aV(\lambda^{S,+}) + (1-a)V(\lambda^{S,-})] - \{\delta[aV(\lambda^{B,-}) + (1-a)V(\lambda^{B,+})]\} \tag{A3.4}$$

If the difference $gE[\alpha \mid b, z] - gE[\alpha \mid s, z]$ decreases in z, in equilibrium, the right hand side also needs to decrease. In order for this to be the case, q, the equilibrium probability of truthtelling must increase (as shown in the proof of Proposition 3.1). Then, I investigate how $gE[\alpha \mid b, z]$ and $gE[\alpha \mid s, z]$ behave when z changes.

$$\frac{\partial gE[\alpha \mid b, z]}{\partial z} = g(a + b - 2ab)[\alpha(p_o^{b,b}) - \alpha(p_o^{b,s})] + g\alpha(p_o^{b,s}) - g\alpha(p) \tag{A3.5}$$

$$\frac{\partial gE[\alpha \mid s, z]}{\partial z} = g(a + b - 2ab)[\alpha(p_o^{s,b}) - \alpha(p_o^{s,s})] + g\alpha(p_o^{s,s}) - g\alpha(1-a) \tag{A3.6}$$

in order for the difference $g\{E[\alpha \mid b, z] - E[\alpha \mid s, z]\}$ to be decreasing in z, a sufficient condition is that $\frac{\partial E[\alpha|b,z]}{\partial z} < 0$ and $\frac{\partial E[\alpha|s,z]}{\partial z} \geq 0$. Under Assumption 3.1, α linear in p. Then, it is possible to see that

$$\frac{\partial E[\alpha \mid b, z]}{\partial z} < 0 \leftrightarrow (a + b - 2ab) < \frac{p - p_o^{b,s}}{p_o^{b,b} - p_o^{b,s}} = pb + (1-p)(1-b)$$

$$pb + (1-p)(1-b) - (a + b - 2ab) = (a + p - 1)(2b - 1) > 0 \tag{A3.7}$$

as $p \geq \frac{1}{2}$ in equilibrium, and $a > \frac{1}{2}, b > \frac{1}{2}$ by assumption. Moreover,

$$\frac{\partial E[\alpha \mid s, z]}{\partial z} = \frac{(2b-1)a(1-a)}{ab + (1-a)(1-b)} - \frac{(2b-1)a(1-a)}{ab + (1-a)(1-b)} = 0 \tag{A3.8}$$

and therefore competition increases truthtelling incentives, as it reduces the expected gains from misreporting information. If the optimal holding α were negative after observing one or two sell recommendations, some of the terms $\alpha(\cdot)$ would be zero. It is easy to see that results would be unchanged, as $\alpha(p_o^{s,s}) < \alpha(1-a) < \alpha(p_o^{s,b})$, and $\alpha(p_o^{b,s}) < \alpha(p) < \alpha(p_o^{b,b})$. Thus, if, say, $\alpha(p_o^{s,s}) < 0$, then $\frac{\partial gE[\alpha|s,z]}{\partial z} = g[(a+b-2ab)\alpha(p_o^{s,b}) - \alpha(1-a)] > 0$. Similarly, it can be verified that results hold in all other cases.

This proof underlines that the conditions $\frac{\partial E[\alpha|b,z]}{\partial z} < 0$ and $\frac{\partial E[\alpha|s,z]}{\partial z} \geq 0$ cannot be satisfied for all possible functions α. For example, if the term $\alpha(p_o^{b,b})$ is very large, which can happen when investors strongly increase their demand for the stock upon observing two buy recommendations, then the first condition is unlikely to be satisfied. Typically, when the function $\alpha(\cdot)$ is either very convex, or very concave, the condition $\frac{\partial E[\alpha|b,z]}{\partial z} < 0$ and $\frac{\partial E[\alpha|s,z]}{\partial z} \geq 0$ will not be satisfied.

3.11 Appendix to Chapter 3 - Estimation Results

Table 3.5 The effect of No Competition from Non Affiliated Analysts on Recommendations

Recommendations issued by analysts on IPOs are analysed in order to investigate whether analysts affiliated with the lead underwriter of the IPO are more likely to issue optimistic recommendations than non affiliated analysts and whether this effect is mitigated by competition. The dependent variable is the probability the recommendation issued by an analyst (both affiliated and non affiliated) in the first 45 days after the IPO is a "Strong Buy". The variable *No Competition* is an indicator variable taking the value 1 if only the analyst affiliated with the lead underwriter of the IPO issues a recommendation on that IPO in the first 45 days after the stock began trading, thus facing no competition from other analysts. The variable *Dumins* is an indicator variable taking the value 1 if the recommendation is issued by an analyst affiliated with the lead underwriter of the IPO. *Size* is the logarithm of the proceeds amount from the IPO in million US Dollars. *First Day* is the return in the first day of trade. *Six month excess return* is the difference between the return on the IPO in the first six months after going public and the return on the CRSP value weighted index during the same period. Returns are in US Dollars. Coefficients significant at the 1, 5 and 10 percent level are indicated by ***, **, and * respectively. Z - Statistics in parenthesis. Standard errors are clustered at the analyst level in the Logit model that does not control for analyst unobserved heterogeneity.

Dependent Variable: Probability(Recommendation="Strong Buy")			
	Logit (1)	*Fixed Effects Logit* (2)	*Random Effects Logit* (3)
No Competition	0.347773 (2.02)**	0.58460 (1.80)*	0.6417182 (2.36)**
Dumins	0.114643 (1.12)	0.945471 (4.71)***	0.6912686 (4.43)***
Size	−0.083949 (−1.75)*	0.255103 (2.44)**	0.0253668 (0.32)
First Day	−0.443601 (−4.42)***	−0.417957 (−3.16)***	−0.6047654 (−5.31)***
Six Month Excess Return	−0.039027 (−1.07)	0.0245549 (0.72)	−0.001182 (−0.03)
Quarterly dummies	*yes*	*yes*	*yes*
Industry dummies	*yes*	*yes*	*yes*
Analyst fixed effects	*no*	*yes*	*no*
Observations	3163	1229	3164
Pseudo R − Squared	0.0574		
Log − Likelihood	−2057.6804	−403.51627	−1720.5621
Number of clusters	1275		

Table 3.6 The Effect of Coverage from Non Affiliated Analysts on Recommendations from Affiliated Analysts

Recommendations issued by analysts affiliated with the lead underwriter of the IPO are analysed in order to investigate whether analysts affiliated with the lead underwriter of the IPO are more likely to issue optimistic recommendations when the coverage on the IPO from non affiliated analysts is weaker. The dependent variable is the probability the recommendation issued by an affiliated analyst in the first 45 days after the IPO is a "Strong Buy". The variable *Numbout* is the logarithm of the number of analysts non affiliated with the lead underwriter of the IPO issuing a recommendation on the IPO in the first 45 days after the IPO. It represents a measure of competition. *Size* is the logarithm of the proceeds amount from the IPO in million US Dollars. The variable *Numbout*Size* is an interaction between the two variables just described. *First Day* is the return on the first day of trade. *Six Month Excess Return* is the difference between the return on the IPO in the first six months after going public and the return on the CRSP value weighted index during the same period. Returns are in US Dollars. Coefficients significant at the 1, 5 and 10 percent level are indicated by ***, **, and * respectively. Z- Statistics in parenthesis. Standard errors are clustered at the analyst level in the Logit model that does not control for analyst unobserved heterogeneity.

Dependent Variable: Probability(Recommendation="Strong Buy")			
	Logit (1)	*Fixed Effects Logit* (2)	*Random Effects Logit* (3)
Numbout	−2.053483 (−3.01)***	−1.78016 (−0.91)	−2.647442 (−2.37)**
Size	−.283014 (−1.55)	0.324747 (0.64)	−0.294397 (−1.03)
*Numbout * Size*	.433780 (2.66)***	0.4165162 (0.89)	0.6006212 (2.19)**
First Day	−1.12741 (−5.17)***	−1.680675 (−3.53)***	−1.650082 (−5.52)***
Six Month Excess Return	−0.009792 (−0.17)	0.0145249 (0.21)	−0.0346514 (−0.54)
quarterly dummies	*yes*	*yes*	*yes*
industry dummies	*yes*	*yes*	*yes*
analyst fixed effects	*no*	*yes*	*no*
Observations	1042	310	1047
Pseudo R − Squared	0.1214		
Log − Likelihood	−634.49421	−77.34829	−590.04642
Number of clusters	588		588

Table 3.7 The Effect of Recommendations from Non Affiliated Analysts on Recommendations from Affiliated Analysts

The table reports results for recommendations issued by analysts affiliated with the lead underwriter of the IPO (Insider) after having observed at least a recommendation from an analyst not affiliated with the lead underwriter of the IPO (Outsider). The dependent variable is an indicator variable taking the value 1 if an Insider issues a "Strong Buy" recommendation. Estimates are from a Probit model for the probability that the insider issues a "Strong Buy" recommendation. The variable *Outopt(avg=4.3)* is an indicator variable taking the value 1 if the average recommendation issued by Outsiders in the three days prior to the date the Insider issued his recommendation is larger than 4.333. The latter is the median of the average recommendation issued by Outsider analysts. *Outopt(best=5)* is an indicator variable taking the value 1 if at least one Outsider issued a "Strong Buy" recommendation in the three days prior to the date the Insider issued his recommendation. *Size* is the logarithm of the proceeds amount from the IPO in million US dollars. *First Day* is the return on the first day of trade. *Six Month Excess Return* is the difference between the return on the IPO in the first six months after going public and the return on the CRSP value weighted index during the same period. Returns are in US Dollars. Coefficients significant at the 1, 5 and 10 percent level are indicated by ***, **, and * respectively. Z - Statistics in parenthesis. Standard errors are clustered at the analyst level.

Dependent Variable: Probability(Recommendation from Insider="Strong Buy")		
$Outopt(avg \geq 4.333)$	0.1023 (0.39)	
$Outopt(best = 5)$		0.0426 (0.16)
$Size$	0.049 (0.38)	0.0464 (0.36)
$First\ Day$	−0.4898 (−2.04)**	−0.4971 (−2.06)**
$Six\ Month\ Excess\ Return$	0.07569 (1.21)	0.0748 (1.19)
$Observations$	101	101
$Pseudo\ R - Squared$	0.0448	0.0440

Table 3.8 Estimation of the Propensity Score

The table reports the estimation of the probability an analyst affiliated with the lead underwriter of the IPO (Insider) is the only analyst issuing a recommendation on the IPO, thus facing no competition from non affiliated analysts (Outsiders). The probability is estimated through a Probit model. *Size* is the logarithm of the proceeds amount from the IPO in million US dollars. *First Day* is the return on the first day of trade. *Six Month Excess Return* is the difference between the return on the IPO in the first six months after going public and the return on the CRSP value weighted index during the same period. Returns are in US Dollars. Coefficients significant at the 1, 5 and 10 percent level are indicated by ***, **, and * respectively. Z - Statistics in parenthesis. Standard errors are clustered at the analyst level. The estimated probability that the insider analyst faces no competition from outsider analysts is the propensity score, which is used to match observations to estimate the average effect of exposing insider analysts to no competition from outsiders controlling for the possible presence of selection bias.

	Prob(No Competition = 1)
Size	−0.33708 (−4.64)***
First Day	−0.51529 (−2.84)***
Six Month Excess Return	−0.17932 (−2.66***)
quarterly dummies	*yes*
industry dummies	*yes*
Observations	1128
Log likelihood	−443.689
Pseudo R2	0.1638

Table 3.9 Summary Statistics of the Propensity Score

The table shows details of the distribution of the estimated propensity score. The propensity score estimates the probability that there is no coverage on the stock from outsider analysts. The balancing property, necessary condition to employ the propensity score to compute a matching estimator, is satisfied. This means that for the estimated propensity score, IPOs for which there is coverage from outsider analysts have the same distribution in terms of size, returns, industry and time of the IPO as those IPOs for which there is no coverage from outsider analysts.

	Percentile			
1%	0.000021			
5%	0.00617		*Obs*	1020
10%	0.018224			
25%	0.0714092		*Mean*	0.2059
			Std.Dev.	0.16081
50%	0.180271		*Skewness*	0.80710
			Kurtosis	3.2278
75%	0.307142			
90%	0.442346			
95%	0.512471			
99%	0.613357			

Table 3.10 Estimation of the Average Effect of No Competition from Outsider Analysts with Nearest Neighbour Matching based on Propensity Score

The table presents estimates of the average effect of not exposing analysts affiliated to the lead underwriter of the IPO to competition from analysts not affiliated with the lead underwriter of the IPO. The estimate is displayed in the column labelled as ATE. The column labelled as STD Error reports the standard error of the estimate. The column labelled as Z, reports the Z-Statistics. The column labelled as P>z represents p-values. Finally, the column labelled as Confidence Interval reports the 95 per cent confidence interval. The first line contains estimates obtained by nearest neighbour matching based on propensity scores. The second line contains the bias adjusted estimate obtained by nearest neighbour matching based upon propensity score, following the procedure proposed by Abadie and Imbens (2002). Significance at the 1, 5 and 10 percent level is indicated by ***, **, and * respectively.

	ATE	STD Error	Z	P>z	Confidence Interval
$Abadie - Imbens$	0.14803	0.08018	1.85*	0.065	$[-0.00912, 0.3052]$
$Bias\ Adjusted$	0.14873	0.08022	1.85*	0.064	$[-0.00855, 0.30603]$
$Number\ of\ Observations$: 1020					

Chapter 4

Sorting, Reputation and Entry in a Market for Expert Advice

4.1 Introduction and Motivation

This chapter provides new insights on the workings of the market for professional (expert) services. A key feature of such markets, which is often overlook, is the important role of client sorting on the incentives of experts to provide the service at a high standard. Most of the literature focussed on the role played by the coexistence of experts with different reputations. Investment banks of different reputation compete in the market for financial services. In the medical practice, patients can be treated by luminaries or general practitioners. Legal assistance can be provided by Perry Mason, as well as by unknown members of the Bar. However, clients can be widely heterogenous too: merging firms can be of different size, so that a merger between two large multinationals can involve greater complexity than one involving two small local firms, patients can require sophisticated operations, or more standard treatments, defendants can go to court facing a complex murder accusation or a trivial quarrel with neighbours. Heterogenous clients derive a different utility from hiring experts of different reputation, so that a firm with a very promising project might value more the services of a famed investment bank in the going public process than firms with less promising investment plans. A patient with a rare illness might benefit more from the expertise of a luminary, than a patient needing to fix a broken arm. Thus, heterogenous clients may find it optimal to sort into experts of different quality who are motivated by reputational concerns. This chapter identifies three channels through which sorting affects the incentives of experts to exert effort. The first channel is that the way clients sort into experts determine the balance between the demand and the supply of services for experts of that reputation, and thus may impact on the premium that clients pay in equilibrium to be served by more reputable experts. This is turn affects the value to build a reputation and thus incentives to exert effort. I dub this the *"fees channel"*. The second channel is that the sorting of clients may influence the informativeness of a success as a signal of talent. If the type of a client provides information on the difficulty of the service to be provided, then if an expert serves successfully clients who are on average "more difficult", she will build a reputation more quickly. This channel can be quite relevant in practice: the reputation of a lawyer winning a complex trial, or an investment bank successfully advising a very big and complex acquisition will get an especially large boost. I dub this the *"signalling channel"*. The third channel is related to the previous one: if the type of a client affects not only the learning process about the expert's talent, but also the likelihood the expert provides the service successfully, then the way clients sort affects the number of successful clients, and thus the rents from being successful. Winning a complex trial can provide a strong boost to a lawyer's reputation, but winning such a trial may be especially difficult: thus, the premium for being successful may increase, but the likelihood of being successful may be reduced. This in turn reduces the measure of successful experts and raises the premium for being successful. I dub the latter the *"toughness channel"*.

This setting is especially useful to analyse the effects of entry of expert on the incentives to exert effort and raise the likelihood the service is provided successfully (or is provided with higher quality). This important issue is at the core of the debate about the desirability of increasing entry in the market for audit services. As increased entry of experts affects the sorting of clients, this impacts on the incentives to exert effort through the three channels identified above (or through some of them). Thus the chapter shows how increased entry can modify the incentives of experts to exert effort. It also provides empirical predictions about the way fees for the services of experts of different reputation behave after entry occurs. Finally, the chapter discusses welfare effects of increased entry and policy implications.

4.2 Related Literature

There is a large literature on reputational incentives and on expert advice. The role of reputational incentives (career concerns) has been firstly modelled in the seminal paper of Holmstrom (1982) who spurred a large literature emphasizing different aspects and applications. Another important paper which clarifies the nature and the mechanics of reputation is Mailath and Samuelson (2001). They underline the notion of reputation as an asset and show the importance of maintaining uncertainty on a player's type in order for reputation to play an incentivizing role. Most of the contributions on reputational incentives for expert advice (or firm behaviour) focus essentially on one expert only and do not really deal with the effects of competition and entry. An important exception is Horner (2002) who shows that competition among firms acts as a strong discipline device and allows to sustain an equilibrium with repeated play of high effort, even when reputational concerns fade out due to learning about firms' type.

This work shares with these contribution the idea that reputation is an asset whose value is affected by the behaviour of the expert. The main difference with these papers is the fact that none of those investigate how the sorting behaviour of clients into experts affects the value of building a reputation and incentives for effort exertion.

There is a large literature investigating the role of competition in markets for expert advice and credence goods. Dulleck and Kerschbamer (2006) provide a thorough survey of the literature and of the most relevant issues: They underline what are the critical assumption that sustain the different results presented by the literature. Using their terminology, this work does not impose either the verifiability assumption (as I assume clients cannot verify the type or quality of service) or the liability assumption (as I assume that clients cannot fine experts for malpractice). However, I assume the quality of the service is observed by the market, that experts are characterized by a different ability in providing a good service and they live more than one period, so that reputational concerns provide incentives for the provision of a good quality service (or for avoiding fraud). At first sight, this chapter describes a setting which is not entirely specific to the credence goods market, as I assume experts perform a service whose quality depends stochastically on the effort exerted by the expert, and I assume all clients need the same service, they know the service they need (e.g. advice on how to successfully conclude an acquisition, or assistance to sue a person or an organization) although they differ in their valuation of a high quality service. Thus, it seems I overlook the problem of mistreatment and of overcharging. On the other hand, what I define as quality of the service can be interpreted as the provision of the correct service for the need of the client, and then what would really be missing in my set up is a distinction between the diagnosis stage and the service provision stage. I discuss this point at some further length in section 4.5. In general, the focus of this chapter differs from that of most of the literature on credence goods, as I wish to investigate the effects of clients sorting on incentives for the provision of a good quality service, and the effects of entry on such incentives through its influence on the sorting behaviour of clients. An important paper on the market for credence goods is Wolinsky (1993). He shows that customers' search may induce specialization and investigates the effects of search cum diagnosis costs on experts' incentives. He also deals with the effects of reputation. However, that is not linked to expert characteristics (intrinsic talent, type) but is modelled as a Folk Theorem result, thus it is not conform to the idea of reputation as an asset that I use in this chapter and that, in my opinion, is more appropriate. An early reference is Pitchik and Schotter (1987) who show that experts do not always provide their advice correctly in equilibrium. In their model advice is cheap talk. They derive their result in a setting where prices are exogenously given. Other contributions in this area that are relevant for this work are Emons (1997), Pesendorfer and Wolinsky (2003), Park (2005) and Fong (2005). Emons (1997) analyzes a set-up where experts offer a credence good and shows that customers can infer the seller's (expert's) incentives from the observations of market data. He also shows that non fraudulent equilibria exists, and a critical element is the presence of cheating costs. Pesendorfer and Wolinsky (2003) discuss the role of second opinions in a market for expert advice. They analyse a situation where experts make a diagnosis and then clients can decide whether to purchase the service or look for a new diagnosis. They show that the possibility of consulting other experts reduces incentives to exert effort and the equilibria fail to achieve even a second best outcome. However, experts in both papers are identical, have no intrinsic quality and there is no role for reputation (at least for the idea of reputation as an asset). Park (2005) investigates the effects of competition in a model where expert advice is cheap talk. He shows that reputation (intended in a Folk-Theorem sense) helps ensuring truthful information transmission, but competition may reduce such incentives. However, a customer can extract full information by consulting a panel of two experts. Finally, Fong (2005) examines a setting where customers are heterogenous on dimensions that are independent from the type of problem they may have. He shows that monopolistic experts cheat customers on some identifiable heterogeneities such as the extent to which customers suffer from the problem, or the difficulty in treating the customer problem. This aspect is related to this work because clients heterogeneity is shown to have important effects on the incentives of experts to provide a good treatment. However, the channels through which this occurs are totally different as sorting affects incentives to exert effort through the effect on the equilibrium fees, through the informativeness of a success as a signal of talent and through changes in the difficulty of the problems experts are hired to solve. In Fong's model selective cheating is a way to price discriminate, which is feasible as experts are monopolists. Therefore, another key difference is that I consider a competitive set up.

This chapter is also related to the literature analysing the role of middlemen. An early reference is Rubinstein and Wolinsky (1987). The authors show that middlemen help reducing time to find a suitable partner for exchange in a search and matching framework. However, in this model there is no scope for moral hazard or adverse selection, and the only role of middlemen is to reduce the costs related to time consuming search for suitable partners. Biglaiser (1993) introduces adverse selection and shows that middlemen have stronger incentives to acquire specific knowledge and specialize in monitoring the quality of products. Such incentives are further raised by reputational concerns. Lizzeri (1999) discusses the strategic information revelation of intermediaries. He shows that intermediaries find it optimal to reveal only whether quality is above a certain standard, but competition among intermediaries may lead to the existence of full revelation equilibria. Another interesting contribution is Faure Grimaud, Peyrache and Quesada (2006) who investigate a market for certification intermediaries (rating agencies) and show circumstances in which contractual arrangements which give clients the option to hide the information contained in the ratings arise in equilibrium. They also show that in this way competition among rating agencies reduces the amount of information revealed by the rating agencies. Finally, Strausz (2005) investigates the way reputation (in a folk theorem sense) is effective in ensuring capture of certifiers does not occur in equilibrium. In his paper, clients are homogenous, and there is no scope for sorting.

This work differs from this literature in two main respects. Firstly, I analyse experts providing a service to clients who value the service in itself, and not as a function of the interaction with another class of agents (final consumers, investors, etc.). However, there is some relation as the distribution of clients of the intermediary have important consequences on the incentives of the intermediary to report her information fully and/or correctly. Secondly, this literature does not investigate the effects of entry through changes in the sorting of clients.

The analysis of the chapter is tangential to the literature on competition and incentives. A key contribution in this area is Raith (2003) who showed that tougher competition raises incentives to exert high effort. Raith derives the results in a context where firms provide explicit incentives to managers in order to induce them to exert effort in reducing production costs. The mechanism at work here is different: firstly there are no explicit incentives to motivate experts to exert effort to provide a high quality service and secondly tougher competition affects incentives through the sorting behaviour of clients.

This work is also related to some interesting papers on investment banking. An important contribution is Chemmanur and Fulghieri (1994). The authors derive a model showing how reputational concerns affect investment banks standards of evaluating IPOs. They also sketch the effects of sorting of clients, but this has not really a direct impact on experts incentives. Furthermore they do not analyse the effect of entry of new experts in the market. Puri (1999) is broadly related as she investigates the effect of entry of commercial banks in the investment banking market. Commercial banks may have an informational advantage in the underwriting market as they may already hold financial claims of firms going public. She shows different underwriters specialize and can coexist in the market. The logic and the focus of this model is clearly quite different. Fernando, Gatchev and Spindt (2005) investigate the matching between issuers and underwriters of

IPOs and SEOs. They show that the equilibrium features positive matching as better firms hire more talented underwriters. However, they do not investigate how such matching impacts on the incentives of the underwriters to provide their service carefully.

The chapter develops as follows: section 4.3 contains the description of the model set up, section 4.4 derives the equilibrium and contains three subsections which investigates the three different channels through which changes in the sorting of clients, induced by increased entry, can affect incentives to exert effort. Section 4.5 discusses results, assumptions and extensions and section 4.6 concludes. The appendix contains proofs of propositions and lemmas.

4.3 The model

The model captures a situation where heterogenous clients decide the expert whom to apply to, clients bid for expert services, fees equate demand and supply, and clients are then matched to experts who provide them the service.

Players and actions: the economy is populated by a continuum of experts and clients and has an overlapping generation structure. Experts are heterogenous both as they are characterized by a different reputation for being talented and as they are of a different vintage: experts live for two periods, and in each period there are young and old experts. There is measure $\frac{1}{2}$ of each so that, overall there is measure 1 of experts. Clients live one period only and there is measure $M > 1$ of them. Clients observe the distribution of experts, bid up for the service and fees are determined in equilibrium. Experts have a capacity constraint, so that if the total measure of experts is smaller than the measure of clients, then some clients are rationed[1]. Each client willing to pay for the service is matched to an expert who performs the service. Experts can exert unobservable effort which increases the likelihood the service provided will be of high quality.

Information structure: Clients are characterized by a parameter θ, representing how they value the service. Such parameter can represent the quality of a firm, the gravity of an illness, the complexity of a judicial case, etc. There is a set of types $\Theta = [\underline{\theta}, \overline{\theta}]$ where $0 < \underline{\theta} < \overline{\theta}$. I assume client's type is private information[2], while the distribution of types is common knowledge. Clients are distributed according to the function G, so

[1]In equilibrium, fees determine those clients who are better off not purchasing the service.

[2]This is not strictly necessary for the results. I can assume the type of clients become known to an expert after being matched with the client. Then, some of the effects unveiled by the model will still be valid. Further discussion of this point will be provided in Section 5.

that $\int_{\underline{\theta}}^{\overline{\theta}} g(\theta)d\theta = M$, as there is measure M of clients[3]. Experts do not learn the type of clients[4]. Experts can be talented or not talented and this is symmetrically unknown. All players know the current reputation of an expert which is denoted by λ_t, indicating the probability, conditional on the information available at time t, that the expert is talented. The outcome (for example, the quality) of the service performed is observed and the market is able to update beliefs about expert's type. I will consider three cases. In the first the type of a client only affects her valuation for the service. In this case, sorting can only affect incentives through the *fees channel.* In the second, the type of clients also affects the probability of success of a talented expert, as follows

$$\Pr(success \mid talented, \theta) = k(\theta) \tag{4.1}$$

$$\text{while } \Pr(success \mid not\ talented, \theta) = z(\theta) \tag{4.2}$$

where $\frac{\partial k}{\partial \theta} > 0$ and $\frac{\partial z}{\partial \theta} \leq 0$. The term $z(\theta)$ can adjust so as to leave the total probability of a success unchanged. When that happens, sorting of clients determines a mean preserving spread in the total probability of success, so that facing higher types is more informative about the expert's talent, but does not raise the likelihood of a success. If θ represents the complexity of a case for a lawyer, this condition says that a success on a more complex case is more likely to come from a talented expert, or that a successful LBO involving a firm with a very troubling balance sheet situation, is a stronger signal that the advisor investment bank is reputable. The market does not observe exactly the type of each client, but knows, in equilibrium, the distribution of types being served by a given expert[5]. In this case, sorting affects incentives both through the *fees channel* and through the *signalling channel.* The third case allows for the possibility that the (expected) type of the client affects the likelihood of success: providing the service successfully is more likely for certain types of clients. In the latter case sorting affects incentives also through the *toughness channel,* together with the *fees channel* and, possibly, the *signalling channel.*

Timing: the model has an overlapping generation structure. Experts live two periods, clients only one period[6]. Each period a cohort of experts and clients drawn from the same

[3]Therefore, technically, the distribution G is not a probability distribution as it integrates to M. However, it represents the mass of clients over a certain set of types. For example, take two types θ^* and θ^{**} with $\theta^{**} < \theta^*$, the mass of clients with type $\theta^{**} < \theta < \theta^*$ is given by $\int_{\theta^{**}}^{\theta^*} g(\theta)d\theta = G(\theta^*) - G(\theta^{**})$. To obtain the probability distribution it is necessary to normalize the distribution G.

[4]This assumption plays a role only when I assume that the type of the client affects the likelihood of a success, or using the terminology of the paper, only when the *thoughness channel* of sorting works (together with the other two channels). Even in that case, all results hold as long as the expert observes a noisy, but not perfect, signal of the client type.

[5]And by all other experts with the same reputation.

[6]Alternatively, clients can live forever, but their type changes. The main idea is that the characteristics of the problem of a client, which are summarized in a client's type, are not constant, but change period by period.

distribution replaces those who exit the market, so that the distribution is stationary. Clients observe the distribution of experts and bid for their services. Then, they get served, until there are idle experts. If some clients cannot be served, they get an outside option of zero. When clients are matched to experts, the latter exert effort and provide the service, whose outcome is observed by the market which updates beliefs about experts' reputation. Then clients exit the market and the period ends. The fee can be paid up-front, or after the service has been provided, but it cannot be made contingent on the observed outcome.

Technology: the service provided by experts generates a high or low outcome depending upon the talent and effort choice of the expert, and in some cases, also upon the intrinsic quality of the client. Talented experts, by exerting effort e can raise the chances of providing a high quality service. The cost of effort is a function $c(e)$ where $c_{ee} > 0$, so that the cost of effort is strictly convex. Untalented experts generate a good quality outcome with a fixed probability independently of effort and of the quality of the client. Formally, I assume that the expected value for a client of type θ of the service provided by an expert of expected talent λ is given by

$$V(\lambda, \theta, e) \tag{4.3}$$

where

$$\frac{\partial V(\lambda,\theta,e)}{\partial \lambda} > 0, \ \frac{\partial V(\lambda,\theta,e)}{\partial e} > 0 \ if \ talented \ and \ \frac{\partial V(\lambda,\theta,e)}{\partial e} = 0 \ otherwise$$

$$\frac{\partial^2 V(\lambda,\theta,e)}{\partial \lambda \partial e} > 0, \frac{\partial^2 V(\lambda,\theta,e)}{\partial \lambda \partial \theta} > 0$$

$$\frac{\partial^2 V(\lambda,\theta,e)}{\partial e \partial \theta} > 0 \ if \ talented, \frac{\partial^2 V(\lambda,\theta,e)}{\partial e \partial \theta} = 0, \ otherwise$$

This says that the expected value of the service is increasing in the expert's talent, it is not decreasing in effort, and the inequality is strict when the expert is talented, otherwise, effort has no effect Secondly, the preferences of clients satisfy single crossing over talent and effort. This implies that if a client of type θ is indifferent between a combination of talent λ and effort e, over another combination $(\widetilde{\lambda}, \widetilde{e})$, then either all clients with types $\theta^{'} > \theta$ prefer (λ, e) over $(\widetilde{\lambda}, \widetilde{e})$, or all clients with types $\theta^{'} < \theta$ prefer (λ, e) over $(\widetilde{\lambda}, \widetilde{e})$ but it cannot happen that both a client with type $\theta^{'} > \theta$ and a client with type $\theta^{''} < \theta$ prefer (λ, e) over $(\widetilde{\lambda}, \widetilde{e})$. Also, the service provided by more reputable experts is more valuable to higher types and the marginal value of effort is increasing in client's types, at least when the expert is talented. There can be many examples of such functions. A very standard one is:

$$V(\lambda, \theta, e) = \theta\{[\lambda(e^* + \gamma) + \frac{1-\lambda}{2}]\overline{\pi} + [\lambda(1 - (e^* + \gamma)) + \frac{1-\lambda}{2}]\underline{\pi}\} \tag{4.4}$$

where λ is the probability the expert is talented, $(e^* + \gamma)$ is the probability that the service provided is of high quality conditional on the expert being talented and exerting expected effort e^*, and γ is a parameter ensuring that a talented expert is valuable even if she exerts no effort[7]. The term $\frac{1-\lambda}{2}$ indicates that the probability of a success if the expert is not talented (which occurs with probability $1 - \lambda$) is $\frac{1}{2}$. The terms $\overline{\pi}$ and $\underline{\pi}$ indicate, respectively, the value of a high and of a low quality service. I also assume a talented expert exerting effort is valuable, therefore, $(e^* + \gamma) > \frac{1}{2}$, at least for the equilibrium value of e. This function is such that the value of a talented expert lies in the larger probability of producing a high quality outcome. Moreover, more talented experts are more likely to produce a good quality outcome if they face higher types. Alternatively, it could happen that the value of a talented expert resides in the way the service is performed, and not in the chance of success. In an extension of the basic model, I also assume the likelihood of success is affected by the type of the client in the same fashion for talented and untalented experts. When this occurs, I assume that a high quality outcome is generated with probability $\frac{1}{E(\theta)}(\lambda(e + \gamma) + \frac{1-\lambda}{2})$, where $E(\theta)$ is the expected type of the client.

Players payoff: experts get a fee F for the service they offer and sustain an unobservable cost of effort $c(e)$, where c is a continuous and convex function. The period payoff for an expert is then given by $F - c(e)$. However, experts live for more than one period and they also take into account the continuation payoff when choosing effort optimally. Therefore the full payoff for an expert is $F_t - c(e_t) + \delta EW(\lambda_{t+1})$ where $\delta \leq 1$ is a discount factor and $EW(\lambda)$ is the expected continuation payoff, function of future beliefs about the expert's talent. Clients obtain expected value $V_t(\lambda, \theta, e)$ from the service and pay the fee F_t. The latter is set competitively as clients bid for experts services. Notice that experts cannot offer screening contracts, both because there is a continuum of measure λ of experts with the same reputation, so that it would not be possible, in equilibrium for such experts to provide rents to different types of clients in order to induce them to reveal their type, and because experts have only one instrument, the fee, to screen clients.

Strategies and beliefs: clients bid for experts services, then fees are determined in equilibrium and clients choose the type of experts from whom to purchase the service. Clients have an application strategy, $p(\theta) : \{\theta \times \lambda \times F \times e^*\} \to [0, 1]$, which is the probability of applying to an expert of reputation λ, which is function also of the type of the client,

[7]This is useful because the model has two periods and in the last period experts exert no effort as they do not have any reputational concern. Then, if $\gamma = 0$, experts in the second period would be valueless. An alternative is to assume that $\gamma = 0$ and that experts in the second period still have a continuation payoff increasing in their quality, so that they will be motivated to exert effort.

the equilibrium fee, and the expected equilibrium effort e^*. Applications determine the balance between demand and supply and in this way, equilibrium fees. Then clients are matched to available experts and the latter chooses optimally her effort level, as a function of their beliefs about their talent and the expected fees in the future period, denoted as F_{t+1}. Formally, $e : \{F_{t+1}, \lambda\} \to [0, 1-\gamma]$, where the latter condition is needed to ensure there is no success with probability larger than 1. Beliefs about experts' talent are updated according to Bayes rule. I consider three cases, in the first the (expected) type of clients does not affect the likelihood a talented expert succeeds. Therefore

$$\Pr(Talented \mid Success, e) = \lambda^+_{t+1} = \frac{\lambda_t(e+\gamma)}{\lambda_t(e+\gamma) + \frac{1-\lambda_t}{2}} \tag{4.5}$$

as the probability of a success conditional on being talented and exerting effort e, is given by $(e+\gamma)$[8], while the probability of a success conditional on the expert being untalented is $\frac{1}{2}$. If the service provided turns out to be poor, the reputation of the expert is lowered to

$$\Pr(Talented \mid Failure, e) = \lambda^-_{t+1} = \frac{\lambda_t[1-(e+\gamma)]}{\lambda_t[1-(e+\gamma)] + \frac{1-\lambda_t}{2}} \tag{4.6}$$

Thus in each period there is measure $\frac{1}{2}$ of newly born experts with reputation λ, measure $[\lambda(e+\gamma) + \frac{1-\lambda}{2}]\frac{1}{2}$ of old experts that were successful in their first period and thus have reputation λ^+_{t+1}, and measure $[1 - \lambda(e+\gamma) - \frac{1-\lambda}{2}]\frac{1}{2}$ of old experts who were unsuccessful in their first period and thus have reputation λ^-_{t+1}.

I also allow for the possibility that the type of the client provides information about the likelihood a talented expert succeeds in providing a high quality service, beliefs about the talent of the expert evolve as follows:

$$\begin{aligned}\Pr(Talented \quad \mid \quad & Success, \theta, e) = \lambda^+_{t+1} = \\ & \frac{\lambda_t(e+\gamma+k(E(\theta\mid\lambda)))}{\lambda_t(e+\gamma+k(E(\theta\mid\lambda))) + (1-\lambda_t)(\frac{1}{2}+z(E(\theta\mid\lambda)))}\end{aligned} \tag{4.7}$$

as the probability of a success conditional on the expert being talented, exerting effort e, and facing clients of expected quality $E(\theta \mid \lambda)$ is $[k(E(\theta \mid \lambda) + e + \gamma]$, while the probability of a success if the expert is untalented is $\frac{1}{2} + z(E(\theta \mid \lambda))$. The total probability of success can be unchanged if

$$\lambda_t(e+\gamma+k(E(\theta\mid\lambda))) + (1-\lambda_t)(\frac{1}{2}+z(E(\theta\mid\lambda))) = \lambda_t(e+\gamma) + \frac{1-\lambda_t}{2} \tag{4.8}$$

[8]The effort level e is the market expectation of the effort exerted by the expert.

which occurs when

$$z(E(\theta \mid \lambda)) = -\frac{\lambda_t k(E(\theta \mid \lambda))}{1-\lambda_t} \tag{4.9}$$

If the service provided turns out to be poor, the reputation of the expert is lowered to

$$\Pr(Talented \mid Failure, \theta, e) = \lambda_{t+1}^{-} = \frac{\lambda_t[1-(e+\gamma+k(E(\theta \mid \lambda))]}{\lambda_t[1-(e+\gamma+k(E(\theta \mid \lambda)))]+(1-\lambda_t)(\frac{1}{2}-z(E(\theta \mid \lambda)))} \tag{4.10}$$

In this case the measure of successful experts in period $t+1$ is $[\lambda_t(e+\gamma+k(E(\theta \mid \lambda)))+(1-\lambda_t)(\frac{1}{2}+z(E(\theta \mid \lambda)))]\frac{1}{2}$, while the measure of unsuccessful experts is $\lambda_t[1-(e+\gamma+k(E(\theta \mid \lambda)))]+(1-\lambda_t)(\frac{1}{2}-z(E(\theta \mid \lambda)))$.

4.4 Equilibrium

The equilibrium concept is Perfect Bayesian Equilibrium. Clients choose optimally their application strategy and experts choose optimally their effort level. Beliefs are confirmed in equilibrium, and updated according to Bayes Rule. I firstly study the most simple model, where the type of clients does not affect either the learning process about experts' talent, or the likelihood that a talented expert succeeds in providing a high quality service.

4.4.1 The basic model

I firstly study the behaviour of experts with different "vintage", then I will turn to derive the equilibrium fee and analyse the application policy and sorting behaviour of clients. In this model, as in other career concerns models, there can exist equilibria where the reputation of experts is not valued by the market. I will focus on equilibria where reputation always has a value.

Lemma 4.1 *Experts exert zero effort in their last period, while they can exert positive effort in their first period.*

Proof. See Appendix to Chapter 4. ■

This result is standard in the literature. The novel part of the analysis lies in the strategic behaviour of clients and in its consequences. Thus, I now derive the preferences of clients over experts with different expected reputation. This allows to determine the equilibrium composition of the sample faced by experts of different reputation, and thus the equilibrium fees. The latter will depend upon the value clients attach to the service, which in turn determines clients bids, and the balance between supply and demand. Therefore they will be function of the reputation of the expert, the expected effort level exerted (e^*), and of the expected type of client applying to experts of that reputation. Thus, equilibrium fees will be functions $F : \{\lambda, E(\theta \mid \lambda), e^*\} \to \mathbb{R}$.

The fact that experts do not exert effort in the last period has interesting implications for the preferences, and thus the sorting behaviour, of clients. It is obvious that all clients prefer new entrants to old unsuccessful experts, as the latter both are less talented and exert no effort. In fact, the assumptions of the model imply that

$$V(\lambda, \theta, e) > V(\lambda^-, \theta, 0), \forall \theta \tag{4.11}$$

as $\lambda > \lambda^-$ and $e > 0$. It is less obvious how do clients rate successful experts relative to new entrants. Experts who are successful in the first period have a larger value for clients, as they are more likely to produce a good quality service. On the other hand, they do not exert effort, while new entrants do, and therefore the latter might provide a service whose value is larger than that offered by more reputable experts. In fact, it is not possible, a priori, to tell whether

$$V(\lambda^+, \theta, 0) > V(\lambda, \theta, e) \text{ or } V(\lambda^+, \theta, 0) < V(\lambda, \theta, e) \tag{4.12}$$

because the increase in value from applying to a more reputable expert can be more than compensated by the decrease in value due to the lower effort level exerted by an expert with no career concerns. Notice that this effect is always present, even in an infinite horizon model, as incentives to exert effort fade out as learning about an expert's type become more precise. I solve the model adding a simplifying assumption which does not change the qualitative results[9].

Assumption 4.1: for all θ, either $V(\lambda^+, \theta, 0) > V(\lambda, \theta, 1-\gamma)$, or $V(\lambda^+, \theta, 0) < V(\lambda, \theta, 1-\gamma)$.

This implies that preferences over expert talent and effort are the same for all clients. Notice that $e = 1 - \gamma$ is the maximum level of effort, as the total probability of success is given by $e + \gamma$ for talented experts. Then, two cases must be distinguished:

Case 1: $V(\lambda^+, \theta, 0) > V(\lambda, \theta, 1 - \gamma)$. This situation is likely to occur in services for which the talent of the expert is extremely relevant, thus I call this situation the "*talent*

[9] I discuss this is greater detail in Section 5.

intensive" case. In equilibrium clients bid for the experts services. In any period t all clients would prefer to be served by experts with reputation λ_t^+, but there is only measure $[\lambda_{t-1}(e_{t-1}^* + \gamma) + \frac{1-\lambda_{t-1}}{2}]\frac{1}{2}$ of them, as talented experts succeed in period $t-1$ with probability $e_{t-1} + \gamma$ and untalented with probability $\frac{1}{2}$, while clients are of measure $M > 1 > [\lambda_{t-1}(e_{t-1}^* + \gamma) + \frac{1-\lambda_{t-1}}{2}]\frac{1}{2}$. Thus the equilibrium fee for the services of experts of reputation λ_t^+ must be such that all experts are busy and therefore demand for the services of experts of that reputation equals supply, and clients have no incentive to deviate. Those clients that are not served by the most reputable experts, get served by new entrant experts with reputation λ_t. Finally, part of the remaining clients are served by the least reputable experts, and some clients get no service at all, as M, the total measure of clients, is larger than 1, the total measure of experts. The model is stationary, so, in order to ease notation, I will drop the reference to period t, and instead denote current period variables without subscript, previous period with subscript -1 and future period with subscript $+1$. The discussion above is formalized in the following:

Proposition 4.1 *In equilibrium, the set of clients is partitioned in four subsets. Clients of type $\theta \in [\theta^*, \overline{\theta}]$ are served by experts of reputation λ^+, clients of type $\theta \in [\theta^{**}, \theta^*]$ are served by experts of reputation λ, clients of type $\theta \in [\theta^{***}, \theta^{**}]$ are served by experts of reputation λ^-. Finally clients of type $\theta \in [\underline{\theta}, \theta^{***}]$ do not get served. The thresholds separating the three subsets satisfy $\theta^{***} < \theta^{**} < \theta^*$ and*

$$\begin{aligned}
[\lambda_{-1}(e_{-1}^* + \gamma) + \frac{1-\lambda_{-1}}{2}]\frac{1}{2} &= M - G(\theta^*) \\
\frac{1}{2} &= G(\theta^*) - G(\theta^{**}) \\
[\lambda_{-1}(1 - (e_{-1}^* + \gamma)) + \frac{1-\lambda_{-1}}{2}]\frac{1}{2} &= G(\theta^{**}) - G(\theta^{***}) \\
M - 1 &= G(\theta^{***})
\end{aligned}$$

equilibrium fees satisfy the following equalities

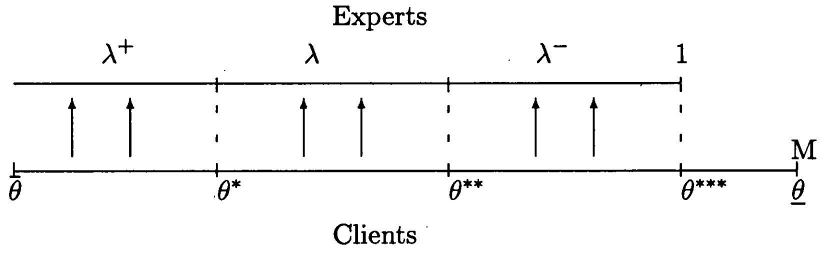
$$\begin{aligned}
V(\lambda^+, \theta^*, 0) - F(\lambda^+, E[(\theta) &\mid \lambda^+], 0) = V(\lambda, \theta^*, e^*) - F(\lambda, E[(\theta) \mid \lambda], e^*) \\
V(\lambda, \theta^{**}, e^*) - F(\lambda, E[(\theta) &\mid \lambda], e^*) = V(\lambda^-, \theta^{**}, 0) - F(\lambda^-, E[(\theta) \mid \lambda^-], 0) \\
V(\lambda^-, \theta^{***}, 0) - F(\lambda^-, E[(\theta) &\mid \lambda^-], 0) = 0
\end{aligned}$$

Proof. See Appendix to Chapter 4. ■

Figure 4.1 illustrates the equilibrium[10].

[10] In figure 1 clients are distributed uniformly.

Figure 4.1 Equilibrium



This proposition shows that clients sort into experts, so that highest types purchase the service from the most reputable experts, intermediate types purchase the service from experts with intermediate reputation, lower types purchase the service from the experts with the lowest reputation, and finally very low types do not get served at all, as they value the service too little. Equilibrium fees ensure that demand equals supply for the services of experts of different reputation and clients have no incentive to deviate.

I now turn to analyse the effects of entry. Increased entry of new experts raises the supply of experts with intermediate reputation. Then, the equilibrium thresholds for clients' sorting are modified and this impacts the types who are indifferent in equilibrium, and, in this way, the incentives to exert effort. This discussion is formalized in the following

Proposition 4.2 *Entry modifies the sorting behaviour of clients both in the current and in the future period. The former has no effect on the incentives to exert effort. However, the change in sorting behaviour of clients in the future period impacts on the premium that clients are willing to pay to be served by the most reputable experts in a way that unambiguously reduces incentives to exert effort.*

Proof. See Appendix to Chapter 4 ■

This proposition shows that it cannot exist an equilibrium where effort is larger after entry occurred. This follows because increased entry in the current period tends to raise both the measure of successful and of unsuccessful experts in the future period. Effort can increase if and only if the premium paid for being served by a more reputable expert[11]

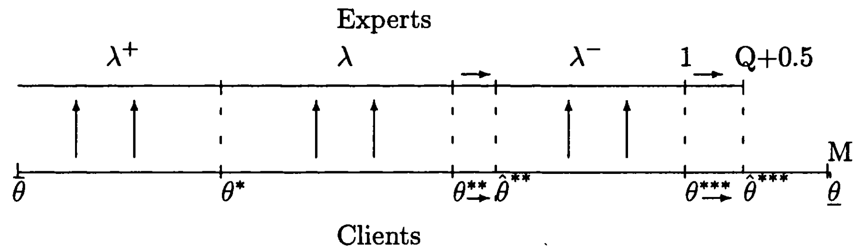
[11] The difference $F_{t+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}), 0) - F_{t+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1})], 0)$

increases. The latter can occur if and only if the type who is indifferent between being served by the most reputable expert or by a new entrant is a type with a higher valuation. However for the latter to occur, effort must be lower, as the measure of "old" experts will be larger in the future period due to increased entry in the current period.

I now describe how the indifferent types change. The threshold $\widehat{\theta}^*_{+1}$ can be either higher or lower than the corresponding threshold had entry not occurred, while $\widehat{\theta}^{**}_{+1} < \theta^{**}_{+1}$ both because of increased entry and because if $\widehat{\theta}^*_{+1} > \theta^*_{+1}$, then $\widehat{\theta}^{**}_{+1} < \theta^{**}_{+1}$ otherwise incentives to exert effort would induce a larger effort level which would necessarily cause $\widehat{\theta}^*_{+1} < \theta^*_{+1}$. Finally, the fact that $\widehat{\theta}^{**}_{+1} < \theta^{**}_{+1}$ also implies that $\widehat{\theta}^{***}_{+1} < \theta^{***}_{+1}$. Figures 4.2 and 4.3 show the effect of entry in the current period and in the future period on the threshold types.

Figure 4.2 Effect of entry of experts in period t: equilibrium in period t

Period t

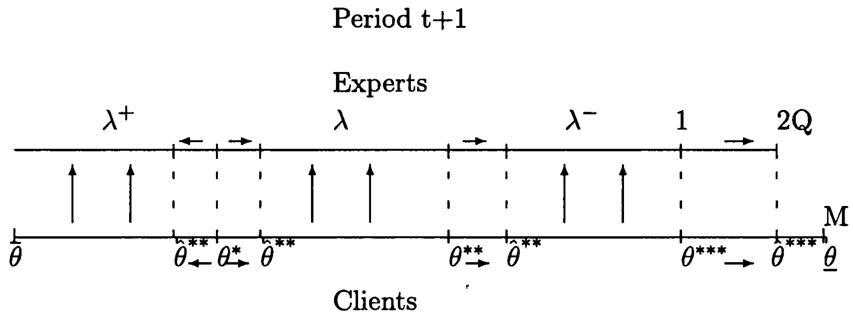


Entry also affects equilibrium fees both in the period when increased entry occurs for the first time, and in future periods.

Proposition 4.3 *Fees charged by new entrants and unsuccessful experts are reduced in the period entry occurs, while the effect on the fees for the service of the most reputable experts is ambiguous. A similar behaviour occurs in future periods when, however, the premium to be paid to get the service from the most reputable experts must be lower.*

Proof. See appendix to Chapter 4 ■

Figure 4.3 Effect of entry of experts in period t: equilibrium in period t+1



This proposition shows that after entry occurs, fees charged by new entrants and by less reputable experts are lower. This is due to the downward movement in the thresholds θ^{**} and θ^{***}. Then, the condition ensuring clients have no incentive to deviate implies that fees for new entrants and less reputable experts must decrease. On the contrary, the effect on the fees paid to most reputable experts is ambiguous. On the one hand, the decrease in the lower thresholds induce all fees to decrease. On the other hand, the decrease in equilibrium effort, raises the difference between the value of being served by the most reputable expert and the value of being served by a new entrant.

Case 2: $V(\lambda^+, \theta, 0) < V(\lambda, \theta, 1-\gamma)$. In this case, experts who were successful in the first period offer an expected service which is less valuable than that offered by new entrants, even if the latter have a lower reputation[12]. This situation is likely to characterize services for which the effort of the expert is extremely relevant, thus I call this case the "*effort intensive*" case. Results are essentially the same as in the previous case. In fact, from the same reasoning as above, in equilibrium it must be that

$$\begin{aligned}
\frac{1}{2} &= M - G(\theta^*) \\
[\lambda(e+\gamma) + \frac{1-\lambda}{2}]\frac{1}{2} &= G(\theta^*) - G(\theta^{**}) \\
[\lambda(1-(e+\gamma)) + \frac{1-\lambda}{2}]\frac{1}{2} &= G(\theta^{**}) - G(\theta^{***}) \\
M - 1 &= G(\theta^{***})
\end{aligned}$$

[12] At first sight it may seem that new entrants could be better off by not offering the service in the first period. That strategy would yield a maximum payoff of $F(\lambda, 0)$. While exerting effort in the first period yields a payoff of $F(\lambda,0) + \max_e\{eF(\lambda^+_{+1}, 0) + (1-e)F(\lambda^-_{+1}, 0) - c(e)\}$. The expression in curly brackets is non negative, as the expert can always set $e = 0$, and it is easy to see that $F(\lambda, 0) + \max_e\{eF(\lambda^+_{+1}, 0) + (1-e)F(\lambda^-_{+1}, 0) - c(e)\} > F(\lambda, 0)$ so that experts always prefer to offer their service in the first period.

where $\theta^{***} < \theta^{**} < \theta^{*}$, and equilibrium fees satisfy

$$\begin{aligned} V(\lambda, \theta^*, e^*) - F(\lambda, E[(\theta) &\mid \lambda], e^*) = V(\lambda^+, \theta^*, 0) - F(\lambda^+, E[(\theta) \mid \lambda^+], 0) \\ V(\lambda^+, \theta^*, 0) - F(\lambda^+, E[(\theta) &\mid \lambda^+], 0) = V(\lambda^-, \theta^{**}, 0) - F(\lambda^-, E[(\theta) \mid \lambda^-], 0) \\ V(\lambda^-, \theta^{***}, 0) - F(\lambda^-, E[(\theta) &\mid \lambda^-], 0) = 0 \end{aligned}$$

Then, the effect of entry can be immediately verified

Proposition 4.4 *Entry reduces incentives to exert effort.*

Proof. The proof is analogous to that of proposition 4.2 and is thus omitted. ■

The main difference with the case of talent intensive services lies in the behaviour of the fees in the current period. In fact, now all fees must be lower. In fact,

$$G(\theta^*) = M - \frac{1}{2} > G(\widehat{\theta}^*) = M - Q \tag{4.13}$$

so that $\theta^* > \widehat{\theta}^*$ as $Q > \frac{1}{2}$. Then, this necessarily implies that $\widehat{\theta}^{**} < \theta^{**}$ and $\widehat{\theta}^{***} < \theta^{***}$. On the contrary, the behaviour of fees in the future period are analogous to the talent intensive case.

4.4.2 The type of the client affects the informativeness of success as a signal of talent

I now allow for the possibility that the probability of success for talented experts depends upon the type of clients. This situation is likely to occur in practice. Think of a lawyer winning a class action suit against a large corporation: typically the case will be difficult, and a success is a strong signal of talent. Similarly, a surgeon performing successfully a liver transplant with an innovative technique will increase her reputation more than if she repairs a knee joint. I assume that when the probability that a successful expert provides a service of high quality is increasing in the client's type, beliefs about the expert talent following a success and a failure evolve as follows

$$\begin{aligned} \Pr(Talented &\mid Success, \theta, e) = \lambda^+_{+1} = \\ &\frac{\lambda_t(e + \gamma + k(E(\theta \mid \lambda)))}{\lambda_t(e + \gamma + k(E(\theta \mid \lambda))) + (1 - \lambda_t)(\frac{1}{2} + z(E(\theta \mid \lambda)))} \end{aligned} \tag{4.14}$$

$$\begin{aligned} \Pr(Talented &\mid Failure, \theta, e) = \lambda^-_{+1} = \\ &\frac{\lambda_t[1 - (e + \gamma + k(E(\theta \mid \lambda))]}{\lambda_t[1 - (e + \gamma + k(E(\theta \mid \lambda)))] + (1 - \lambda_t)(\frac{1}{2} - z(E(\theta \mid \lambda)))} \end{aligned} \tag{4.15}$$

where $k(E(\theta \mid \lambda))$ is increasing in θ and thus in $E(\theta \mid \lambda)$, while $z(E(\theta \mid \lambda))$ is non increasing in θ, and thus in $E(\theta \mid \lambda)$. As the market does not know the exact type of the client served by a given expert, beliefs will be updated using the average type applying to experts with a certain reputation. Then, sorting of clients generates a further effect on the incentives to exert effort: as $k(E(\theta \mid \lambda))$ moves, a success can be more or less informative about an expert's talent, and in this way, the value of getting the service from a talented (and from an untalented) expert changes. In fact, if $E(\theta \mid \lambda)$ is reduced, $k(E(\theta \mid \lambda))$ goes down and λ_{+1}^{+} will be lower, while λ_{+1}^{-} will be larger. Thus, $V(\lambda_{+1}^{+}, \theta, 0)$ will be lower and $V(\lambda_{+1}^{-}, \theta, 0)$ larger, for all θ. I dub this the "*signalling effect*" of sorting. However, the total probability of a success is now $\lambda_t(e + \gamma + k(E(\theta \mid \lambda))) + (1 - \lambda_t)(\frac{1}{2} + z(E(\theta \mid \lambda)))$. If this changes with $E(\theta \mid \lambda)$, then, the measure of successful experts in the future period changes, and this can critically affect future period equilibrium fees. I firstly assume that clients sorting only induces a change in the informativeness of success as a signal of talent. In this case, as shown above,

$$z(E(\theta \mid \lambda)) = -\frac{\lambda_t k(E(\theta \mid \lambda))}{1 - \lambda_t} \tag{4.16}$$

so that

$$\lambda_t(e + \gamma + k(E(\theta \mid \lambda))) + (1 - \lambda_t)(\frac{1}{2} + z(E(\theta \mid \lambda))) = \lambda_t(e + \gamma) + \frac{1 - \lambda_t}{2} \tag{4.17}$$

Then, it is easy to show that

Proposition 4.5 *When the informativeness of success depends upon the type of clients, and the total probability of success is not affected by sorting of clients, entry reduces the incentives to exert effort, both through the change in equilibrium fees, and through a reduction in the learning process about experts' talent.*

Proof. See Appendix to Chapter 4 ∎

In this case, the sorting behaviour of clients affects the fees both through the increase in the supply of expert services, and through the change in the informativeness of good performance as a signal of the talent of the expert. In particular, if the average type being served by new entrants is lower, then learning about an expert type occurs more slowly and less information is released after the market observes the outcome of the service.

The slower learning about an expert type also affects equilibrium fees in the future period. Although it is still not possible to tell precisely whether fees for successful experts increase or not, slower learning tends to reduce fees, as the value of being served by successful experts is reduced because $\widehat{\lambda}^{+}_{+1} < \lambda^{+}_{+1}$. On the contrary, the slowdown in learning tends to increase the fees for unsuccessful experts, as $\widehat{\lambda}^{-}_{+1} > \lambda^{-}_{+1}$, although it is not possible to tell whether this effect more than compensate for the increase in the measure of experts, which tends to decrease fees.

It is interesting to discuss what happens if sorting of clients affects the total probability of a success. This is a form of the "*toughness channel*". Suppose that $\lambda_t(e+\gamma+k(E(\theta \mid \lambda)))+(1-\lambda_t)(\frac{1}{2}+z(E(\theta \mid \lambda)))$, raises with θ[13]. Then, it is possible to prove the following

Proposition 4.6 *When the signalling effect is at work, entry may lead to stronger incentives to exert effort if clients sorting affects the total probability of a success in a way that makes new entrants less likely to succeed.*

Proof. See Appendix to Chapter 4 ■

This proposition shows that increased entry may induce new entrants to exert more effort in providing high quality services. It also shows the mechanism through which this can occur. If clients type affects the likelihood talented experts succeed, this can also affect the total probability of success. Then, clients may sort in a way that can reduce the signalling value of a success, and that can also reduce the total likelihood of a success. The latter tends to reduce the measure of successful experts in the second period, thus raising the premium for being served by a successful expert. This in turn, raises the incentives to exert effort. The fact that the total likelihood of success is reduced can ensure that the total measure of successful expert decrease, even in the presence of higher effort exertion from new entrants. It should be stressed that this proposition only shows that it is possible to observe equilibria where new entrant experts exert higher effort in the presence of larger entry, and it delineates the channel through which the effect operates. The existence of such an equilibrium, should be verified on a case by case basis as a function of parameters, clients preferences and of the shape of the distribution of clients type.

I now discuss a further variant of the "*toughness channel*". I introduce the possibility that the type of the client affects the total probability the expert is successful, impacting on the marginal efficiency of effort. This is a reasonable extension of the previous case: a doctor facing a though operation is less likely to succeed. This may directly impact the effectiveness of effort. This can ensure that entry raises the incentives to exert effort.

[13]This is a possible form "*toughness channel*" can take. Literally this implies that providing the service to higher types leads to larger probability of a successful provision of the service. This may not be reasonable in all applications.

Formally, I assume that the unconditional probability of a success depends inversely upon the average type of the applicant. Then, the payoff of a new entrant expert becomes

$$F_t(\lambda, E_t[(\theta) \mid \lambda], e^*) - c(e_t) + \frac{1}{E(\theta)}[\lambda(e_t+\gamma) + \frac{1-\lambda}{2}]F_{+1}(\lambda^+, E_{t+1}[(\theta) \mid \lambda^+), 0) +$$
$$(1 - \frac{1}{E(\theta)})[\lambda(1-(e_t+\gamma)) + \frac{1-\lambda}{2}]F_{+1}(\lambda^-, E_{t+1}[(\theta) \mid \lambda^-)], 0) \tag{4.18}$$

and the first order condition for optimal effort exertion becomes

$$\frac{\partial c(e_t)}{\partial e_t} = \lambda[\frac{1}{E(\theta \mid \lambda)}F_{+1}(\lambda^+, E_{+1}[(\theta) \mid \lambda^+), 0) - (1 - \frac{1}{E(\theta \mid \lambda)})F_{+1}(\lambda^-, E_{+1}[(\theta) \mid \lambda^-)], 0)] \tag{4.19}$$

thus, if the expected type applying to new entrant goes down, $E(\theta \mid \lambda)$ is reduced, providing incentives to exert effort, as now a success is more likely. This effect may compensate for the *signalling* and the *fees* effects, identified in the previous subsections, that tend to reduce the incentives to exert effort. In fact, it is possible to prove the following

Proposition 4.7 *When the clients' type affects the likelihood the service is provided successfully, entry may increase the incentives to exert effort.*

Proof. See Appendix to Chapter 4 ■

The proof shows that it may exist an equilibrium where effort increases after entry occurs. The reason is that even though competition compresses the gains from building a reputation through the effect of sorting on equilibrium fees it can raise the likelihood of a success as new entrants face a pool or relatively "easier" cases. Then, exerting effort is, in expectation, more productive. It is not possible to determine in general which effect dominates. When the type of the client affects the chances the expert succeeds in producing a high quality service, the sorting behaviour of clients after entry occurs, generates a "gentler" environment to new entrants, as they face clients whose needs can be satisfied relatively more easily. It should be stressed that, again, this is a possibility result, and that the conditions ensuring that entry leads to an increase in the incentives to exert effort, depend upon the distribution of types, as well as on technological variables such as the cost of effort.

4.5 Discussion and Policy Implications

This section analyzes the role of the main assumptions and discusses the policy implications of the results.

4.5.1 Assumptions and features of the model

The assumptions of the model are quite standard, although assumption 4.1 may appear a bit restrictive. it is possible that preferences over talent and effort are not perfectly correlated with the type of the client, so that $V(\lambda^+, \theta, 0) > V(\lambda, \theta, e)$, $V(\lambda^+, \widehat{\theta}, 0) < V(\lambda, \widehat{\theta}, e)$ and again $V(\lambda^+, \theta', 0) > V(\lambda, \theta', e)$ for $\theta > \widehat{\theta} > \theta'$. In that case, little changes as what matters for the level of the equilibrium fees is how the threshold types θ^*, θ^{**} and θ^{***}, move. Thus, it will still be possible to identify connected sets of types who prefer a more reputable expert even if she does not exert effort and connected sets of types who prefer a new entrant that exerts positive effort. Then, threshold types will be identified as those who ensure supply is equal to demand for experts of a given reputation, and equilibrium fees will make such threshold types indifferent. However, entry can have more complex effects, as now new entrants may be able to attract a pool of clients with a larger average type. Then the *signalling* may induce stronger incentives to exert effort after entry occurs. The role of the effects will still be the same, although their sign may be different without assumption 4.1. The other assumptions that may deserve further comment are those about clients preferences. These are reasonable to capture the kind of market I have in mind, where clients heterogeneity influences their willingness to pay for the services of experts of different talent.

The model imagines a setting where clients face different experts as if they were meeting in the marketplace. An alternative formulation could have been to think of clients as searching for experts. I believe the way of modelling the market for experts used in this chapter is reasonable, as somehow a client has an idea of the difficulty of the problem she wants the expert to solve, and thus will look directly for an expert of appropriate quality. The way current period fees are set when the client is matched to an expert would not matter as the critical element is how the value of building a reputation evolves. Investigating the effect of clients sorting and the effect of entry in a search and matching framework certainly constitutes an interesting avenue for future research. In a search and matching context, it could be interesting to investigate a second task that is typically performed by experts: the diagnosis of the problem. This has been investigated in the literature[14]. However, less attention has been put on the study of the way sorting impacts

[14] See Wolinsky (1993) and Emons (1997) among others.

on the incentives to exert effort on the diagnosis as opposed to exert effort on the actual solution of the problem. I do not deal with diagnosis in my model, although that is clearly an important feature of a market for experts, and this, again, could be an interesting extension of this model.

Another aspect which is not dealt with in this model, is that in some instances, obtaining the service from very reputable experts, also embeds a signalling value. This is especially true when the client purchase the service to interact with other agents who extract information on the client's quality from the identity of the expert. Think about IPOs, where the identity of the bookrunner often provides investors a signal about the quality of the firm. It seems the main insight of this model would still be valid, although this represents another relevant issue which would deserve a fuller treatment.

A final point worth discussing is to what extent this can be considered a model for a market for professional services. At first sight, there is little in the assumed technology that prevents the application of this model to the analysis of the production of any good, as long as its quality were not observable, so that the price cannot be made contingent on quality. The same model could be applied to the production of a car, or a fridge, etc for which clients have an heterogenous valuation. This is less true when I allow clients types to affect the signalling value of the expert's performance: it would be difficult to interpret the model as one were a firm produces an homogenous good. Then, the model could rather be applied to the production of a very customised good, but then, this renders more transparent why this can be really considered as a model for the provision of a service by an expert, and much less a model for a market of manufactured goods.

4.5.2 Policy Implications

The model shows that in some instances entry can reduce incentives to exert effort. Only when the type of the client affects the likelihood of success, increased entry may lead to an equilibrium where effort is higher. However, in all cases entry has a beneficial effect as a larger fraction of clients get served. This follows because the increase in the supply of experts modifies threshold types, this impacts on fees, and now some clients who preferred to get no service at the ongoing fees, decide to purchase the service. Therefore entry can generate a higher level of social welfare even if effort is reduced in equilibrium. This can be seen formally, as welfare before entry, in the talent intensive case[15], is

$$\int_{\theta^{***}}^{\overline{\theta}} V(\lambda,\theta,e)dG(\theta) - c(e) = \int_{\theta^{*}}^{\overline{\theta}} V(\lambda^{+},\theta,0)dG(\theta) + \int_{\theta^{**}}^{\theta^{*}} V(\lambda,\theta,e)dG(\theta) + \int_{\theta^{***}}^{\theta^{**}} V(\lambda^{-},\theta,0)dG(\theta) - c(e) \tag{4.20}$$

while welfare in the period entry occurs is

$$\int_{\widehat{\theta}^{***}}^{\overline{\theta}} V(\lambda,\theta,\widehat{e})dG(\theta) - c(\widehat{e}) = \int_{\widehat{\theta}^{*}}^{\overline{\theta}} V(\lambda^{+},\theta,0)dG(\theta) + \int_{\widehat{\theta}^{**}}^{\widehat{\theta}^{*}} V(\lambda,\theta,\widehat{e})dG(\theta) + \int_{\widehat{\theta}^{***}}^{\widehat{\theta}^{**}} V(\lambda^{-},\theta,0)dG(\theta) - c(\widehat{e}) \tag{4.21}$$

leaving the cost of effort aside, it can be seen that clients with type $\theta \in [\widehat{\theta}^{***};\theta^{***}]$ now get a service of value $V(\lambda^{-},\theta,0)$, while they were getting zero before entry occurred. Moreover, as $\widehat{\theta}^{**} < \theta^{**}$, types $\theta \in [\widehat{\theta}^{**};\theta^{**}]$ get a service of value $V(\lambda,\theta,\widehat{e})$, while before entry, they were getting a service of value $V(\lambda^{-},\theta,0)$. On the other hand, those clients with type $\theta \in [\theta^{*};\theta^{**}]$ are still served by a new entrant, but now get a service of value $V(\lambda,\theta,\widehat{e}) < V(\lambda,\theta,e)$, as $\widehat{e} < e$. The effect on welfare in the period after entry occurred is similar, although the slower learning about old successful and unsuccessful types may reduce welfare[16].

A possible way to avoid the potential adverse effect of entry on the incentives to exert effort is to introduce a test, or a certification system for successful experts. The certificate, to be valuable, must be correlated with talent. Then, if only the top end of the distribution of experts got the certificate, it would be possible to restore rents from exerting effort and succeed in the first period. In fact, even if entry occurs, those who succeed have a chance to get into the top league and the premium to be served by top league successful experts would be independent of entry[17]. Somehow, this kind of institutions seem to arise in practice: league tables for investment banks or financial analysts are published every year, and that could be a way to preserve the rents from building a reputation even if competition is fierce. Entry could still have some adverse effects as the premium for

[15]The effort intensive case is essentially analogous.

[16]However, $\widehat{\lambda}^{-} > \lambda$, so those clients who get served by the least reputable experts derive a larger value from the service.

[17]Maybe there could be an effect through the probability of getting into the top league, but it depends on the design of the certification system.

successful experts also depends upon the whole structure of fees in the market, in fact

$$F_{+1}(\lambda^+_{+1}, E[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E[(\theta) \mid \lambda^-_{+1}], 0) =$$
$$[V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda_{+1}, \theta^*_{+1}, e^*_{+1})] + [V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1}) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)]$$

depends upon $V(\lambda_{+1}, \theta^*_{+1}, e^*_{+1})$, $V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1})$ and $V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)$. However, "rationing" the supply of the most talented experts could help to boost the benefit from increasing entry in a market for expert services.

4.6 Conclusion

This chapter investigates how the sorting behaviour of clients affects the incentives of experts motivated by reputational concerns. The model shows that sorting can affect incentives in three ways: firstly through a change in the equilibrium fees, and thus in the difference between the fees charged by most reputable experts and the fees charged by less reputable ones (*fees channel)*; secondly by affecting the informativeness of a successful provision of the service by the expert: if successful provision of the service for certain type of the clients is more likely to be delivered by talented experts, then, the pool of clients applying to an expert affects the updating of beliefs about an expert talent when performance is observed (*signalling channel)*; finally, if the type of the client affects the likelihood an expert succeeds, facing "tougher" types could reduce the total probability of success (*toughness channel)*, even if the signal provided by a success would be stronger. I analyze the effect of entry in this framework. Entry affects the sorting behaviour of clients in a way that reduces incentives to exert effort when the fees and signalling channel operates while the toughness channel does not. When also the latter is at work, there can exist equilibria where equilibrium effort is larger after entry occurs. In general, even if entry reduces equilibrium effort, it can lead to higher welfare as more clients get access to the service. The model also provides a rationale for the use of league tables, or other certification mechanisms aiming at "constraining" the supply of more reputable experts: these are beneficial as they preserve the rents from building a reputation.

4.7 Appendix to Chapter 4 - Proofs

Proof of Lemma 4.1. The payoff of any expert in the last period is given by $F_t - c(e_t)$, where F_t cannot depend upon the effort level e_t, nor on realized performance. Thus, current period effort e_t does not affect the revenues from providing the services, while it costs $c(e_t)$, therefore $e_t = 0$ is the unique optimal effort choice for oldest vintage experts. The behaviour of experts in their second (penultimate) period is more interesting, although the logic is still quite standard. Payoff for experts in their first period is

$$F_t + [\lambda(e_t + \gamma) + \frac{1-\lambda}{2}]F_{t+1}(success) + \\ [\lambda(1 - (e_t + \gamma)) + \frac{1-\lambda}{2}]F_{t+1}(failure) \tag{A4.1}$$

and the first order condition for effort exertion is

$$\frac{\partial c(e_t)}{\partial e_t} = \lambda[F_{t+1}(success) - F_{t+1}(failure)] \tag{A4.2}$$

and now exerting effort in period t, raises the chances of obtaining in period $t+1$ the fee conditional on being successful in the period t. Incentives to exert effort increase in the premium for being served by an expert who has been successful in the first period, and thus improved her reputation. As the cost of effort is strictly convex, the expert exerts a strictly positive effort in equilibrium if reputation has value.

Proof of Proposition 4.1. All clients prefer the services of experts with reputation λ^+. Then, fees raise so that demand equal supply and there is no incentive to deviate. As higher types are more willing to pay for the services, when fees go up they will still be willing to pay for the services of most reputable experts. As there are $[\lambda_{-1}(e^*_{-1} + \gamma) + \frac{1-\lambda_{-1}}{2}]\frac{1}{2}$ experts with reputation λ^+ this represents supply, while $M - G(\theta^*)$ is demand. The latter follows because the valuation for experts services is increasing in clients' type. Fees then must make the marginal client indifferent between applying to experts of reputation λ^+ and applying to experts with reputation λ. Then, it can be seen that all clients with $\theta > \theta^*$ do not want to deviate. In fact, by getting the service from an expert with reputation λ^+ they get $V(\lambda^+, \theta, 0) - F(\lambda^+, E[(\theta) \mid \lambda^+], 0)$ and by trying to be served by an expert with reputation λ they get $V(\lambda, \theta, e^*) - F(\lambda, E[(\theta) \mid \lambda], e^*)$. Then it must be true that:

$$V(\lambda^+, \theta, 0) - F(\lambda^+, E[(\theta) \mid \lambda^+], 0) > V(\lambda, \theta, e^*) - F(\lambda, E[(\theta) \mid \lambda], e^*) \tag{A4.3}$$

or

$$V(\lambda^+, \theta, 0) - V(\lambda, \theta, e^*) > V(\lambda^+, \theta^*, 0) - V(\lambda, \theta^*, e^*) \tag{A4.4}$$

or

$$V(\lambda^+, \theta, 0) - V(\lambda^+, \theta^*, 0) > V(\lambda, \theta, e^*) - V(\lambda, \theta^*, e^*) \tag{A4.5}$$

I am considering case 1, $V(\lambda^+, \theta, 0) > V(\lambda, \theta, e^*)$ for all θ, and by assumption $V_{\theta\lambda} > 0$, therefore the inequality is verified as $\theta > \theta^*$. Then, types $\theta > \theta^*$ have no incentive to deviate and cannot do better than pay $F(\lambda^+, E[(\theta) \mid \lambda^+], 0)$ and being matched to an expert with type λ^+. A similar reasoning applies to clients of type $\theta \in [\theta^{**}, \theta^*]$. They get served by an expert of reputation λ. By applying to an expert with higher reputation they would get $V(\lambda^+, \theta, 0) - F(\lambda^+, E[(\theta) \mid \lambda^+], 0)$. Then it is possible to show that

$$V(\lambda^+, \theta, 0) - F(\lambda^+, E[(\theta) \mid \lambda^+], 0) < V(\lambda, \theta, e^*) - F(\lambda, E[(\theta) \mid \lambda], e^*) \tag{A4.6}$$

as

$$V(\lambda^+, \theta, 0) - V(\lambda, \theta, e^*) < V(\lambda^+, \theta^*, 0) - V(\lambda, \theta^*, e^*) \tag{A4.7}$$

by the same reasoning as above and noting that $\theta < \theta^*$. In the same fashion it is possible to show that also the other types of clients have no incentive to deviate. To complete the proof, I can show that experts cannot do better: experts would prefer to compete for types with higher valuation. However, clients types are unknown and rents have to be left to induce clients to separate and reveal their type. Experts competing for the best types will have no rents to leave, and therefore no separating contract will be feasible in equilibrium. Moreover, experts can only set fees to screen clients.

Proof of Proposition 4.2. I denote with a hat the variables after entry occurs. Therefore $\widehat{\theta}^*$ is the threshold θ^* after entry occurred. Suppose after entry in period t there is now measure $M - \frac{1}{2} > Q > \frac{1}{2}$ of new entrants[18] with reputation λ. I firstly illustrate how the equilibrium changes in period t, even though this has no effect on the incentives to exert effort. In equilibrium, in period t

$$\begin{aligned}
[\lambda_{-1}(e^*_{-1} + \gamma) + \frac{1-\lambda}{2}]\frac{1}{2} &= M - G(\widehat{\theta}^*) \\
Q &= G(\widehat{\theta}^*) - G(\widehat{\theta}^{**}) \\
[\lambda(1 - (e + \gamma)) + \frac{1-\lambda}{2}]\frac{1}{2} &= G(\widehat{\theta}^{**}) - G(\widehat{\theta}^{***}) \\
M - 1 &= G(\widehat{\theta}^{***})
\end{aligned} \tag{A4.8}$$

It can be seen that $\widehat{\theta}^* = \theta^*$, so that there is no change after entry, in the current period. However, this implies that $\widehat{\theta}^{**}$ is now lower. In fact $\widehat{\theta}^*$ is unchanged, while there is now measure $Q > \frac{1}{2}$ entrants, and $G(\widehat{\theta}^{**}) = G(\widehat{\theta}^*) - Q$ implies that $\widehat{\theta}^{**}$ is lower. This also implies that $\widehat{\theta}^{***}$ is reduced. This, however, would have no effect on the incentives to

[18] Assuming the measure of new entrants is $Q > 1$ would change very little.

exert effort, as the latter depend upon future period fees. However, entry in period t, also implies that there will be a different measure of experts in the second period. Successful experts will be

$$[\lambda(\widehat{e}^* + \gamma) + \frac{1-\lambda}{2}]Q \tag{A4.9}$$

and unsuccessful experts

$$[\lambda(1 - (\widehat{e}^* + \gamma)) - \frac{1-\lambda}{2}]Q \tag{A4.10}$$

where $\widehat{e}^*$ is the level of effort after entry occurs. Thus, the measure of successful and unsuccessful experts depends both upon the measure of entrants, Q, and endogenously on the new equilibrium effort level $\widehat{e}^*$. The measure of successful, unsuccessful experts, and entrants in period $+1$, determine the thresholds for indifference $\widehat{\theta}^*_{+1}, \widehat{\theta}^{**}_{+1}, \widehat{\theta}^{***}_{+1}$ and the equilibrium fees in that period. The latter are critical for effort exertion in the previous period. The first order condition for effort exertion is given by

$$\frac{\partial c(e_t)}{\partial e_t} = \lambda\{F_{+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}), 0) - F_{+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1})], 0)\} \tag{A4.11}$$

exploiting the equilibrium conditions it is possible to show that

$$\begin{aligned} F_{+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}), 0) = [V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda_{+1}, \theta^*_{+1}, e^*_{+1})] + \\ [V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1}) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)] + V(\lambda^-_{+1}, \theta^{***}_{+1}, 0)] \end{aligned} \tag{A4.12}$$

and

$$F_{+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1})], 0) = V(\lambda^-_{+1}, \theta^{***}_{+1}, 0) \tag{A4.13}$$

so that

$$\begin{aligned} F_{+1}(\lambda^+_{+1}, E[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E[(\theta) \mid \lambda^-_{+1}], 0) = \\ [V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda_{+1}, \theta^*_{+1}, e^*_{+1})] + [V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1}) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)] \end{aligned} \tag{A4.14}$$

Then, incentives to exert effort can be increased if and only if this expression raises after entry occurs. From the assumptions about preferences, both

$$[V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda_{+1}, \theta^*_{+1}, e^*_{+1})] \tag{A4.15}$$

and

$$[V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1}) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)] \tag{A4.16}$$

increase in θ. Thus, as the thresholds θ^*, θ^{**} move, the equilibrium fees move. First of all, consider $\widehat{\theta}^*_{+1}$. The only way this can be larger than θ^*, the counterfactual threshold had increased entry not occurred, is that $[\lambda(\widehat{e}^* + \gamma) + \frac{1-\lambda}{2}]Q < [\lambda(e^* + \gamma) + \frac{1-\lambda}{2}]\frac{1}{2}$. However, as

$Q > \frac{1}{2}$, this can only occur if $\widehat{e}^* < e^*$. The threshold $\widehat{\theta}^{**}_{+1}$ can increase, in principle, if and only if $\widehat{\theta}^*_{+1}$ raises sufficiently to compensate for the increase in the measure of entrants. In fact, $G(\widehat{\theta}^{**}_{+1}) = G(\widehat{\theta}^*_{+1}) - Q$ and $Q > \frac{1}{2}$. However, in order to have $\widehat{\theta}^{**}_{+1} > \theta^{**}_{+1}$ it must be that $\widehat{\theta}^*_{+1} > \theta^*_{+1}$, but then this implies $\widehat{e}^* < e^*$ and for this to happen in equilibrium it must be that $F_{+1}(\lambda^+_{+1}, E[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E[(\theta) \mid \lambda^-_{+1}], 0)$ decreases after entry occurs. Effort could increase if the expected effort of new entrants in period $t+1$ is low enough. In fact the terms[19] $V(\widehat{\lambda}_{+1}, \widehat{\theta}^*_{+1}, \widehat{e}^*_{+1})$ and $V(\widehat{\lambda}_{+1}, \widehat{\theta}^{**}, \widehat{e}^*_{+1})$ which enter in the first order condition respectively with a negative and with a positive sign, are both reduced but the former can be lowered so as to more than compensate all other effects. However, in a perfect Bayesian equilibrium, there cannot exist beliefs supporting an equilibrium with new entrants in the current period exerting higher effort and new entrants in the future period exerting lower effort, given they have the same objective function. Therefore, effort must be unambiguously lower after entry.

Proof of Proposition 4.3.

The previous proposition showed that, when entry occurs in the current period:

$$\widehat{\theta}^* = \theta^*, \widehat{\theta}^{**} < \theta^{**}, \widehat{\theta}^{***} < \theta^{***} \tag{A4.17}$$

so that θ^* is constant, while θ^{**} and θ^{***} are both reduced. Equilibrium fees are as follows

$$F(\lambda^-, E[(\widehat{\theta}) \mid \lambda^-), 0) = V(\lambda^-, \widehat{\theta}^{***}, 0) < F(\lambda^-, E[(\theta) \mid \lambda^-), 0) = V(\lambda^-, \theta^{***}, 0) \tag{A4.18}$$

in fact, $V(\lambda^-, \widehat{\theta}^{***}, 0)$ is lower than before entry, as $\widehat{\theta}^{***} < \theta^{***}$. Then,

$$\begin{aligned} F(\lambda, E[(\widehat{\theta}) \mid \lambda), e) &= V(\lambda, \widehat{\theta}^{**}, e^*) - V(\lambda^-, \widehat{\theta}^{**}, 0) + V(\lambda^-, \widehat{\theta}^{***}, 0) < \\ F(\lambda, E[(\theta) \mid \lambda), e) &= [V(\lambda, \theta^{**}, e) - V(\lambda^-, \theta^{**}, 0)] + V(\lambda^-, \theta^{***}, 0)] \end{aligned} \tag{A4.19}$$

as $F(\lambda, E[(\widehat{\theta}) \mid \lambda), e)$ is reduced because the difference $V(\lambda, \theta^{**}, e^*) - V(\lambda^-, \theta^{**}, 0)$ increases in θ^{**}, but after entry $\widehat{\theta}^{**} < \theta^{**}$, and both $\widehat{e}^*$ and $V(\lambda^-, \widehat{\theta}^{***}, 0)$ are lower. Finally,

$$\begin{aligned} F(\lambda^+, E[(\widehat{\theta}) \mid \lambda^+), 0) &= [V(\lambda^+; \widehat{\theta}^*, 0) - V(\lambda, \widehat{\theta}^*, e)] + \\ &[V(\lambda, \widehat{\theta}^{**}, e) - V(\lambda^-, \widehat{\theta}^{**}, 0)] + V(\lambda^-, \widehat{\theta}^{***}, 0)] \lesseqgtr \\ F(\lambda^+, E[(\theta) \mid \lambda^+), 0) &= [V(\lambda^+; \theta^*, 0) - V(\lambda, \theta^*, e)] + \\ &[V(\lambda, \theta^{**}, e) - V(\lambda^-, \theta^{**}, 0)] + V(\lambda^-, \theta^{***}, 0)] \end{aligned} \tag{A4.20}$$

[19] I denote all variables with a hat to stress that I am now considering the value for clients after increased entry of new experts occurred. However, notice that $\widehat{\lambda} = \lambda$, as the prior probability an entrant is talented does not change. On the contrary, $\widehat{\lambda}^+_{+1}$ and $\widehat{\lambda}_{+1}$ are changed through the change in $\widehat{e}^*$.

as $F(\lambda^+, E[(\widehat{\theta}) \mid \lambda^+), 0)$ moves in an ambiguous way. In fact, the terms $[V(\lambda, \widehat{\theta}^{**}, e) - V(\lambda^-, \widehat{\theta}^{**}, 0)] + V(\lambda^-, \widehat{\theta}^{***}, 0)]$ are reduced, while $[V(\lambda^+; \widehat{\theta}^*, 0) - V(\lambda, \widehat{\theta}^*, e)]$ raises as $\widehat{\theta}^*$ is unchanged, and $\widehat{e}^*$ is lower, so that $V(\lambda, \widehat{\theta}^*, \widehat{e})$ is lower. Fees in future periods behave similarly, as the thresholds in period +1, behave essentially in the same way, with the exception of $\widehat{\theta}^*_{+1}$ which can be either larger or smaller than θ^*, although this would not alter the (absence of) prediction about $F(\lambda^+, E[(\widehat{\theta}) \mid \lambda^+), 0)$.

Proof of Proposition 4.5. As $z(E(\theta \mid \lambda)) = -\frac{\lambda_t k(E(\theta|\lambda))}{1-\lambda_t}$, sorting of clients does not affect the total probability of providing the service successfully. Then, the effect on the indifferent types $\theta^*, \theta^{**}, \theta^{***}$ is the same as in Propositions 4 and 5. The further effect of the change in the informativeness of a success on fees follows easily, as in equilibrium either

$$\begin{gathered} F_{+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1}], 0) = \\ [V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda, \theta^*_{+1}, e^*_{+1})] + [V(\lambda_{+1}, \theta^{**}_{+1}, e^*_{+1}) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0)] \end{gathered} \tag{A4.21}$$

when $V(\lambda^+, \theta, 0) > V(\lambda, \theta, e^*)$, or

$$\begin{aligned} F_{+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1}], 0) = \\ V(\lambda^+_{+1}; \theta^*_{+1}, 0) - V(\lambda^-_{+1}, \theta^{**}_{+1}, 0) \end{aligned} \tag{A4.22}$$

when $V(\lambda^+, \theta, 0) < V(\lambda, \theta, e^*)$. When entry occurs, both in the talent intensive ($V(\lambda^+, \theta, 0) > V(\lambda, \theta, e^*)$) and in the effort intensive ($V(\lambda^+, \theta, 0) < V(\lambda, \theta, e^*)$) case, the difference

$$F_{+1}(\lambda^+_{+1}, E_{+1}[(\theta) \mid \lambda^+_{+1}], 0) - F_{+1}(\lambda^-_{+1}, E_{+1}[(\theta) \mid \lambda^-_{+1}], 0) \tag{A4.23}$$

is (further) reduced as $\widehat{\lambda}^+_{+1} < \lambda^+_{+1}$ and $\widehat{\lambda}^-_{+1} > \lambda^-_{+1}$ because $k(E(\widehat{\theta} \mid \lambda) < k(E(\theta \mid \lambda)$ as $\widehat{\theta}^* = \theta^*$ in the talent intensive case and $\widehat{\theta}^* < \theta^*$ in the effort intensive case, while $\widehat{\theta}^{**} < \theta^{**}$ in both cases (what matters for informativeness is the distribution of types in the current period). Then, incentives to exert effort are reduced. As $z(E(\theta \mid \lambda)) = -\frac{\lambda_t k(E(\theta|\lambda))}{1-\lambda_t}$, sorting of clients does not affect the total probability of providing the service successfully.

Proof of Proposition 4.6. The effects unveiled in Proposition 6 will still be at work. However, now, the total measure of successful experts, in period +1, after entry occurs in the current period (period 0) is given by

$$[\lambda_t(e + \gamma + k(E(\theta \mid \lambda))) + (1 - \lambda_t)(\frac{1}{2} + z(E(\theta \mid \lambda)))]Q \tag{A4.24}$$

Then, it is possible to have $\widehat{\theta}^* > \theta^*$, and $\widehat{e}^* > e^*$, because, $E(\widehat{\theta} \mid \lambda) < E(\theta \mid \lambda)$. I distinguish the talent intensive case from the effort intensive case. In the former,

$$F_{+1}(\lambda_{+1}^{+}, E_{+1}[(\theta) \mid \lambda_{+1}^{+}], 0) - F_{+1}(\lambda_{+1}^{-}, E_{+1}[(\theta) \mid \lambda_{+1}^{-}], 0) = \\ [V(\lambda_{+1}^{+}; \theta_{+1}^{*}, 0) - V(\lambda, \theta_{+1}^{*}, e_{+1}^{*})] + [V(\lambda_{+1}, \theta_{+1}^{**}, e_{+1}^{*}) - V(\lambda_{+1}^{-}, \theta_{+1}^{**}, 0)] \tag{A4.25}$$

A raise in the threshold type $\widehat{\theta}^{*}$, so that $\widehat{\theta}^{*} > \theta^{*}$, induces an increase in the difference $V(\lambda_{+1}^{+}; \theta_{+1}^{*}, 0) - V(\lambda, \theta_{+1}^{*}, e_{+1}^{*})$ with respect to the pre-entry situation. On the other hand, $\widehat{e}_{+1}^{*} > e_{+1}^{*}$ moves the difference in the opposite direction. The effect of sorting on λ_{+1} is ambiguous. In fact, as the total probability of a success is smaller, it is possible either that $\widehat{\lambda}_{+1}^{+} < \lambda_{+1}^{+}$, or that $\widehat{\lambda}_{+1}^{+} > \lambda_{+1}^{+}$. If the latter situation occurs, that raises the likelihood that an equilibrium with increased effort after entry exists, while if the former situation occurs, that is less likely. If $\widehat{\theta}^{*} > \theta^{*}$, it is also possible to have $\widehat{\theta}^{**} > \theta^{**}$. In the latter case $[V(\lambda_{+1}, \theta_{+1}^{**}, e_{+1}^{*}) - V(\lambda_{+1}^{-}, \theta_{+1}^{**}, 0)]$ can be larger than in the pre-entry case because $\widehat{\theta}^{**} > \theta^{**}$, $\widehat{e}_{+1}^{*} > e_{+1}^{*}$. Therefore, it is possible to have an equilibrium where new entrants exert larger effort after entry occurs. In the effort intensive case,

$$F_{+1}(\lambda_{+1}^{+}, E_{+1}[(\theta) \mid \lambda_{+1}^{+}], 0) - F_{+1}(\lambda_{+1}^{-}, E_{+1}[(\theta) \mid \lambda_{+1}^{-}], 0) = \\ V(\lambda_{+1}^{+}; \theta_{+1}^{*}, 0) - V(\lambda_{+1}^{-}, \theta_{+1}^{**}, 0) \tag{A4.26}$$

then, again, if $\widehat{\theta}^{*} > \theta^{*}$, the premium for being successful may raise, even when $\widehat{\lambda}_{+1}^{+} < \lambda_{+1}^{+}$ and $\widehat{\lambda}_{+1}^{-} > \lambda_{+1}^{-}$. Thus, also in the effort intensive case, there can exist an equilibrium where new entrants exert higher effort after entry occurs.

Proof of Proposition 4.7. Entry reduces all thresholds $\theta_{+1}^{*}, \theta_{+1}^{**}, \theta_{+1}^{***}$. This implies that the difference $F_{+1}(\lambda^{+}, E_{+1}[(\theta) \mid \lambda^{+})], 0) - F_{+1}(\lambda^{-}, E_{+1}[(\theta) \mid \lambda^{-})], 0)]$ is reduced after entry occurs. Moreover, the change in $E(\theta)$, may increase the measure of successful experts, reinforcing the effect of entry on $\theta_{+1}^{*}, \theta_{+1}^{**}, \theta_{+1}^{***}$. However, effort can still be larger due to the decrease in $E(\theta)$, which raises the marginal efficiency of effort. The exact condition is

$$\lambda[\frac{1}{E(\widehat{\theta} \mid \lambda)} F_{+1}(\lambda^{+}, E_{+1}[(\widehat{\theta}) \mid \lambda^{+}), 0) - (1 - \frac{1}{E(\widehat{\theta} \mid \lambda)}) F_{+1}(\lambda^{-}, E_{+1}[(\widehat{\theta}) \mid \lambda^{-})], 0)] > \\ \lambda[\frac{1}{E(\theta \mid \lambda)} F_{+1}(\lambda^{+}, E_{+1}[(\theta) \mid \lambda^{+}), 0) - \\ (1 - \frac{1}{E(\theta \mid \lambda)}) F_{+1}(\lambda^{-}, E_{+1}[(\theta) \mid \lambda^{-})], 0)] \tag{A4.27}$$

which can be verified as $E(\widehat{\theta} \mid \lambda) < E(\theta \mid \lambda)$.

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