GOVERNANCE AND THE EFFICIENCY
OF ECONOMIC SYSTEMS
GESY

Discussion Paper No. 401

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May 2013

Financial support from the Deutsche Forschungsgemeinschaft through SFB/TR 15 is gratefully acknowledged.

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March 13, 2013

Abstract

We analyze the optimal allocation of authority in an organization whose members have conflicting preferences. One party has decision–relevant private information, and the party who obtains authority decides in a self–interested way. As a novel element in the literature on decision rights, we consider exit option contracts: the party without decision rights is entitled to prematurely terminate the relation after the other party's choice. We show that under such a contract it is always optimal to assign authority to the informed and not to the uninformed party, irrespective of the parties' conflict of interest. Indeed, the first–best efficient solution can be obtained by such a contract.

Keywords: Authority, decision rights, exit options, incomplete contracts, asymmetric information.
JEL Classification No.: D23, D82, D86.

*Support by the German Science Foundation (DFG) through SFB/TR 15 is gratefully acknowledged. We thank Eugen Kovac, Johannes Münster, Tymofiy Mylovanov, Klaus Schmidt, Roland Strausz, and Stefan Terstiege for helpful comments.

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1 Introduction

Determining who should have authority over which decisions is one of the central problems for firms, organizations, or, more generally, for any contracting parties who operate in environments in which not all decisions can be contractually pre–specified in advance. As pointed out already by Simon (1951), one of the key problems is that the party in authority decides in a self–interested way. Therefore, the optimal assignment of authority depends on the extent to which *decision incentives* can be created to align the decision maker's preferences with the organization's objective. An additional problem is that decision–relevant information is often dispersed among the organization's members. As Jensen and Meckling (1992) argue, communication costs can be avoided by letting the informed party take decisions. Whether this is indeed optimal, depends on how effectively *communication incentives* can be designed to reduce losses from information transmission.

In this paper, we propose a solution to both incentive problems for contracting relations that can be prematurely terminated as they proceed. This kind of environment enables the parties to write exit option contracts which specify provisions for the case that one party terminates the relation. Our main result provides a novel justification for the view that decision rights should be given to the informed party: under an exit option contract, delegating decision rights to the informed party always generates a higher surplus than the alternative regime where the uninformed party has authority. Our conclusion that authority should unambiguously reside with the informed party is remarkably robust; it depends neither on the probability distribution of private information nor on the size of the parties' conflict of interest.[1] Moreover, we show that the first–best efficient outcome can be implemented under the optimal allocation of the decision right. Hence, combined with the appropriate allocation of authority, exit options permit fully efficient contracting even in the presence of contractual incompleteness and asymmetric information.[2]

How exit options affect the optimal allocation of authority over non–contractible decisions is a natural question because exit options have been shown both theoretically and empirically to be an effective instrument to overcome incentive problems caused by contractual incompleteness. It is a well–known insight that when contracts

[1] We measure the conflict of interest by the distance between the parties' most preferred decisions under perfect information about the state of nature.

[2] While our result is phrased as an efficiency result, our analysis implies a more fundamental implementability result: in our setting, if the informed party has the decision right, every outcome that is in between the parties' ideal decisions and that can be implemented when decisions are contractible, can also be implemented with an exit option contract when decisions are not contractible.

are incomplete, incentives for opportunistic behavior by the party in charge of the decision can be mitigated through an exit option for the other party.[3] Empirically, exit options are a pervasive feature of incomplete real–world contracts. For example, Lerner and Malmendier (2010) document the widespread use of exit options in joint ventures between a financing and a research firm in the biotech industry and provide evidence that the use of termination clauses is more common when research decisions are non–contractible.[4]

To study optimal authority with exit options, we adopt the by now standard framework where a principal hires an agent to undertake a joint project whose payoffs depend on a non–contractible decision.[5] The agent receives decision–relevant private information but disagrees with the principal over the ideal course of action. Even though the decision is not contractible, the right over taking the decision can be contractually assigned to one of the parties. Moreover, we allow that the parties can exchange contractible monetary transfers. This implies that the first–best efficient decision, which maximizes the parties' joint surplus, is a compromise between the principal's and the agent's favorite decision.

While most work considers the case that the parties have to complete an initiated project, in many situations of economic interest the relation can be prematurely terminated. For example, the shareholders of a corporation can fire the management; a buyer can decline (part of) a delivery; employees have the right to quit their job; venture capitalists can refuse to provide more funding to start–ups, etc. To capture this, we depart from existing work by analyzing the case where the relation can be terminated after the decision has been taken. In particular, we consider exit option contracts that assign the right to prematurely exit the relation, possibly conditional on the exchange of exit payments, to the party who does not have authority over the decision. Premature exit destroys some (though not necessarily all) project payoffs so that efficiency mandates completing the project.

[3] See, e.g., Aghion et al. (1994), Bester and Krähmer (2012), Che and Chung (1999), Chung (1991), Edlin and Reichelstein (1996), Evans (2008), Nöldeke and Schmidt (1995, 1998).

[4] Further examples of exit option contracts comprise contracts for house re–modeling, book publishing, advertising pilot campaigns, real estate agency services, or procurement contracts for specialized equipment which frequently specify only payments contingent on delivery (see Taylor (1993), Che and Chung (1999)). Also, performance contingent termination clauses in loan contracts or non–promotion clauses in labor contracts, or certain financial contracts such as convertible bond securities can be interpreted as forms of exit options (see Aghion et al. (2004), Kahn and Huberman (1988), Stiglitz and Weiss (1983)).

[5] More precisely, we assume that the decision is observable by both parties but not verifiable. That is, the decision cannot be legally enforced by a court.

To isolate the effect of exit options on the allocation of authority, we first study the benchmark case in which the agent does not have private information, but information is publicly known. We show that in this case, the allocation of authority is irrelevant in the sense that a first–best efficient exit option contracts exists both under agent– and under principal–authority. The reason is well–known from the incomplete contracts literature: the exit payments have to be designed so that at the first–best decision the party with the exit option refrains from exercising the option but is indifferent between exiting and continuing the relation. This disciplines the decision making party since, if it were to choose a more partisan decision than the first–best, exit would occur.

The reason for why the allocation of authority is no longer irrelevant under asymmetric information, is that now in addition to *decision incentives* also *communication incentives* matter. Since the agent's information, his 'type', is relevant for selecting the right decision, a first–best efficient contract must provide incentives for the agent to reveal his information. At the same time, to prevent opportunistic behavior by the decision maker, the exit option has to keep the other party indifferent between exiting and continuing the relation at the first–best decision. Our key insight is that these two requirements can be met when the principal delegates but not when she keeps the control right.

The intuition is easiest to illustrate for the case that the agent's benefit from the project in the event of exit is zero, independently of his type. When the principal keeps control, it is the agent who must be indifferent between exiting and continuing the relation. Clearly, each type of the agent can ensure himself the payoff from exiting. Since the termination benefit is zero for all types, by incentive compatibility the payment that the agent receives after exerting the exit option must be type independent. The indifference requirement therefore implies that the agent's utility from continuing has to be independent of his type. At the same time, however, to elicit the agent's type truthfully, his utility from staying in the relation cannot be constant in his type, because otherwise standard screening arguments imply that 'more efficient' agent types cannot be deterred from mimicking 'less efficient' types.[6] Hence, providing the appropriate decision incentives for the principal through the agent's exit option is incompatible with the agent's communication incentives for information revelation.

In contrast, when the principal delegates control, it is the principal who must be

[6]When the termination value is a fraction of the completion value of the project, then the indifference condition implies that the slope of the agent's utility is smaller than what is needed to screen the agent and make him stay in the relation.

indifferent between exiting and continuing the relation. This breaks the link between the agent's exit and continuation utility, and so communication and decision incentives can be separated. Indeed, by an appropriate payment schedule the agent can be incentivized to truthfully reveal his information. Further, he can be given decision incentives by being punished with a sufficiently low payoff whenever the principal exits the relation. The latter is easiest to achieve when a third party is available who acts as a budget breaker. In this case, a heavy penalty can be imposed on the agent should the principal exit (but none if she continues). We show however that third party payments are not always needed for efficient exit option contracts under agent–authority: third party payments are redundant if the conflict of interest between the agent and the principal and the termination value of the project are not too large.

Related Literature

To describe a principal–agent relation in which the parties have conflicting interests and the agent is better informed than the principal, we built on the classical 'cheap talk' model of Crawford and Sobel (1982). In their model, there are no monetary transfers, the agent strategically decides about information transmission, and the principal has the authority to select a decision.[7] This setup is frequently used in the literature as a starting point for the analysis of allocating decision rights. Indeed, Dessein (2002) allows the principal to delegate authority to the agent. He compares the outcomes under delegation and cheap talk and shows that the principal prefers delegating control rather than relying on cheap talk when the conflict of interest is small. Somewhat related to our exit option, Dessein also considers the possibility that the principal delegates authority to the agent but retains the right to approve or veto proposals by the agent and, in case of veto, implements a default option. Yet, he finds that keeping veto power generally does not dominate full delegation.[8] Cheap talk in a multi–divisional organization is used by Alonso, Dessein and Matouschek (2008) to

[7]For work on delegation with contractible decisions, private information and non–transferable utility see Holmström (1984), Almador and Bagwell (2012), or Alonso and Matouscheck (2008); for a comparison of mechanisms, depending on the decision making party's commitment power, see Goltsman et al. (2009). Mylovanov (2008) shows that contractible decisions can also be implemented by giving the principal a veto right in combination with a contractually specified default option.

[8]Shimizu (2012) introduces an exit option for the informed party in the cheap talk model of Crawford and Sobel (1982) and shows that when the agent's utility from exit grows large and the principal wants to avoid exit, the cheap talk outcome converges to the delegation outcome. While similar in spirit to our result, Shimizu's result rests heavily on the asymmetry of the value of exit for the informed and the uninformed party, while in our model, a party's value of exit is endogenously determined by the contract.

compare centralized and decentralized decision rights.

While the above mentioned work considers organizations in which monetary transfers are not feasible, our paper belongs to the part of the literature on delegation where the principal can contractually commit to such transfers.[9] Our contribution is to introduce exit options to this environment. More specifically, Krishna and Morgan (2006), in a setup similar to ours, derive the optimal contract when the principal maintains authority and the relation cannot be terminated and find that delegation outperforms authority only if the conflict of interest is sufficiently small. In contrast, we show that with exit options delegation *always* dominates keeping authority. Under the provisio that Krishna and Morgan (2006) – unlike us – consider an agent protected by limited liability, this suggests that exit options have a profound effect on the optimal allocation of authority. Also Bester (2009) and Krähmer (2006) study contracting environments with monetary transfers and show that, for large conflict of interest, it may be optimal for the principal to keep authority. Moreover, first–best efficiency can typically not be achieved. The main difference to the present paper, again, is that these papers do not consider exit options. Related to our paper is also recent work by Lim (2012a, 2012b) who, instead of taking an optimal contracting perspective, studies various bargaining procedures whereby the uninformed principal can sell the right over decision making to the informed agent.[10] Lim constructs equilibria in which, similar to our findings, delegation always occurs irrespective of the conflict of interest. In contrast to what we find, however, the agent chooses his favorite action in these equilibria, preventing first–best efficiency.

While we show that delegating decision rights to the informed party achieves efficiency in our setup, there might be other mechanisms that also achieve efficiency. Bester and Krähmer (2012) also consider a setting with contractual incompleteness, asymmetric information, and transferable utility, and construct an efficient mechanism where the uninformed party selects the decision. This mechanism, unlike the simple scheme in the present paper, involves complex message games involving both parties, and randomization off the equilibrium path.[11] A different reason for allocating decision rights to the more poorly informed party is provided by Zabojnik (2002). In a multi–tasking context, he shows that delegating task selection to the better in-

[9]For work on delegation without private information, see also Aghion and Tirole (1997), Bester and Krähmer (2008), or section 2 in Bester (2009).

[10]In Lim (2012a), the principal makes a price offer, possibly predated by a round of cheap talk. In Lim (2012b), the agent makes the price offer.

[11]It is not clear whether a similar mechanism can be constructed in the present setting for the technical reason that Bester and Krähmer (2012) consider a discrete type space, whereas here, a continuous type space is considered.

formed party might encourage suboptimal task selection when the other party needs to be motivated to exert effort.

Our paper is organized as follows. Section 2 describes the problem of allocating authority in a principal–agent environment in which the agent has private information. In Section 3 we show that the assignment of decision rights is irrelevant in the benchmark case with symmetric information. Section 4 contains the main results of our analysis: we show that a simple exit option contract can implement the first–best outcome if the principal delegates the decision right to the agent, but not if she maintains authority. Section 5 concludes. Most of our formal results are rather straightforward and explained in the main text; only some more technical and lengthy proofs are relegated to an appendix in Section 6.

2 The model

2.1 The environment

A principal (she) can hire an agent (he) to undertake a joint project such as developing a new product line, restructuring organizational processes, launching an advertising campaign, expanding into new markets etc. In the course of the project various decisions have to be taken that affect the payoff from the project whose details are impossible to specify in advance. For example, the uncertainty and long planning horizon involved in the development of a new product make it practically impossible to ex ante foresee the decisions required to resolve unexpected problems in the development process and thus to write complete contracts. To capture this, we assume that the payoff from the project depends on a (for simplicity, single) non–contractible decision $d \in D = \mathbb{R}$. We adopt an incomplete contract approach and assume that d is not verifiable (neither ex ante nor ex post), but observable by both parties. In particular, the decision is not legally enforceable by a court.

Moreover, the payoff from the project also depends on a state of the world $\theta \in \Theta = [0, 1]$ which captures the fact that a decision may be more or less appropriate depending on exogenous circumstances. For example, the success of various design decisions when developing a new product line depends on customer demand, competitors' strategies etc. We will focus on the case that the state of the world is privately observed by the agent (e.g. division managers are typically better informed about demand conditions than headquarters). Hence, we refer to the state of the world as the agent's type. The distribution of the agent's type is common knowledge. Our results hold for any distribution of the agent's type with support Θ. Finally, the principal and the agent disagree about the appropriate course of action (e.g. division managers benefit more from a certain product design than headquarters).

As in Crawford and Sobel (1982), the principal's and the agent's (gross) payoffs are described by the utility functions $U_P(\theta, d)$ and $U_A(\theta, d)$, which are twice continuously differentiable and satisfy for $i = P, A$

$$\frac{\partial^2 U_i(\theta, d)}{\partial d^2} < 0, \quad \frac{\partial^2 U_i(\theta, d)}{\partial d \partial \theta} > 0, \quad \frac{\partial U_i(\theta, d_i(\theta))}{\partial d} = 0 \tag{1}$$

for some $d_i(\theta) \in D$. Hence each party $i \in \{P, A\}$ has a unique *ideal decision* $d_i(\theta)$ in each state θ. The second condition in (1) is a Spence–Mirrlees single crossing property and implies that ideal decisions are strictly increasing in the state: $\partial d_i(\theta)/\partial \theta > 0$ for $i = P, A$. In addition to the usual assumptions of the Crawford–Sobel model, we assume that the following *regularity* condition holds for $i \in \{P, A\}$:

$$\frac{\partial U_i(\theta, d)}{\partial \theta} \neq 0 \quad \text{for all} \quad d \neq d_i(\theta). \tag{2}$$

This ensures that, at least for non–ideal decisions, the parties' preferences are sensitive to the state θ.

The conflict of interest between the principal and the agent is described by the difference between their ideal decisions

$$b(\theta) \equiv d_A(\theta) - d_P(\theta), \tag{3}$$

which in the following we refer to as the agent's *bias*. We assume that

$$\frac{\partial U_A(\theta, d)}{\partial d} > \frac{\partial U_P(\theta, d)}{\partial d} \tag{4}$$

for all θ and d. Therefore, $b(\theta) > 0$ for all θ.

After the decision is taken and observed by both parties, the project can be prematurely terminated. For example, the principal can dismiss the agent, or the agent can quit. In this case, the principal receives only a fraction $\alpha_P \in [0, 1)$ of her completion payoff U_P, and the agent receives only a fraction $\alpha_A \in [0, 1)$ of his completion payoff U_A.

We consider the case with transferable utility and assume that the parties can commit to the exchange of monetary transfers without limited liability restrictions. Since some surplus is lost when the project is prematurely terminated, completing an initiated project is always optimal. The *first–best decision* $d^*(\theta)$ therefore maximizes the joint surplus $U_P(\theta,d)+U_A(\theta,d)$. By our assumptions the surplus is strictly concave in d and so $d^*(\theta)$ is uniquely defined by the first–order condition

$$\frac{\partial U_P(\theta,d^*(\theta))}{\partial d}+\frac{\partial U_A(\theta,d^*(\theta))}{\partial d}=0. \tag{5}$$

Therefore[12]

$$d_P(\theta)<d^*(\theta)<d_A(\theta), \quad \text{and} \quad \partial d^*(\theta)/\partial\theta>0, \tag{6}$$

that is, the first–best decision is in between the parties' ideal decisions and strictly increasing in the state of the world. In what follows, we assume that for all values of θ

$$U_P(\theta,d^*(\theta))+U_A(\theta,d^*(\theta))>0. \tag{7}$$

Combined with the assumption that both parties receive zero utility from not cooperating, this ensures that undertaking the project is optimal whenever the first–best can be implemented.

In the following sections we illustrate our findings by an example with a quadratic specification of payoffs, which is the leading example in applications of Crawford and Sobel (1982). The example satisfies all our assumptions (1), (2), and (4). Further, for simplicity termination of the project is taken to destroy the entire surplus.

Example: Consider the special case where

$$U_P(\theta,d)=r_P-(\theta-d)^2, \quad U_A(\theta,d)=r_A-(\theta+b-d)^2, \quad \alpha_P=\alpha_A=0. \tag{8}$$

The ideal decisions are $d_P(\theta)=\theta$ for the principal and $d_A(\theta)=\theta+b$ for the agent. The agent's bias is thus equal to b and does not depend on θ. The solution of (5) yields the first–best decision

$$d^*(\theta)=\theta+\frac{b}{2}, \tag{9}$$

and assumption (7) requires that $r_P+r_A>b^2/2$. ◇

2.2 Exit option contracts

We follow the literature on incomplete contracts in assuming that decisions and the gross payoffs from decisions are observable to the contracting parties but not to outsiders. Therefore, decisions are not contractible. The parties, however, can commit

[12] To see this, observe that (4) and (5) imply $\partial U_P(\theta,d^*(\theta))/\partial d<0<\partial U_A(\theta,d^*(\theta))/\partial d$. Since payoffs are strictly concave in d this yields the first statement in (6). Finally, by differentiating (5) with respect to θ one immediately obtains by (1) that $\partial d^*(\theta)/\partial\theta>0$.

to the allocation of decision rights. That is, they can sign a binding agreement on whether the principal or the agent is entitled to select the decision d.[13] In addition to the allocation of authority, the parties can contractually assign to the party not in charge of the decision the right to prematurely terminate the relation after the decision d has been observed. Thus, a court can verify whether the relation has been prematurely terminated or not. We refer to the right to terminate the relation as *exit option*.

The objective of our analysis is to examine how the efficiency properties of exit option contracts depend on the allocation of decision rights. Under an exit option contract the principal's payment to the agent is contingent upon whether the party with the exit option does or does not exercise its exit option.[14] These payments are functions of a verifiable report $\theta \in \Theta$ by the agent about his true type. Thus, the principal has to pay $P_Y(\theta)$ if the project is completed, and $P_N(\theta)$ if the project is terminated because the exit option has been exercised. In addition, a contract specifies the allocation of authority $h \in \{P,A\}$ which assigns the right to choose d either to the principal ($h = P$) or the agent ($h = A$). Finally, we allow the contracting parties to use penalty payments to a passive third party:[15] the party who has the decision right over d has to pay the penalty $\Pi(\theta) \geq 0$ if the other party exercises the exit option after observing d. Thus the third party payment $\Pi(\theta) \geq 0$ serves as a disciplining device for the party who has authority. Note that for contracts under which the parties can share the first–best surplus in any state θ, the penalty $\Pi(\theta)$ only deters deviating behavior and is never paid in equilibrium. Observe that since $\Pi(\theta) \geq 0$, no outside funds are available.[16] The third party payment may also be interpreted as the cash equivalent of a (contractible) penalty that harms the decision making party but does not benefit

[13]The allocation of authority may be enforced by the legal access to the assets and resources that are necessary to implement a decision.

[14]In contrast, Compte and Jehiel (2007) define *quitting rights* by requiring that transfers are zero in the disagreement case.

[15]Allowing for third party payments is not uncontroversial since three party contracts of this sort may be difficult to implement, as they raise the problem of collusion between two of the agents against the third, cf. Hart and Moore (1988), especially footnote 20. For an argument in support of three party agreements, see Baliga and Sjöström (2009) who show in a complete information setting that if all coalitions have access to the same contracting technology, introducing a third party allows implementation of the first–best, even if the third party is corruptible.

[16]Note that it is not substantial that the decision making party pays the penalty in case of exit. For example, under P–authority, instead of having the principal pay Π in case of exit, one can simply reduce P_N by Π so that, in effect, the agent reimburses the principal for paying Π. This is payoff equivalent to our formulation. Moreover, we do not consider penalty payments when the project is completed. This is so because we will focus on the question whether the first–best can be implemented which requires that the project is not terminated and no money is left on the table.

the other party. For example, in an organization the decision making party may be degraded in rank or suffer a reputation loss as a result of exit.[17]

In summary, an *exit option contract (with h–authority)* is a schedule

$$\gamma = (h, P_Y(\cdot), P_N(\cdot), \Pi(\cdot)). \tag{10}$$

The relation proceeds as follows. Before the agent privately observes his type, the principal and the agent sign a contract γ. Their outside payoffs at this stage are zero.[18] After the agreement the agent observes his type and submits a report about his type to the principal. Then the party in charge selects a decision and, after having observed the decision, the other party decides wether to exit or not. Finally, payments are made.

A contract induces a dynamic game of incomplete information. We assume that the parties play a Perfect Bayesian Equilibrium of that game. In a Perfect Bayesian Equilibrium, each player acts optimally given his beliefs, and conditional on the opponent's strategy, beliefs are derived by Bayes' rule whenever possible. In particular, if the agent announces his type truthfully in equilibrium, the principal believes that the agent's type is equal to the observed report with probability 1.[19]

We refer to a contract γ as *first–best efficient* if the induced game has a Perfect Bayesian Equilibrium in which the party in charge selects the first–best decision $d^*(\theta)$ for any agent type θ and the other party does not exit. Note that since the agent's private information arrives after contracting, both parties agree at the contracting stage to maximize their joint surplus. Hence, only first–best efficient contracts are optimal whenever they are feasible.

Exit option contracts are not the most general contracts for the contracting environment we consider and are restrictive in two ways. First, they restrict communication between the agent and the principal to direct communication. In general, a contract could employ a mediator who coordinates communication between the parties. But, as we argue below, the restriction to direct communication is without loss

[17] See Diamond (1984) for an elaboration of this idea in the context of a borrower lender relationship.

[18] The division of surplus depends on the parties' bargaining power at the contracting stage. Indeed, our analysis shows that under an optimal contract the payments in (10) are determined only up to a constant.

[19] More precisely, under *A*–authority the principal's beliefs depend on both the agent's report and his decision. In an equilibrium in which the agent tells the truth, the principal's beliefs therefore need to be equal to the agent's report only if also the agent's actual decision coincides with the prescribed equilibrium decision of this agent type.

of generality for our purposes. Second, exit option contracts assign the right to terminate the relation exclusively to one of the parties. In general, a contract could make termination contingent on a message game between both parties.[20] In this paper, we focus on simple exit option contracts for two reasons. First, as argued in the Introduction, exit option contracts are attractive to investigate because they are widely observed in practice and easy to implement. Second and most important, we show that there is a first–best efficient exit option contract with *A*–authority. Hence, more general contracts cannot generate higher payoffs in our setup.

3 Benchmark: Symmetric information

In this section, we discuss the benchmark case where the agent's type θ is publicly observable. Thus there is no need to provide communication incentives; the only contractual problem is to induce efficient decision behavior by the party who obtains authority. We argue that in this situation the allocation of authority is irrelevant to the extent that there are first–best efficient exit option contracts both with *P*– and with *A*–authority. More formally, below we prove the following statement:

Proposition 1 *The allocation of authority is irrelevant if the agent's type is public information: under both P– and A–authority there is a first–best efficient exit option contract.*

To see this, consider first a contract with *P*–authority. Suppose the payments $P_Y(\theta), P_N(\theta)$ are defined by

$$U_A(\theta, d^*(\theta)) + P_Y(\theta) = \alpha_A U_A(\theta, d^*(\theta)) + P_N(\theta). \tag{11}$$

This means that when the principal chooses the first–best decision $d^*(\theta)$, the agent is indifferent between exiting and continuing the relation. Accordingly, since the agent's utility is increasing in d for $d \leq d^*(\theta)$, he optimally exits when the principal chooses a decision smaller than $d^*(\theta)$. Likewise, the agent exits if the principal chooses a sufficiently large decision. More precisely, let $\bar{d}(\theta)$ be the largest decision such that the agent is indifferent between exiting and not exiting, which is defined by the solution $\bar{d}(\theta) > d^*(\theta)$ to[21]

$$U_A(\theta, \bar{d}(\theta)) + P_Y(\theta) = \alpha_A U_A(\theta, \bar{d}(\theta)) + P_N(\theta). \tag{12}$$

[20] See Bester and Krähmer (2012) for an elaboration of this point.

[21] The assumptions on U_A imply that there is exactly one such decision $\bar{d}(\theta)$.

Thus, the agent optimally exits whenever the principal chooses a decision outside the interval $[d^*(\theta), \bar{d}(\theta)]$, and continues the relation otherwise. On the other hand, since the principal prefers decisions smaller than the first–best, her optimal decision to prevent exit is therefore $d^*(\theta)$, while her optimal decision to trigger exit is her ideal decision $d = d_P(\theta) < d^*(\theta)$. Therefore, whenever

$$U_P(\theta, d^*(\theta)) - P_Y(\theta) \geq \alpha_P U_P(\theta, d_P(\theta)) - P_N(\theta) - \Pi(\theta), \tag{13}$$

she optimally chooses $d^*(\theta)$.

Conditions (11) and (13) are satisfied by the payments

$$\begin{aligned} P_Y(\theta) &= c - U_A(\theta, d^*(\theta)), \quad P_N(\theta) = c - \alpha_A U_A(\theta, d^*(\theta)), & (14)\\ \Pi(\theta) &\geq \max\left[0, \alpha_P U_P(\theta, d_P(\theta)) + (\alpha_A - 1)U_A(\theta, d^*(\theta)) - U_P(\theta, d^*(\theta))\right], & (15)\end{aligned}$$

where c is some constant. Since these payments induce the principal to select $d^*(\theta)$ and the agent to refrain from exercising the exit option, both parties can share the first–best surplus by adjusting the parameter c in (14). If, for example, the principal has all the bargaining power at the contracting stage, she can appropriate the entire surplus from completing the project. Note that by (7) and (15) one can set $\Pi(\theta) = 0$ if α_P and α_A are small enough. Thus positive penalty payments are required only if the loss from terminating the project is relatively small.

Intuitively, the first–best is achieved because the possibility of exit can be exploited to align the principal's incentives with the first–best. In fact, the payments are chosen such that the principal claims the residual total surplus when she chooses the first–best decision. This means that she fully internalizes the impact of her decision on the joint surplus.[22]

The same logic implies that a first–best efficient exit option contract also exists under A–authority. Indeed, consider the payments

$$\begin{aligned} P_Y(\theta) &= c + U_P(\theta, d^*(\theta)), \quad P_N(\theta) = c + \alpha_P U_P(\theta, d^*(\theta)), & (16)\\ \Pi(\theta) &\geq \max\left[0, \alpha_A U_A(\theta, d_A(\theta)) + (\alpha_P - 1)U_P(\theta, d^*(\theta)) - U_A(\theta, d^*(\theta))\right], & (17)\end{aligned}$$

for some constant c. Then by (16) the principal is indifferent between exiting and not exiting at the first–best decision. She therefore will accept the agent's choice of d as long as $d \in \left[\underline{d}(\theta), d^*(\theta)\right]$ for some $\underline{d}(\theta) < d^*(\theta)$. Since the agent's utility is increasing over this interval, he will choose $d^*(\theta)$ if he wants to avoid project

[22]This feature of exit options is well appreciated in the literature. See, e.g. Proposition 1 in Che and Hausch (1999).

termination. In fact, this is optimal for the agent because the penalty in (17) ensures that he cannot gain by choosing his ideal project $d_A(\theta) > d^*(\theta)$, as this would trigger exit by the principal.

Example: For the specification in (8), the payments under P–authority in (14) and (15) simplify to

$$P_Y = c - r_A + b^2/4, \quad P_N = c, \quad \Pi \geq \max\left[0, -(r_P + r_A - b^2/2)\right], \tag{18}$$

and the agent optimally continues the relation only if the principal chooses a decision $d \in [d^*(\theta), \bar{d}(\theta)] = [\theta + b/2, \theta + 3b/2]$. The payments under A–authority in (16) and (17) are

$$P_Y = c + r_P - b^2/4, \quad P_N = c, \quad \Pi \geq \max\left[0, -(r_P + r_A - b^2/2)\right], \tag{19}$$

and the principal optimally refrains from exiting as long as the agent selects $d \in [\underline{d}(\theta), d^*(\theta)] = [\theta - b/2, \theta + b/2]$. In either case, it is possible to set $\Pi = 0$ because $r_P + r_A > b^2/2$ by assumption (7). ◇

In the following section we show that Proposition 1 no longer holds if the agent is privately informed about the state θ. The reason is that the payments described in (14) and (16) do not induce the agent to report his information truthfully.

4 Asymmetric information

In what follows, we show that the optimal allocation of authority is unambiguously determined under asymmetric information. In fact, we prove that there is a first–best efficient exit option contract with A–authority but none with P–authority. Therefore, assigning authority to the agent rather than to the principal is always the optimal contractual choice. We begin by analyzing contracts with P–authority.

4.1 P–authority

In this section, we show that decision and communication incentives necessarily conflict with each other under P–authority so that achieving the first–best is impossible:

Proposition 2 *There is no first–best efficient exit option contract with P–authority.*

We prove Proposition 2 by contradiction. We will derive a number of necessary conditions for first–best implementation under P–authority and show that they are incompatible with one another.

We start with the simple observation that there is no loss in generality by considering "direct" exit option contracts that require the agent to report his type rather than a message from some other, more general message set.[23] The reason is that under a first–best efficient contract, the principal has to choose the first–best decision $d^*(\theta)$ for all agent types θ. Since $d^*(\theta)$ is distinct for every agent type, it is thus necessary that the agent truthfully reveals his type to the principal. It follows by an argument in the spirit of the Revelation Principle that if the first–best can be implemented by some exit option contract, it can be implemented by a direct contract where the message space coincides with the type space. In addition, we can restrict attention to contracts which induce the agent to report his type truthfully.[24]

Because we can restrict attention to direct contracts where the agent tells the truth, a first–best efficient exit option contract with P–authority satisfies the following three incentive constraints:

(i) Agent type θ reports his type truthfully;

(ii) Upon receiving a report θ, the principal believes that the agent's type is θ and selects the first–best decision $d^*(\theta)$;

(iii) After observing the decision $d^*(\theta)$, the agent does not exit but continues the relation.

Under such a contract, agent type θ therefore receives utility

$$V_A(\theta) \equiv U_A(\theta, d^*(\theta)) + P_Y(\theta). \tag{20}$$

We now show that the incentive constraints (i)-(iii) cannot be jointly satisfied by deriving three necessary conditions which turn out to be incompatible. Constraints (ii) and (iii) imply that the agent must actually be indifferent between exiting and continuing the relation given the first–best decision.

Lemma 1 *Under a first–best efficient contract with P–authority, for all $\theta \in \Theta$,*

$$V_A(\theta) = \alpha_A U_A(\theta, d^*(\theta)) + P_N(\theta). \tag{21}$$

[23]Note that for this argument we cannot directly appeal to the Revelation Principle of Myerson (1979) because we consider communication without a mediator and imperfect commitment to decisions (cf. Bester and Strausz (2001)).

[24]A first–best efficient exit option contract employing some message space M can be replicated by the direct contract which requires the agent to report a type in Θ and that then implements the contract terms which are induced by the message of this type under the original contract.

Condition (21) parallels condition (11) from the benchmark case with symmetric information and follows jointly from the requirements that the principal chooses the first–best decision and that the agent stays in the relation. The right hand side is agent type θ's utility if the principal has chosen the first–best decision and the agent exits. For the agent to stay in the relation, the utility from staying, $V_A(\theta)$, needs therefore to be weakly larger than the right hand side. On the other hand, if there was a strict inequality in (21), the agent would still stay in the relation even if the principal chose a decision slightly smaller than the first–best decision. Since the principal would be better off with such a decision, she would not choose the first–best decision in this case. Hence, under a first–best efficient contract, equality has to hold in (21).

Next, we derive two necessary conditions that follow from the requirement (i) that the agent reveals his type truthfully. First, truth–telling requires that type θ must not be better off by submitting a report $\hat{\theta} \neq \theta$ and then accepting the induced decision $d^*(\hat{\theta})$. That is, for all $\theta \in \Theta$:

$$V_A(\theta) = \max_{\hat{\theta}} \left[U_A(\theta, d^*(\hat{\theta})) + P_Y(\hat{\theta}) \right]. \tag{22}$$

By a standard envelope argument, this pins down the derivative of V_A:[25]

Lemma 2 *Under a first–best efficient contract with P–authority, for all $\theta \in \Theta$,*

$$V_A'(\theta) = \frac{\partial U_A(\theta, d^*(\theta))}{\partial \theta}. \tag{23}$$

The second implication of the truth–telling requirement is that type θ must not be better off by submitting a report $\hat{\theta} \neq \theta$ and then exiting after the principal chose $d^*(\hat{\theta})$. This means, it must be the case that for all $\theta, \hat{\theta} \in \Theta$

$$V_A(\theta) \geq \alpha_A U_A(\theta, d^*(\hat{\theta})) + P_N(\hat{\theta}). \tag{24}$$

Together with the indifference condition (21) in Lemma 1, it follows that

$$V_A(\theta) = \max_{\hat{\theta}} \alpha_A U_A(\theta, d^*(\hat{\theta})) + P_N(\hat{\theta}). \tag{25}$$

Applying again an envelope argument, we get in analogy to Lemma 2 the following result:

[25]Intuitively, because θ is a maximizer of $\tilde{U}_A(\theta, \hat{\theta}) \equiv U_A(\theta, d^*(\hat{\theta})) + P_Y(\hat{\theta})$, the first order condition for truth–telling to be optimal implies that $\partial \tilde{U}_A(\theta, \theta)/\partial \hat{\theta} = 0$. Thus, $V_A'(\theta) = \partial \tilde{U}_A(\theta, \theta)/\partial \theta + \partial \tilde{U}_A(\theta, \theta)/\partial \hat{\theta} = \partial \tilde{U}_A(\theta, \theta)/\partial \theta$.

Lemma 3 *Under a first–best efficient contract with P–authority, for all $\theta \in \Theta$,*

$$V_A'(\theta) = \alpha_A \frac{\partial U_A(\theta, d^*(\theta))}{\partial \theta}. \tag{26}$$

Note that $\partial U_A(\theta, d^*(\theta))/\partial \theta \neq 0$ by assumption (2) because $d^*(\theta) \neq d_A(\theta)$ by (6). Since $\alpha_A < 1$, Lemma 3 therefore yields a contradiction to Lemma 2 and this proves Proposition 2.

The intuition for the impossibility result in Proposition 2 is straightforward for the case that $\alpha_A = 0$. In this case, the agent's value of exit is independent of his true type. In fact, if type θ announces some other type $\hat{\theta} \neq \theta$ and then exits, he cashes in the exit payment $P_N(\hat{\theta})$ corresponding to the announcement $\hat{\theta}$. But, if $\alpha_A = 0$, the indifference condition (21) implies that type $\hat{\theta}$'s utility exactly amounts to this exit payment $P_N(\hat{\theta})$. Therefore, by announcing $\hat{\theta}$ and exiting, type θ can secure the *same* utility as type $\hat{\theta}$. But the implication that all types get the same utility, is inconsistent with providing incentives for truthful communication and implementing the first–best decision, because incentive compatibility implies that different agent types obtain different payoffs. In summary, the exit option cannot be designed so that it prevents shirking by the principal and at the same time induces the agent to reveal his type and not to exit the relation.

If $\alpha_A > 0$, the agent's value of exit does depend on his true type because the termination value of the project is no longer zero. Thus, if type θ announces some $\hat{\theta} \neq \theta$ to exit later on, he has to take into account that the principal will choose $d^*(\hat{\theta})$ after the report. While this effect may work in favor of truth–telling, cheating and exiting still allows the agent to obtain a higher payoff than truthful reporting and accepting the principal's decision.

While by Proposition 1 exit options can solve the incentive problems that arise through contractual incompleteness under P–authority in the benchmark case, they fail to do so when the agent's type is private information. The deeper reason for this is that under P–authority, the decision right is not in the hands of the party that possesses private information. As we show next, if authority resides with the agent, an exit option contract exists that solves the incentive problems that arise from the combination of contractual incompleteness and asymmetric information.

4.2 *A*–authority

The problem under P–authority in the previous section is that providing incentives for the principal to choose the first–best decision necessarily creates incentives for some agent types to trigger exit. We now show that this tension can be resolved by giving the decision right to the agent:

Proposition 3 *There is a first–best efficient exit option contract with A–authority.*

We prove Proposition 3 constructively by designing a first–best efficient exit option contract explicitly. To do so, we will first construct candidate payments by exploiting conditions that a first–best efficient exit option contract with *A*–authority necessarily has to satisfy. In a second step, we will then verify that these payments indeed constitute a first–best exit option contract.

A first–best efficient exit option contract with *A*–authority has to satisfy the following three incentive constraints:

(i) Agent type θ reports his type truthfully;

(ii) Agent type θ chooses the first–best decision $d^*(\theta)$;

(iii) Upon receiving a report θ and observing decision $d^*(\theta)$, the principal believes that the agent's type is θ and continues the relation.

Before we derive implications of these incentive constraints, we discuss how the principal's beliefs are formed if the agent's report and his decision are inconsistent with one another. More precisely, under a first–best efficient exit option contract, agent type θ reports θ and selects $d^*(\theta)$. Therefore, observing a report θ and a decision $d \neq d^*(\theta)$ constitutes a zero probability event under a first–best efficient exit option contract. Accordingly, the principal's beliefs about the agent's type cannot be determined by Bayes' rule. Throughout, we assume that in this case the principal believes that the agent's type is equal to his report with probability 1.[26]

We now examine implications of the incentive constraints stated above. Constraints (ii) and (iii) imply that the principal must actually be indifferent between exiting and continuing the relation after having observed the agent's report θ and the first–best decision $d^*(\theta)$.

Lemma 4 *Suppose that upon receiving the report $\hat{\theta}$, the principal believes that the agent's type is $\hat{\theta}$. Then under a first–best efficient contract with A–authority, for all $\theta \in \Theta$,*

$$U_P(\theta, d^*(\theta)) - P_Y(\theta) = \alpha_P U_P(\theta, d^*(\theta)) - P_N(\theta). \tag{27}$$

[26]Other specifications of the principal's out-of-equilibrium beliefs also work. For example, our arguments go through in an analogous manner if, after an off-the-path event, the principal believes that the agent is type $\theta = 0$ with probability 1.

The condition parallels the indifference conditions (11) and (21), but now adapted to *A*–authority. The condition follows from the joint requirements that the agent chooses the first–best decision and that the principal stays in the relation. The left (resp. right) hand side is the principal's utility if agent type θ has chosen the first–best decision and the principal stays (resp. exits). For the principal to stay in the relation, the left hand side therefore needs to be weakly larger than the right hand side. On the other hand, if there was a strict inequality in (27), the principal would still stay in the relation even if the agent chose a decision slightly larger than the first–best decision.[27] Since the agent would be better off with such a decision, he would not choose the first–best decision in this case. Hence, under a first–best efficient contract, equality (27) has to hold.

Next, we show that the requirement in (i) that the agent reveals his type truthfully, determines the payments $P_Y(\cdot)$, as stated in the next lemma.

Lemma 5 *Under a first–best efficient contract with A–authority, for all $\theta \in \Theta$,*

$$P_Y(\theta) \quad = \quad c - \int_\theta^1 \frac{\partial U_A(t, d^*(t))}{\partial \theta} dt - U_A(\theta, d^*(\theta)), \qquad (28)$$

for some constant c. Moreover, $P_Y(\cdot)$ is strictly decreasing in θ.

To understand (28), denote agent type θ's utility under a first–best efficient contract again by

$$V_A(\theta) \equiv U_A(\theta, d^*(\theta)) + P_Y(\theta). \qquad (29)$$

Truth–telling requires that type θ must not be better off by submitting a report $\hat{\theta} \neq \theta$ and then choosing the decision $d^*(\hat{\theta})$, anticipating that the principal continues the relation in that case. That is, for all $\theta \in \Theta$:

$$V_A(\theta) = \max_{\hat{\theta}} \left[U_A(\theta, d^*(\hat{\theta})) + P_Y(\hat{\theta}) \right]. \qquad (30)$$

This is the same condition as (22) and by employing the envelope theorem, we can again deduce that $V_A'(\theta) = \partial U_A(\theta, d^*(\theta))/\partial \theta$ as in (23). Therefore, the payments $P_Y(\cdot)$ can be recovered by integration, which yields the expression in Lemma 5.[28]

[27]Observe that if the agent announces θ and chooses a decision $d = d^*(\theta)+\epsilon$ slightly larger than the first–best, the principal still believes that the agent is of type θ with probability 1 by our assumption on the principal's beliefs. Thus, she would stay in the relation if the inequality in (27) was strict.

[28] $P_Y(\theta) = V_A(\theta) - U_A(\theta, d^*(\theta)) = V_A(1) - \int_\theta^1 [\partial U_A(t, d^*(t))/\partial \theta] dt - U_A(\theta, d^*(\theta))$. The constant c is thus equal to the utility, $V_A(1)$, of the agent of type $\theta = 1$.

Hence, as is familiar in screening problems of this kind, we obtain that up to a constant, incentive compatibility uniquely pins downs the payments $P_Y(\cdot)$ as a function of the implemented decision. To complete the proof of Lemma 5, we show in the Appendix that the derivative of $P_Y(\cdot)$ is negative.

The continuation payments $P_Y(\cdot)$ also determine the exit payments $P_N(\cdot)$ by condition (27). We take these payments as our candidate payments for a first–best efficient exit option contract. To complete the construction of the contract, we now define a penalty Π which is sufficient to deter the agent from a deviation that would induce the principal to exercise her exit option. Under a first–best efficient contract, agent type θ must prefer truth–telling and choosing the first–best decision to the deviation that consists in submitting some report $\hat{\theta} \in \Theta$ and then taking some decision d which the principal rejects. The agent's utility from such a deviation is $\alpha_A U_A(\theta, d) + P_N(\hat{\theta}) - \Pi$. Clearly, this cannot be higher than $\alpha_A U_A(\theta, d_A(\theta)) + \max_{\hat{\theta}} P_N(\hat{\theta}) - \Pi$. Thus, a sufficient condition to prevent such a deviation by the agent is that the penalty satisfies

$$V_A(\theta) \geq \alpha_A U_A(\theta, d_A(\theta)) + \max_{\hat{\theta}} P_N(\hat{\theta}) - \Pi. \tag{31}$$

for all $\theta \in \Theta$. Accordingly, if for all $\theta \in \Theta$ we set

$$\Pi(\theta) = \Pi \equiv \max\left[0, \max_{\theta'}[\alpha_A U_A(\theta', d_A(\theta')) - V_A(\theta')] + \max_{\theta'} P_N(\theta')\right], \tag{32}$$

then this suffices to guarantee that the agent will avoid triggering exit by the principal.

When constructing the candidate payments, we have only exploited conditions that a first–best efficient exit option contract with A–authority necessarily needs to satisfy. We now prove the reverse and show that these payments do in fact constitute a first–best efficient exit option contract with A–authority.

As the first step, we characterize the principal's optimal behavior, given the agent has announced some type $\hat{\theta}$ and chosen a decision d. To deduce the principal's optimal strategy, recall our assumption that the principal's belief always coincides with the agent's report. Accordingly, since the principal's utility declines in d for all $d \geq d_P(\theta)$, the indifference condition (27) implies that the principal optimally exits if the decision d is larger than the first best–decision $d^*(\hat{\theta})$. Likewise, the principal exits if the agent chooses a sufficiently small decision. More precisely, let $\underline{d}(\hat{\theta})$ be the smallest decision such that the principal is indifferent between exiting and not exiting, which is defined by the solution $d < d^*(\hat{\theta})$ to[29]

$$U_P(\hat{\theta}, \underline{d}(\hat{\theta})) - P_Y(\hat{\theta}) = \alpha_P U_P(\hat{\theta}, \underline{d}(\hat{\theta})) - P_N(\hat{\theta}). \tag{33}$$

[29]The definition of $\underline{d}(\hat{\theta})$ parallels the definition of the decision $\bar{d}(\theta)$ in (12) in the benchmark case with symmetric information, but now applied to the case with A–authority. Our assumptions imply that $\underline{d}(\hat{\theta})$ is unique.

Thus, upon receiving a report $\hat{\theta}$, the principal exits whenever the agent chooses a decision outside the interval

$$Y(\hat{\theta}) \equiv [\underline{d}(\hat{\theta}), d^*(\hat{\theta})], \tag{34}$$

and continues the relation otherwise. We summarize these considerations in the next lemma:

Lemma 6 *Let $P_Y(\cdot)$ and $P_N(\cdot)$ be given by (27) and (28). Suppose that upon receiving the report $\hat{\theta}$, the principal believes that the agent's type is $\hat{\theta}$. Then given decision d, the principal stays in the relation if and only if $d \in Y(\hat{\theta})$.*

We can now complete our argument that the payments $P_Y(\cdot), P_N(\cdot), \Pi$ constitute a first–best efficient exit option contract with A–authority. First, observe that Lemma 6, in particular implies that the principal continues the relation if the agent chooses the first–best decision, as is required for first–best implementation. Therefore, what remains to be shown is that the payments $P_Y(\cdot), P_N(\cdot)$, and Π induce the agent to tell the truth and choose the first–best decision. This is stated in the next lemma, which we prove in the Appendix.

Lemma 7 *Let $P_Y(\cdot)$ and $P_N(\cdot)$ be given by (27) and (28), and let Π be given by (32). Then,*

(i) it is never optimal for the agent to misrepresent his type and choose the respective first–best decision. That is, for all $\theta, \hat{\theta} \in \Theta$:

$$V_A(\theta) \geq U_A(\theta, d^*(\hat{\theta})) + P_Y(\hat{\theta}); \tag{35}$$

(ii) it is never optimal for the agent to announce some type and choose a decision smaller than the first–best decision that leads the principal to stay in the relation. That is, for all $\theta, \hat{\theta} \in \Theta$, $d \in Y(\hat{\theta})$ with $d < d^*(\hat{\theta})$:

$$V_A(\theta) \geq U_A(\theta, d) + P_Y(\hat{\theta}); \tag{36}$$

(iii) it is never optimal for the agent to announce some type and choose a decision that triggers exit by the principal. That is, for all $\theta, \hat{\theta} \in \Theta$, $d \notin Y(\hat{\theta})$:

$$V_A(\theta) \geq \alpha_A U_A(\theta, d) + P_N(\hat{\theta}) - \Pi. \tag{37}$$

Part (i) of Lemma 7 says that the payments $P_Y(\cdot)$ imply the "global" incentive compatibility constraints that the agent has no incentive to misrepresent his type and choose the corresponding first–best decision. Note that global incentive compatibility does not follow from construction directly since we have constructed the payments by employing only the "local" incentive compatibility constraints. That they indeed satisfy also the global constraints is because in our setup the Spence–Mirrlees condition $\partial^2 U_A/\partial\theta\partial d > 0$ holds and since $d^*(\cdot)$ is increasing. It is well–known that in this case, local incentive compatibility is sufficient for global incentive compatibility.

Part (ii) of Lemma 7 says that it is never optimal for the agent to adopt a deviation where he chooses a report $\hat{\theta}$ and a decision $d < d^*(\hat{\theta})$ such that the principal continues the relation. Intuitively, this is so because if such a deviation was optimal, then the agent would be even better off by announcing a slightly smaller report $\hat{\theta} - \epsilon$ and choose the same decision d. The principal would still continue the relation in this case (by Lemma 6), but the payment $P_Y(\hat{\theta} - \epsilon)$ for the agent would be higher as $P_Y(\cdot)$ is decreasing by Lemma 5. Thus, this kind of deviation cannot be optimal.

Finally part (iii) of Lemma 7 says that the agent cannot benefit from choosing a report and a decision that triggers exit by the principal. This is a direct consequence of how we set up the penalty payment Π. Lemma 7 together with Lemma 6 imply Proposition 3.

In sum, we have shown that there is an exit option contract with A–authority that implements the first–best. Both parties can share the surplus by adjusting the payments through the parameter c in (28). If the principal has all the bargaining power at the contracting stage, she can appropriate the entire surplus from completing the project. Note also that the penalty payments defined in (32) are independent of the agent's message, and that no punishment occurs on the equilibrium path.

Example: Computing the payments in (27) and (28) for the example specified in (8) yields

$$P_Y(\theta) \;=\; c - r_A + b(1-\theta) + \frac{b^2}{4}, \quad P_N(\theta) = c - r_A - r_P + b(1-\theta) + \frac{b^2}{2}, \tag{38}$$

for some constant c. The principal continues the relation if $d \in Y(\hat{\theta}) = [\hat{\theta} - b/2, \hat{\theta} + b/2]$. Since $V_A(\theta) = b(1-\theta) + c$ and $P_N(\theta)$ are decreasing in θ, we obtain from (32) the penalty payment

$$\Pi \;=\; \max\left[0, -V_A(1) + P_N(0)\right] = \max\left[0,\, b + \frac{b^2}{2} - r_P - r_A\right].$$

Interestingly, $\Pi = 0$ as long as the agent's bias b is not too large, because $r_P + r_A > b^2/2$ in our example by assumption (7). ◇

Propositions 2 and 3 reveal a significant distinction between P– and A–authority. The intuition for this difference is as follows. Because the decision is not contractible, first–best efficiency requires the party who is not in charge to be indifferent between exiting and continuing the relation after observing the first–best decision so as to discipline the decision making party (Lemma 1 and Lemma 4). Under P–authority, this implies that each agent type can guarantee himself the same utility as some other agent type by mimicking this type and exiting. But since the agent's information is private, this undermines the possibility that different agent types obtain different information rents and thus prevents truth–telling by the agent.

In contrast, under A–authority, it is the principal who needs to get the same utility from exiting and continuing the relation. This breaks the link between the agent's exit and continuation utility, and it becomes possible to provide the agent with a strictly smaller utility when he triggers exit than when he chooses a decision that the principal accepts. In fact, the easiest way to prevent the agent from triggering exit under A–authority is to impose a sufficiently high third party payment on the agent should the principal exit (but none if she continues). Since third party payments are controversially discussed in the literature,[30] it may be worth indicating that in some situations this can also be achieved without third party payments. As our example suggests, this is the case if the project's termination value is zero and the parties' conflict of interest sufficiently small.

Indeed, let $(\alpha_P, \alpha_A) = (0, 0)$. It then follows from (32) that we can set $\Pi = 0$ if $\min_\theta V_A(\theta) - \max_\theta P_N(\theta) > 0$. Using the definition of $V_A(\theta)$ in (29) and solving the principal's indifference condition (27) for $P_N(\theta)$ yields the equivalent condition

$$\min_\theta \left[U_A(\theta, d^*(\theta)) + P_Y(\theta)\right] + \min_\theta \left[U_P(\theta, d^*(\theta)) - P_Y(\theta)\right] > 0. \tag{39}$$

Since by Lemma 5 the payment $P_Y(\cdot)$ is decreasing, condition (39) certainly holds if

$$\min_\theta U_A(\theta, d^*(\theta)) + \min_\theta U_P(\theta, d^*(\theta)) > P_Y(0) - P_Y(1). \tag{40}$$

The right–hand side of this inequality tends to zero if the agent's bias, as defined in (3), becomes negligible for all $\theta \in \Theta$. To see this, note that the requirement of truthful reporting in (30) implies the first order condition

$$\frac{\partial U_A(\theta, d^*(\theta))}{\partial d} \frac{\partial d^*(\theta)}{\partial \theta} = -P_Y'(\theta). \tag{41}$$

[30]Cf. footnote 15.

As the agent's bias tends to zero, $d^*(\theta) \to d_A(\theta)$ and so $\partial U_A(\theta, d^*(\theta))/\partial d \to 0$ by (1). Thus the payment schedule $P_Y(\cdot)$ becomes flat as the bias disappears. Therefore, condition (40) holds if the agent's bias is sufficiently small and the payoffs $U_A(\theta, d^*(\theta))$ and $U_P(\theta, d^*(\theta))$ are positive for all θ. This means that even without third party payments the agent can be deterred from triggering project termination if the parties' conflict of interest and the termination value of the project are sufficiently small.

5 Conclusion

We have shown that introducing exit options in environments with contractual incompleteness and asymmetric information has a significant impact on both the allocation of authority and on efficiency. Our result that delegating decision rights to the informed party always outperforms decision making by the uninformed party provides a novel justification for the view that authority should reside with the informed party. Reversely, our analysis predicts that exit rights should reside with the uninformed party. This conclusion holds under surprisingly weak assumptions. It is independent of the distribution of the agent's type and the size of the conflict of interest, as measured by the bias.

While we have focussed on the implementation of the first–best efficient outcome, our analysis implies a more fundamental implementability result: if the informed party has the decision right, a large class of outcomes that can be implemented when decisions are contractible, can also be implemented with an exit option contract when decisions are not contractible. This follows because the property which drives our efficiency result under delegation is that the first–best efficient decision is increasing in the agent's type and lies in between the parties' ideal decisions. Therefore, any such decision rule that is increasing in the agent's type and, for each type, specifies a decision in between the parties' ideal decisions can be implemented with an exit option contract under delegation. But in our setting with a single–crossing condition, being increasing in the agent's type is the only requirement for a decision rule to be implementable when decisions are contractible. In particular, this requirement is satisfied if the agent receives information *ex ante* before the contract is signed, rather than ex post as in our analysis. An exit option contract under delegation can then implement the second–best efficient outcome that is optimal with contractible decisions under private ex ante information. In this sense, our results are robust with respect to the timing of information arrival.

Our paper studies the problem of allocating authority in bilateral relations between an uninformed principal and a single informed agent. An interesting extension of our analysis would be to consider organizations in which decision relevant knowledge is distributed among several agents. In a corporation, for example, optimal decision making may depend on the combined information held by its experts in engineering, marketing, and finance. We conjecture that exit option contracts are also useful in such environments. Under such a multi-party contract, the principal delegates decision authority to one of the informed agents but keeps the right to terminate operations. All agents report their private information to the principal and to the agent who has obtained authority. The latter agent thus decides on the basis of all available information. As long as the optimal decision is monotone in the agents' types, appropriate payment schemes can provide communication incentives for truthful information revelation. Further, the principal's exit option allows creating decision incentives for the agent in authority to deter him from misusing the decision right.

6 Appendix

This appendix contains the proofs of Lemmas 5 and 7. Propositions 1–3 and Lemmas 1–4, and 6 are substantiated in the main text.

Proof of Lemma 5 As (28) has been shown in the main text, it remains to show that $P_Y(\theta)$ is strictly decreasing. Since the first-best decision $d^*(\theta) \in (d_P(\theta), d_A(\theta))$ lies between the ideal decision of the principal and the agent, our assumptions imply:

$$\frac{\partial U_A(\theta, d^*(\theta))}{\partial d} > 0. \tag{42}$$

Since $\partial d^*(\theta)/\partial\theta > 0$, taking the derivative of (28) yields

$$P_Y'(\theta) = \frac{\partial U_A(\theta, d^*(\theta))}{\partial\theta} - \frac{\partial U_A(\theta, d^*(\theta))}{\partial\theta} - \frac{\partial U_A(\theta, d^*(\theta))}{\partial d}\frac{\partial d^*(\theta)}{\partial\theta} < 0, \tag{43}$$

and this shows that $P_Y(\cdot)$ is strictly decreasing. Q.E.D.

Proof of Lemma 7 (i) Observe that in our setup, for all (θ, d) the Spence–Mirrlees condition $\partial^2 U_A(\theta, d)/\partial\theta\partial d > 0$ holds. By an argument due to Mirrlees (1971), it is well–known that condition (28) and the fact that $d^*(\cdot)$ is increasing then imply (35).
(ii) Let $\theta, \hat{\theta} \in \Theta$ and $d \in Y(\hat{\theta})$ with $d < d^*(\hat{\theta})$. We distinguish two cases. First, suppose that there is a $\theta' \in \Theta$ so that $d = d^*(\theta')$. Since $d < d^*(\hat{\theta})$ and $d^*(\cdot)$ is increasing, we have that $\theta' < \hat{\theta}$. Moreover, by Lemma 5, $P_Y(\cdot)$ is decreasing. Hence,

$$U_A(\theta, d) + P_Y(\hat{\theta}) = U_A(\theta, d^*(\theta')) + P_Y(\hat{\theta}) \leq U_A(\theta, d^*(\theta')) + P_Y(\theta') \leq V_A(\theta), \tag{44}$$

where the final inequality follows from (35). Hence, (36) is met, as desired.

Next, suppose that for all θ', it holds that $d \neq d^*(\theta')$. Since $d < d^*(\hat{\theta})$ and since $d^*(\cdot)$ is increasing, this means that $d < d^*(0)$. Now observe that $d^*(0)$ is smaller than any agent type θ's ideal decision $d_A(\theta)$ and that the agent's utility is increasing in d for $d \leq d_A(\theta)$. Thus, $U_A(\theta, d) \leq U_A(\theta, d^*(0))$, and we can deduce:

$$U_A(\theta, d) + P_Y(\hat{\theta}) \leq U_A(\theta, d^*(0)) + P_Y(\hat{\theta}) \leq U_A(\theta, d^*(0)) + P_Y(0) \leq V_A(\theta). \tag{45}$$

The second inequality follows because $P_Y(\cdot)$ is decreasing by Lemma 5, and the final inequality follows from (35). This establishes (36).
(iii) Let $\theta, \hat{\theta} \in \Theta$, $d \notin Y(\hat{\theta})$. Since $U_A(\theta, d) \leq U_A(\theta, d_A(\theta))$ for all θ, d, we have

$$\begin{aligned} &\alpha_A U_A(\theta, d) + P_N(\hat{\theta}) - \Pi \leq \alpha_A U_A(\theta, d_A(\theta)) + P_N(\hat{\theta}) - \Pi \\ &\leq \alpha_A U_A(\theta, d_A(\theta)) - \max_{\theta'}[\alpha_A U_A(\theta', d_A(\theta')) - V_A(\theta')] + P_N(\hat{\theta}) - \max_{\theta'} P_N(\theta') \\ &\leq V_A(\theta). \end{aligned} \tag{46}$$

The inequality in the second line follows from the definition of Π in (32), and the final inequality is obvious. This completes the proof. Q.E.D.

7 References

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