The Limits of Authority: Motivation versus Coordination

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Abstract

This paper studies the effects of open disagreement on motivation and coordination. It shows how, in the presence of differing priors, motivation and coordination impose conflicting demands on the allocation of authority, leading to a trade-off between the two.

The paper first derives a new mechanism for delegation: since the agent thinks, by revealed preference, that his own decisions are better than those of the principal, delegation will motivate him to exert more effort when effort and correct decisions are complements. A need for implementation effort will thus lead to more decentralization. The opposite is true when effort and decisions are substitutes.

Delegation, however, reduces coordination when people disagree on the right course of action. The paper shows that, with differing priors, the firm needs to rely more on authority (as opposed to incentives) to solve coordination problems, relative to the case with private benefits. An interesting side-result here is that the principal will actively enforce her decisions only at intermediate levels of the need for coordination.

The combination of the two main results implies a trade-off between motivation and coordination, both on a firm level and across firms. I derive the motivation-coordination possibility frontier and show the equilibrium distribution of effort versus coordination. I finally argue that strong culture, in the sense of homogeneity, is one (costly) way to relax the trade-off.

JEL Codes: D8, L2, M5

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1 Introduction

Motivation and coordination are two of the most central concerns in organization design. In particular, once people join hands in an organization, their actions must be coordinated to realize the benefits of organization, while they must also get motivated since they do not bear the full consequences of their actions any more (Milgrom and Roberts 1992). To a large extent, the problem of organization is to capture the benefits of specialization and scale while minimizing the motivation and coordination losses. In practice, this often leads to a trade-off between motivation and coordination. In fact, many of the key choices in organization design can be framed in terms of that trade-off.

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This paper studies the interaction between, on the one hand, differing priors about the right course of action, and, on the other hand, motivation and coordination. In particular, the paper shows that, in the presence of differing priors, motivation and coordination impose conflicting demands on the allocation of authority, which causes a trade-off between the two.

To study these issues, I consider the setting of a manager-entrepreneur who undertakes a project and who needs to employ an agent to realize that project. In the context of this project, both the principal and the agent will need to make a decision, and the agent also needs to exert effort to execute his decision. The project’s success depends on the quality of the decisions, on the coordination between the decisions, and on the effort exerted by the employee. The principal can contract with the agent on the outcome of the project, and chooses to either control the agent’s decision or to delegate that decision to the agent.

The paper first derives a new rationale for delegation. The starting point is the observation that, by revealed preference, the agent believes that his own choices and decisions are better than these imposed by his principal. As a consequence, if effort is a complement\(^1\) to making good decisions, then the agent will expect a higher return from his effort, and thus exert more effort, when he can make the decision himself. In other words, delegation will increase the agent’s effort or motivation. An important example of such effort that is complementary to correct decisions is ‘implementation effort’, i.e., effort to implement and execute a decision. Of course the opposite also holds: when effort is a substitute to good decisions, as is sometimes the case when effort can make up for wrong decisions (‘compensatory effort’), then delegation will decrease the agent’s effort. Since complementary effort seems to be the more likely of the two, as I discuss later, the key prediction here is that a need for implementation effort will favor delegation.

Delegation, however, reduces coordination when people disagree on the right course of action since each player will want to follow the course of action that he considers best. The key result here is that with differing priors we typically need to rely more on authority (relative to incentives) to solve coordination problems. In particular, while coordination problems that originate in private benefits may be mitigated or even eliminated through an appropriate allocation of residual income, this approach is less (if at all) effective when the coordination problem comes from differing priors. The reason is that, in the case of differing priors, shifting residual income to a player not only makes him internalize more of his externalities, but also increases his incentives to just do what he thinks is right. These two forces often go in opposite directions. In particular, in the model of this paper, the two effects exactly cancel each other out so that incentives are completely ineffective to get coordination. For an analogous model with private benefits, on the other hand, I do show that incentives can solve the coordination problem. More broadly, this result suggests that incentives are less effective to solve externalities when these externalities originate in differing priors.

A second interesting, though less important, result is that the principal will actively enforce her decisions only when the importance of coordination is intermediate. The reason is that coordination being more important also gives the players reasons to try to coordinate on their own initiative, and thus makes active enforcement of centralized coordination decisions less necessary.

Combining these results leads to the final conclusion that disagreement induces a trade-off between coordination and motivation. I first show that, for exogenously given levels of incentives, firms face a trade-off between motivation and coordination, and derive the effort-coordination

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\(^1\)The notion of complements and substitutes plays an important role in this argument. The first paragraphs of section 3 discuss these concepts in detail. In short, effort is a complement to a decision if effort is more useful when the decision is correct than when the decision is wrong, and vice versa for substitutes.
possibility frontier (Roberts 2004).\footnote{Roberts (2004) gives an informal discussion of this concept. The frontier indicates for a given level of resources spent (on motivation and coordination) how much motivation we can get for a desired level of coordination. A downward-sloping frontier implies a trade-off between motivation and coordination. He illustrates how this concept explains some important organizational changes and some implications for the ‘markets-firms’ trade-off.} I further show how the trade-off manifests itself in a cross-section of firms. I finally argue that strong culture, in the sense of shared beliefs (Schein 1985), may relax the trade-off (although it also comes at a cost).

**Literature** There are two other papers that deal, directly or indirectly, with the motivation-coordination trade-off: Athey and Roberts (2001) and Dessein, Garicano, and Gertner (2005). I will discuss both papers in detail in section 7, at which point it will be easier to compare the different mechanisms. As I will show there, the papers differ substantially from the current one, both in mechanism and in empirical predictions.

The delegation/motivation effect is also related to the economic literature on delegation, in particular to Aghion and Tirole (1997) and Zábojník (2002).\footnote{Other papers on delegation and related topics are Baker, Gibbons, and Murphy (1999), Dessein (2002), Hart and Holmstrom (2002), Prendergast (2002) Aghion, Dewatripont, and Rey (2003), Marino and Matsusaka (2004), and Marino, Matsusaka, and Zábojník (2006), but none of these deals with the issues that are central to this paper.} I discuss the difference with these papers, such as the empirical predictions on substitutes versus complements or the role that delegation plays, in detail in section 3.

Finally, as I will discuss in section 6, two papers that are closely related to the current one also have implications for the motivation-coordination tradeoff. The first is Van den Steen (2005c), which shows that for a principal to have interpersonal authority over an agent, it may be necessary to minimize the agent’s pay-for-performance and other outcome-based incentives. The second is Van den Steen (2006), which studies the optimal allocation of control under differing priors (in the absence of coordination and incentive considerations).

**Contribution** The contribution of this paper is threefold. It derives a new rationale for delegation, it shows that coordination problems that emerge from disagreement have to be solved with authority rather than incentives, and it shows that the combination of these two effects forces a trade-off between motivation and coordination. It also shows that the enforcement of centralized decisions may be non-monotone in the importance of coordination.

The next section introduces the model. Sections 3 and 4 derive the motivation effect and coordination effect in partial equilibrium (with the agent’s incentives exogenously given). Section 5 combines these results and endogenizes incentives, thus deriving the motivation-coordination tradeoff. Section 6 discusses other effects and potential solutions to the trade-off, section 7 compares to other papers, while section 8 concludes.

# 2 The Model

The model in this paper captures the common organizational setting in which employees must make decisions and exert effort to make a particular project succeed but, at the same time, the actions of different agents and of the principal need to be coordinated. A key question will then be whether the principal chooses to control the agent’s decisions or, instead, prefers to delegate them to the agent, and how that affects the agent’s choice of effort.

Formally, consider a principal $P$ who employs an agent $A$ for a project. As part of the project, $A$ and $P$ each will make a decision, denoted respectively $D_A$ and $D_P$, from the set $\{X, Y\}$. Moreover,
A also chooses whether to exert effort to execute his decision, i.e., he chooses \( e \in \{0, 1\} \). Depending on all these actions, the project will ultimately either succeed or fail, generating an income of respectively 1 or 0. As mentioned earlier, the probability of success will, in particular, depend on 3 factors that I discuss now: the correctness of each player’s decision, whether the decisions are coordinated, and whether \( A \) exerted effort. First, a player’s decision will be correct if and only if it fits the state of the world \( S \in \{x, y\} \). That state of the world is unknown, however, and each player \( i \) has his or her own subjective belief \( \mu_i \) that the state is \( x \). The players have differing priors, i.e., \( \mu_A \) and \( \mu_P \) may differ even though no player has private information about the state.\(^4\) I will discuss below how these beliefs get determined. Second, the players’ decisions are coordinated if and only if \( D_A = D_P \). Third, the agent’s effort is a binary choice \( e \in \{0, 1\} \) that imposes some private cost of effort on the agent \( A \), as discussed below.

To specify the project’s probability of success formally, let \( d_i = I_{D_i=S} \) be the indicator function that the decision of person \( i \) is correct, \( C = I_{D_A=D_P} \) the indicator function that the two decisions are identical (‘Coordinated’), and \( e \) the indicator function whether the agent exerted effort. While I will at times consider simplifications to make the analysis more transparent, most of the paper will be concerned with the following specification for the probability of success \( \Pi \):

\[
\Pi = d_A + d_P - \beta_c c_c (1 - C) - \beta_e (1 - e) d_A
\]

with \( \beta_c, \beta_e \geq 0 \) and \( \beta_e + \beta_c \leq 1 \). This function is a weighted sum of three terms, with \( \beta_c \) and \( \beta_e \) denoting the relative weights. The first term, \( d_A + d_P \), is the basic payoff and simply depends on whether the respective decisions are correct or not. The second term, \( -c_c (1 - C) \), captures the effect of coordination. If both players choose the same decision, then \( C = 1 \) and this term vanishes. If not, then the term imposes a ‘coordination cost’ \( c_c \).\(^5\) The third term captures the effect of effort. If the agent exerts effort \( (e = 1) \), then this third term again vanishes, but if the agent does not exert effort then this term imposes a cost. As I will discuss later, the agent’s effort is, in this specification, complementary to the decision being correct. The agent’s private cost of effort will be \( \beta_e c_c^2 / 2 \). The reason for scaling the effort cost by \( \beta_e \) is that I want \( \beta_e \) to capture the importance of the effort component, without changing the cost-benefit of effort in itself.

The timing of the game, indicated in figure 1, is as follows. The principal first contracts with the agent on the outcome of the project. In particular, \( P \) offers \( A \) a wage \( w \) and a share \( \alpha \) of the project revenue upon success. \( A \) accepts or rejects the offer, where rejection ends the game immediately. Furthermore, \( A \) is protected by limited liability and has an outside wage equal to zero. This will imply that in equilibrium \( w = 0 \). Once the players have contracted, \( c_c \sim U[0,1], c_e \sim U[0,1] \), and the \( \mu_i \) are realized. The idea of having the costs and beliefs being drawn after the contract negotiation is that the contentious issues arise only after the project has been started, so that it is only at that time that it becomes clear which issues and thus which costs and beliefs are relevant.\(^6\)

\(^4\)Differing priors do not contradict the economic paradigm: while rational agents should use Bayes’ rule to update their prior with new information, nothing is said about those priors themselves, which are primitives of the model. In particular, absent any relevant information agents have no rational basis to agree on a prior. Harsanyi (1968) observed that ‘by the very nature of subjective probabilities, even if two individuals have exactly the same information and are at exactly the same high level of intelligence, they may very well assign different subjective probabilities to the very same events’. For a more extensive discussion, see Morris (1995) or Van den Steen (2005a).

\(^5\)As will become clear below, \( c_c \) is a random variable. I also include \( \beta_e \) to transparently parameterize the importance of coordination.

\(^6\)We could formalize this by assuming that there are many potential issues on which the players may disagree. Both players’ beliefs on each of the issues are known, but it is revealed only at the end of period 1 which issue is relevant to this project. Letting \( c_c, c_e \) and \( \mu_i \) be drawn before the contract negotiations would qualitatively preserve the results of the paper, but makes some results more difficult to state and interpret.
1 2 3
Contracting

a P offers A a contract \((w, \alpha)\).
b A accepts or rejects. Upon rejection, the game is over and both get 0.
c The costs \(c_e\) and \(c_c\) get drawn publicly.
d The beliefs \(\mu_i\) get drawn privately.

Actions

a P decides \(D_P\) and chooses whether to decide himself \(D_A\) or delegate that decision to \(A\).
b A decides \(D_A\) if \(P\) delegated, and also chooses \(e \in \{0, 1\}\).

Payoff

a Project payoffs and costs are realized.
b Contract terms \((w, \alpha)\) are executed.

Figure 1: Time line of the model

To keep the analysis transparent and tractable, I assume a very simple degenerate and independent distribution for the prior beliefs. In particular, for some given parameters \(\nu_A, \nu_P \in (0.5, 1)\), \(\mu_i\) will equal either \(\nu_i\) or \(1 - \nu_i\), with equal probability. In other words, \(\mu_i\) is drawn from a 2-point distribution with half its weight on \(\nu_i\) and half on \(1 - \nu_i\). It follows that each player will believe half the time that \(x\) is the most likely state, and half the time that \(y\) is the most likely state. Since the prior beliefs are independent draws, the players will agree only half the time, and disagree the other half. Moreover, each player always has the same strength of belief, \(\nu_i\), in the state that he considers most likely. These belief realizations are private information. At the start of period 2, the principal makes his decisions, including whether to decide \(D_A\) himself or delegate that decision to the agent. Then the agent chooses his decision, if applicable, and his effort. The choices in period 2 are all public. In period 3, finally, the payoffs get realized and the contract is executed. The principal’s utility is then \(u_P = (1 - \alpha)\Pi - w\) and the agent’s utility is \(u_A = \alpha\Pi + w - \beta e^2/2\).

In what follows, I do the analysis in two steps. First, in sections 3 and 4, I consider the subgame starting in period 1d, thus taking \(w, \alpha, c_c\), and \(c_e\) as exogenously given. This case with \((\alpha, w)\) given builds intuition for the final result but is also important in its own right. In particular, in many instances the contract \((\alpha, w)\) is longer-term or determined by other factors, while the delegation and coordination decisions are part of daily decision making. In that case, this partial analysis is the right approach to derive empirical predictions. In section 5, I endogenize the contract and derive the full equilibrium and the trade-off.

3 Motivation and Delegation in Subgame Equilibrium

Since complements and substitutes (in the sense of monotone comparative statics) play such a central role in this analysis of delegation, let me first clarify the meaning of these concepts in the current context.

In general, two variables \(x\) and \(y\) are complements with respect to an objective function \(Z\) if the objective function has increasing differences in \(x\) and \(y\), i.e., if for \(x \leq \overline{x}\) and \(y \leq \overline{y}\), \(Z(x, \overline{y}) - Z(x, y) \geq Z(\overline{x}, y) - Z(\overline{x}, \overline{y})\) (Milgrom and Roberts 1990, Milgrom and Roberts 1994). Note that a smooth function has increasing differences if and only if its cross-partial derivative is non-negative. Analogously, the variables are substitutes if the objective function has decreasing differences in \(x\) and \(y\), i.e., for \(x \leq \overline{x}\) and \(y \leq \overline{y}\), \(Z(x, \overline{y}) - Z(x, y) \leq Z(\overline{x}, \overline{y}) - Z(\overline{x}, y)\).

In the current context, effort and the agent’s decision \(D_A\) are thus complements if the objective
function has increasing differences in $e$ and $d_A$, i.e., iff

\[
\frac{\partial \Pi(e, d_A = 1)}{\partial e} \geq \frac{\partial \Pi(e, d_A = 0)}{\partial e}
\]

In words, effort and the agent’s decision $D_A$ are complements if effort is more useful when the decision is correct than when the decision is wrong. The prototypical case of such complementarity is the situation where effort is necessary to implement a decision. Implementing a wrong decision is not very useful so that implementation effort on a wrong decision is more or less wasted. Effort to implement a correct decision, on the other hand, is very useful.

The opposite case is that effort and the decision are substitutes, i.e., $\Pi$ has decreasing differences in $e$ and $d_A$. In other words, effort is more useful when the decision is wrong. It is more difficult to find clean examples of this. One situation that comes to mind is when effort can make up for a wrong decision. Imagine for example that the project is a success if and only if it achieves a specific level of quality, and that effort and decision quality are additive. In this case, there is usually a range of values where effort and decisions are substitutes (although there is usually also a range where they are complements).\(^7\)

Although the issue whether decision and effort are complements or substitutes is an empirical one, the above examples and informal observations suggest that complementary effort is more common and more important than substitute effort.

Given complements or substitutes, how does delegation affect the agent’s motivation when the principal and agent disagree on the optimal course of action? As discussed earlier, the agent will, by revealed preference, always consider his own decision to be better than that of the principal, i.e., he believes that the decision $D_A$ is more likely to be correct when he made it than when it was made and imposed by his principal.\(^8\) He will thus expect a higher return from his effort under delegation when effort and decisions are complements, and a lower return when they are substitutes. In other words, delegation increases the agent’s effort if and only if effort is a complement to the decision. Given the above observation that complements seem more prevalent than substitutes, delegation tends to have a motivating effect and will thus typically be favored when motivation is important. This is, in particular, always true for implementation effort.

To obtain these results formally, I start from the model of section 2, but consider the subgame starting in period 1d. In other words, I take $\alpha$, $w$, $c_e$, and $c_c$ as exogenously given. Also, in order to capture both substitutes and complements and to keep the analysis maximally transparent, I will consider variations on the earlier specification for the probability of success (and project return) $\Pi$.

Let me first formally show the intuition that effort will be higher under delegation if and only if effort and decisions are complements. This result is actually demonstrated most transparently by simplifying the specification to a probability of success $\Pi$ that is increasing in $e$ and $d_A$, which includes the specification of section 2. Let $J_A \in \{A, P\}$ denote the identity of the player who decides on decision $D_A$, and let $\hat{e}$ denote the agent’s choice of effort. The following proposition then captures formally the result that effort will be higher under delegation if effort and decisions are complements, and lower if they are substitutes.

**Proposition 1** If $\frac{\partial \Pi(e, d_A = 1)}{\partial e} \geq \frac{\partial \Pi(e, d_A = 0)}{\partial e}$ $\forall e$, then $\hat{e}(J_A = A) \geq \hat{e}(J_A = P)$. If, on the contrary, $\frac{\partial \Pi(e, d_A = 1)}{\partial e} \leq \frac{\partial \Pi(e, d_A = 0)}{\partial e}$ $\forall e$, then $\hat{e}(J_A = A) \leq \hat{e}(J_A = P)$.

\(^7\)For an example, let the outcome function $R$ be an additive function of the decision indicator $d$ and the effort level $e$, i.e., $R = d + e$ with $d, e \in \{0, 1\}$. Assume that the project is a success with payoff 1 if and only if $R \geq \overline{R}$, and give payoff 0 otherwise. In this case, effort compensates for bad decisions. Note now that $e$ and $d$ are substitutes when $\overline{R} < 1$, but they are complements when $\overline{R} > 1$.

\(^8\)Obviously, this would be different in, for example, a model where $P$ has private information about the actions.

more delegation if effort and decisions are complements but not so if they are substitutes. Let the following proposition then confirms the result that an increase in the importance of effort leads to

Proof: Let \( \alpha \) denote the share of project revenue that goes to player \( i \), let \( Z_i = \arg\max_{D_A \in \{X,Y\}} E_i[\alpha \Pi(e, d_A)] \) denote the best action according to player \( i \), and let \( Q_i,A = E_i[d_A \mid D_A = Z_i] \) denote \( i \)'s estimate of the probability that \( j \) is right. By revealed preference \( Q_A,A \geq Q_A,P \), or \( Q_A,A - Q_A,P \geq 0 \). If now \( \frac{\partial \Pi(e, d_A, 1)}{\partial e} \geq \frac{\partial \Pi(e, d_A, 0)}{\partial e} \) for all \( e \), then

\[
(Q_A,A - Q_A,P) \frac{\partial \Pi(e, 1)}{\partial e} \geq (Q_A,A - Q_A,P) \frac{\partial \Pi(e, 0)}{\partial e}
\]

or

\[
Q_A,A \frac{\partial \Pi(e, 1)}{\partial e} + (1 - Q_A,A) \frac{\partial \Pi(e, 0)}{\partial e} \geq Q_A,P \frac{\partial \Pi(e, 1)}{\partial e} + (1 - Q_A,P) \frac{\partial \Pi(e, 0)}{\partial e}
\]

or

\[
\frac{\partial}{\partial e} E_A[\Pi(e, d_A) \mid D_A = Z_A] \geq \frac{\partial}{\partial e} E_A[\Pi(e, d_A) \mid D_A = Z_P]
\]

or, with \( G(e,j) = jE_A[\alpha \Pi(e, d_A) \mid D_A = Z_A] + (1 - j)E_A[\alpha \Pi(e, d_A) \mid D_A = Z_P] \),

\[
\frac{\partial^2 G(e,j)}{\partial e \partial j} \geq 0
\]

At the same time, using notation \( c(e) = \beta e c_e e \),

\[
\hat{e}(J_A = A) = \arg\max_{e \in \{0,1\}} E_A[\alpha \Pi(e, d_A) - c(e) \mid D_A = Z_A] = \arg\max_{e \in \{0,1\}} G(e,1) - c(e)
\]

while

\[
\hat{e}(J_A = P) = \arg\max_{e \in \{0,1\}} E_A[\alpha \Pi(e, d_A) - c(e) \mid D_A = Z_P] = \arg\max_{e \in \{0,1\}} G(e,0) - c(e)
\]

The proof of the first part then follows by monotone comparative statics. The second part is analogous.  

This result suggests straightforward implications for delegation and centralization: when effort and decisions are complements, delegation should increase in the importance of effort, while the opposite is true when effort and decisions are substitutes. To study that issue, consider the following slight elaboration of the specification in section 2:

\[
\Pi(\gamma) = d_A + d_P - \beta c_e (1 - C) - \beta_\gamma e (1 - \gamma) d_A + (1 - \gamma) e (d_A - 1)
\]

for \( \gamma \in [0,1] \), which equals the original specification when \( \gamma = 1 \). Note that effort and the decision are complements if and only if \( \gamma \geq 1/2 \) and they are substitutes if and only if \( \gamma \leq 1/2 \). The following proposition then confirms the result that an increase in the importance of effort leads to more delegation if effort and decisions are complements but not so if they are substitutes. Let \( J_A \) denote the person who optimally decides on \( D_A \) from the perspective of the principal.

Proposition 2 When \( \gamma > 1/2 \), then there exists (for any \( (\nu_A, \nu_P, \beta, c_e, c_e) \) and \( (\alpha, w) \) a \( \hat{\beta} \) such that \( J_A = A \) if \( \beta_e \geq \hat{\beta} \), and \( J_A = P \) otherwise. If \( \gamma < 1/2 \), \( J_A = P \) for any set of parameters.

Proof: Let \( Z_i \) denote the action that player \( i \) considers best. Note that \( A \) exerts effort if \( \alpha \beta_e [\gamma E_A[d_A] + (1 - \gamma)(1 - E_A[d_A])] \geq \beta_e c_e \) or \( \sqrt{2\alpha(1 - \gamma) + (2\gamma - 1)E_A[d_A]} \leq c_e \).

Consider the case that \( \gamma > 1/2 \). If \( \sqrt{2\alpha(1 - \gamma) + (2\gamma - 1)(1 - \nu_A)} \geq c_e \) then \( A \) will always exert effort, if \( \sqrt{2\alpha(1 - \gamma) + (2\gamma - 1)\nu_A} \geq c_e \) then \( A \) will exert effort iff \( D_A = Z_A \).
and if \( c_e \geq \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)\nu_A]} \) then \( A \) will never exert effort. Since these 3 cases do not depend on \( \beta_e \), I can show the result case by case.

If \( \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)(1 - \nu_A)]} \geq c_e \), so that \( A \) always exerts effort, then \( P \) doesn’t gain from allowing \( D_A = Z_A \) and will therefore make sure that \( D_A = D_P = Z_P \), so that \( J_A = P \) for any set of parameters such that \( \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)(1 - \nu_A)]} \geq c_e \).

If \( \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)\nu_A]} \leq c_e \), so that \( A \) never exerts effort, \( P \) again doesn’t gain from allowing \( D_A = Z_A \), so that she will make sure that \( D_A = D_P = Z_P \), so that \( J_A = P \) for any set of parameters such that \( \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)\nu_A]} \leq c_e \).

If, finally, \( \sqrt{2\alpha[(1-\gamma) + (2\gamma - 1)\nu_A]} \geq c_e \), so that \( \beta \) exerts effort iff \( D_A = Z_A \), then \( P \) has the following choices:

1. \( D_A = D_P = Z_P \), but \( e = 0 \) when \( Z_A \neq Z_P \), so that \( U_P = (1-\alpha) \left( 2\nu_P - \frac{\beta_e}{2} (\gamma \nu_P + (1-\gamma)(\nu_P - 1)) \right) \).
2. \( D_P = Z_P, D_A = Z_A \), and \( e = 1 \), so \( U_P = (1-\alpha) \left( \nu_P + \frac{\nu_P + (1-\nu_P)}{2} - \frac{\beta_e c_e}{2} - \beta_e (1-\gamma)(\frac{\nu_P + (1-\nu_P)}{2} - 1) \right) \).

Note that in this case \( J_A = A \) if and only if case 2 is optimal. So I need to show that there exists a \( \hat{\beta} \) (which may be \(-\infty \) or \( \infty \)) such that case 2 is optimal iff \( \beta_e \geq \hat{\beta} \). Some algebra shows that this is indeed true with \( \hat{\beta} = \frac{\beta_e}{c_e} + \frac{\nu_P - 1}{2} \).

Consider now the case that \( \gamma < 1/2 \). A will exert effort iff \( \sqrt{2\alpha[(1-\gamma) - (1-2\gamma)\nu_A]} \geq c_e \). It follows that if \( \sqrt{2\alpha[(1-\gamma) - (1-2\gamma)\nu_A]} \geq c_e \) then \( A \) will always exert effort, if \( \sqrt{2\alpha[(1-\gamma) - (1-2\gamma)(1 - \nu_A)]} \geq c_e \), then \( A \) will exert effort iff \( D_A = Z_P \), and if \( c_e \geq \sqrt{2\alpha[(1-\gamma) - (1-2\gamma)(1 - \nu_A)]} \) then \( A \) will never exert effort. It follows further that \( P \) will always make sure that \( D_A = Z_P \) so that \( J_A = P \) for all parameters.

There is something remarkable about this result for \( \gamma > 1/2 \) : the principal delegates even though she knows that delegation can only make the decision worse. Moreover, she would not overturn a decision that she believes is wrong even if she could do so. In fact, instead of delegating, the principal could also ask her employees to suggest a course of action and then rubberstamp that decision (even if she actually believes it is wrong, which is in contrast to rubberstamping in Aghion and Tirole (1997)’s P-formal authority model). While this may sound a bit surprising, it is actually not at all unusual in organizations for a manager to allow her employees to follow a course of action that she believes to be inferior but that she knows ‘fires up the troops’.

I will now argue that this theory of delegation differs both in terms of predictions and in terms of underlying mechanisms from Aghion and Tirole (1997) and Zábojník (2002).

In Aghion and Tirole (1997), agent and principal get (initially unknown) private benefits from alternative courses of action, and can spend effort on learning these private payoffs. The role of delegation, or A-formal authority as they also refer to it, is to give the agent maximal returns from, and thus incentives for, collecting information, by allowing him to choose his most preferred action. Since effort is an input to making decisions in their model, effort and decisions are neither complements nor substitutes so that they have no predictions regarding this distinction. Second, information collection by the principal, which is absent from the current model, plays a crucial role in theirs: without such information collection, delegation would not matter since the principal would anyways always follow the agent’s advise. Third, commitment (to delegation) is essential in Aghion and Tirole (1997): if the principal were able to overturn the agent’s decision whenever he finds out what his optimal action is, then he would do so, and the effect of delegation would be eliminated. In the current paper, on the contrary, the principal would not overturn the agent’s decision, even if he could. Finally, the papers’ mechanisms are very different in the following sense: in Aghion and Tirole (1997), the agent put in effort in order to select (in the future) an attractive
action, while here the agent put in effort because an attractive action was selected (in the past).

In Zábojník (2002), agent and principal each get a private signal about which action is most likely to succeed. Since ordering the agent what to do reveals the principal’s signal, delegation is necessary if the principal wants to hide his signal. Zábojník (2002) shows that hiding the principal’s signal may increase the agent’s effort, and that this may happen both when effort and decision are complements and when they are substitutes. In particular, in the case of substitutes, the purpose of delegation in Zábojník (2002) is to make the agent more pessimistic (by shielding him from the principal’s signal when the two of them agree) so that he spends more effort to compensate for the wrong decision. This is clearly the opposite prediction of the current paper. It also shows that the role of delegation is very different: in Zábojník (2002), delegation shields the employee from the manager’s information in a way that makes him exert more effort, while in the current paper delegation guarantees by revealed preference that the agent works on the project he considers best.

4 Coordination in Subgame Equilibrium

Consider now the issue of coordination. Since coordination is a special case of externalities, two ways to deal with coordination issues come immediately to mind. The first is to use incentives. The idea here is to make the agent internalize the externality he causes by not coordinating with the other, and thus to make it in his interest to coordinate (at least when coordination is efficient). This incentive approach plays, for example, an important role in both Athey and Roberts (2001) and Dessein, Garicano, and Gertner (2005). In both cases, the agent’s incentives will become more broad-based or more balanced as coordination becomes more important. The second way to get coordination is by using authority. In particular, when the principal can tell the agent what to do, then it is as if all decisions are made by one person and thus automatically coordinated. This suggests that centralization should increase when coordination becomes more important.

The main result of this section is that the incentive solution to coordination often doesn’t work, or works less well, when differing priors (rather than private benefits) are the source of the coordination problems. The reason is that giving the agent more residual income not only makes him care more about coordination but also increases his incentives to follow his own beliefs, even if that means losing coordination. In the model of this paper, these two effects exactly cancel each other out so that incentives don’t work at all to solve coordination problems. To better illuminate the role of differing priors, I contrast the differing priors model with an analogous private benefits model and get a very different conclusion: while residual income allocation has no effect on coordination in the differing priors model, it always allows to achieve efficient coordination in the private benefits model. Although this is just one comparison (though an important one), and thus does not allow us to conclude that incentives never work with differing priors and/or always work with private benefits, the contrast does provide some clear clues as to why residual income performs worse in solving the coordination problem in the differing priors model than in the private benefits model. The main implication of this analysis is that organizations have to rely more heavily on authority to solve coordination problems when they are caused by differing priors.

\textsuperscript{9}This ‘pessimism by delegation’ is introduced at the start of the proof of proposition 4b of Zábojník (2002). In particular, ‘\(\pi_d^i > \pi_c^i\) because \(p < p(1,1)\)’ means that ‘the profits under full incentives/delegation are larger than under full incentives/centralization because the agent is more pessimistic under decentralization (\(p\) than under centralization with identical signals (\(p(1,1)\)).’ It is this ‘full incentives/delegation’ which is implemented in this part of the proof.

\textsuperscript{10}I focus here on coordination issues caused by conflicting benefits or beliefs, and thus disregard awareness, equilibrium selection, and information issues, which are also important sources of coordination problems.
To study this effect formally, consider the model in section 2. Since the purpose of the analysis is to see what can or cannot be achieved (in terms of coordination) by appropriately allocating residual income, the analysis gets more transparent if we eliminate authority for now. To that purpose, assume that the principal somehow committed to delegation, i.e., $D_A$ will always be chosen by the agent. The principal thus relinquishes his right to decide (in stage $2a$) who will choose $D_A$. For simplicity, also assume that $\beta_c = 0$, so that the project revenue equals

$$R = d_A + d_P - \beta_c c_c (1 - C)$$

with income shares $\alpha$ and $(1 - \alpha)$.$^{11}$

Note that if the players could contract on the actions and the income rights (and a transfer) then they would always agree to coordinate. In other words, joint utility maximization always requires coordination. Absent the ability to contract on actions, the players could try to achieve coordination just by using incentives. In particular, they could try to allocate the income shares so that each player internalizes his effect on the coordination cost, $\beta_c c_c (1 - C)$, in a way that makes the players coordinate. The following proposition says that this is impossible, as long as $\alpha$ is not 0 or 1. In particular, it implies that whether the players end up coordinating or not is completely independent of the distribution of income $\alpha$.

**Proposition 3a** The players coordinate if and only if $\min_{i=A,P}(2\nu_i - 1) \leq \beta_c c_c$. This condition is independent of $\alpha$, as long as $\alpha \in (0,1)$.

**Proof:** To get coordination, at least one player must be willing to forgo his preferred course of action.$^{12}$ Player $i$, with share $\alpha_i$ of the project revenue, is willing to do so if

$$\alpha_i (1 - \nu_i) \geq \alpha_i (\nu_i - \beta_c c_c)$$

or $\beta_c c_c \geq 2\nu_i - 1$. This implies the proposition. $\blacksquare$

To clarify what is happening, it is useful to contrast this with an analogous model with private benefits. In particular, consider a standard private benefits model in which the players share a common prior $\mu > .5$ that the state is $S = x$, but player $i$ gets, apart from his share of the project revenue, a private benefit $B_i$ (which may be negative) when he undertakes $X$. Note that, for any given set of differing priors and for fixed $\alpha_i$, this private benefits model gives the same expected utilities as the differing priors model if we let $B_i = \alpha_i (\mu - \mu)$. In analogy to before, assume that $B_1 > 0 > B_2$ so that the players’ private preferences conflict. The following proposition now says that, for given $\mu$ and $B_i$, the coordination problem can always be solved by an appropriate choice of $\alpha$.

**Proposition 3b** In the model with private benefits and for given $\mu$ and $B_i$, whenever coordination is efficient there exists some $\alpha$ that implements coordination.

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$^{11}$Note that, once the principal has committed to delegation and for given $(w, \alpha)$, there is actually no reason any more to call one player the principal and the other the agent. I keep the same terminology to make it easy to compare to the original model and interpret the results in that context.

$^{12}$If both are willing to forgo their preferred course of action, then it will (in this model) always be the second-mover who will get his less-preferred outcome, independent of who has the stronger beliefs. If neither is willing to forgo his preferred course of action, then there will be no coordination.

$^{13}$Obviously, the correspondence between the two models gets lost when the $\alpha_i$ change, which is exactly what drives the difference between the differing priors case, where the ‘equivalent private benefits’ are embodied in the residual income, and the private benefits case, where they are private.
Proof: Let $b_i = |B_i|$. The total payoffs are

- if both do X: $2\nu + b_1 - b_2$
- if both do Y: $2(1 - \nu)$
- if 1 does X and 2 does Y: $1 + b_1 - \beta c_c$

The social efficient solution is to

- do both X if $2(2\nu - 1) + b_1 \geq b_2$ and $(2\nu - 1) \geq b_2 - \beta c_c$, or $(2\nu - 1) \geq \max \left( \frac{b_1 + b_2}{2}, b_2 - \beta c_c \right)$
- do both Y if $b_2 \geq 2(2\nu - 1) + b_1$ and $0 \geq (2\nu - 1) + b_1 - \beta c_c$, or if $(2\nu - 1) \leq \min \left( \frac{b_1 + b_2}{2}, \beta c_c - b_1 \right)$
- do different things if $b_2 \geq \beta c_c + 2\nu - 1$ and $2\nu - 1 + b_1 \geq \beta c_c$, or $\beta c_c \leq \min (2\nu - 1 + b_1, b_2 - (2\nu - 1))$

Consider first the case that ‘both do X’ is socially optimal. In order to implement this, we need that $\alpha_1 [(2\nu - 1) + \beta c_c] + b_1 \geq 0$ and $\alpha_2 [(2\nu - 1) + \beta c_c] \geq b_2$. We can definitely find $\alpha_1$ to implement this if $(2\nu - 1) + \beta c_c + b_1 \geq b_2$. The fact that ‘both X’ is socially optimal does imply that $(2\nu - 1) + \beta c_c \geq b_2$, so that this is indeed possible. For example, $\alpha_1 = 0$ will implement this.

Consider next the case that ‘both do Y’ is socially optimal. In order to implement this, we need that $\alpha_1 [(2\nu - 1) - \beta c_c] + b_1 \leq 0$ and $\alpha_2 [(2\nu - 1) - \beta c_c] \leq b_2$. We can definitely find $\alpha_2$ to implement this if $(2\nu - 1) - \beta c_c + b_1 \leq b_2$, or $2\nu - 1 \leq b_2 + \beta c_c - b_1$. The latter is implied by the condition for social optimality of ‘both Y’ that $2\nu - 1 \leq \beta c_c - b_1$. For example, $\alpha_1 = 1$ will implement this.

Consider finally ‘do different things’ being optimal. In order to implement this, we need that $\alpha_1 [2\nu - 1 - \beta c_c] + b_1 \geq 0$ and $b_2 \geq \alpha_2 [2\nu - 1 + \beta c_c]$. Again, $\alpha_1 = 0$ will implement this since we get as conditions $b_1 \geq 0$ and $b_2 \geq (2\nu - 1) + \beta c_c$ which is implied by social efficiency. This completes the proof.

To see the intuition behind these contrasting results, consider what happens in the case of private benefits. Each player’s action choice exerts an externality on the other player through its impact on the project revenue. Shifting project revenue to a player has two effects: it makes that player care more, not only about his miscoordination externality, but also about the course of action he ends up taking, and these two effects exactly cancel each other out. Another way to see this is that with differing priors, the residual income is the embodiment of the private benefits. As a consequence, shifting residual income simultaneously changes the corresponding private benefits. And in this case, the change in corresponding private benefits goes exactly opposite to what the parties desire to achieve.

In the differing priors model, on the contrary and as mentioned earlier, allocating more residual income to a player makes that player care more, not only about his miscoordination externality, but also about the course of action he ends up taking, and these two effects exactly cancel each other out. Another way to see this is that with differing priors, the residual income is the embodiment of the private benefits. As a consequence, shifting residual income simultaneously changes the corresponding private benefits. And in this case, the change in corresponding private benefits goes exactly opposite to what the parties desire to achieve.

The second result of this section is that the principal will only enforce, or need to enforce, her decisions at intermediate costs of miscoordination. The reason is that when miscoordination is very damaging to the project then the agent has independent incentives to coordinate (if the agent somehow cares about the outcome), which then reduces the need to enforce authority. At low levels of miscoordination costs, this independent incentive is insufficient to cause effective coordination, so that it is necessary to enforce the principal’s decisions to get coordination. But low levels of miscoordination costs also mean that there is little to gain from coordination, so that the gain from enforcement is low. At the other extreme, when miscoordination costs are very high, the incentives for autonomous coordination become sufficient to cause effective coordination. In the differing priors model above, for example, the players coordinated autonomously if $\beta c_c \geq \min_{i=1,2} (2\nu_i - 1)$.
High levels of miscoordination costs \( c_e \) then reduce the need for enforcing the principal’s decisions. Overall, the need for enforcement is thus indeed highest at intermediate levels of \( \beta_e c_c \).

To see simultaneously both results, i.e., the use of authority at high levels of \( \beta_e c_c \) and the use of enforcement at intermediate levels of \( \beta_e c_c \), consider the model of section 2 with probability of success

\[
\Pi = d_A + d_P - \beta_e c_c (1-C) - \beta_e(1-e) d_A
\]

where \( C = 1_{D_A = D_P} \) is the indicator function that \( D_A \) and \( D_P \) are coordinated (‘Coordinated’). Let \( \gamma_c = \beta_e c_c \) and let \( F \) be the indicator function that \( P \) needs to enforce her decisions, i.e., that \( A \) would disobey \( P \) if he had the chance. The following proposition says that, for exogenously given \( \alpha \), increasing \( \gamma_c = \beta_e c_c \) leads to more coordination (\( C = 1 \)) and less decentralization (\( \hat{J}_A = P \)). Enforcement of \( P \)’s decisions (\( F = 1 \)), however, is necessary only at intermediate levels of \( \gamma_c \).

Moreover, all the cutoff levels are independent of \( \alpha \), which means that incentives are completely ineffective to achieve coordination.

**Proposition 4** For any \((\nu_A, \nu_P, \alpha, \beta_e, c_e)\), there exist \( \gamma_1, \gamma_2, \gamma_3, \gamma_4 \) (which may sometimes be \( \infty \)) such that

- \( C = 1 \) iff \( \gamma_c \geq \gamma_1 \)
- \( \hat{J}_A = P \) iff \( \gamma_c \geq \gamma_2 \)
- \( F = 1 \) iff \( \gamma_3 \leq \gamma_c \leq \gamma_4 \)

The \( \gamma_1, \gamma_2, \gamma_3, \) and \( \gamma_4 \) are independent of \( \alpha \).

**Proof:** As before, it will suffice to show this for each of the following (mutually exclusive, collectively exhaustive) cases:

1. \( c_e \geq \sqrt{2\alpha \nu_A} \) so that \( A \) never exerts effort,
2. \( c_e \leq \sqrt{2\alpha(1-\nu_A)} \) so that \( A \) always exerts effort, and
3. \( \sqrt{2\alpha \nu_A} \geq c_e \geq \sqrt{2\alpha(1-\nu_A)} \) so that \( A \) exerts effort iff \( D_A = Z_A \).

In case 1 (where \( e = 0 \)), \( P \) will always make sure that \( D_A = Z_P \) and \( C = 1 \), so that \( \gamma_1 = 0 \) and \( \gamma_2 = 0 \).

Enforcement will be necessary \( (F = 1) \) if (and only if) \( A \) prefers \( Z_A \) rather than \( Z_P \), which is when \( (1-\beta_e)\nu_A - \beta_e c_c \geq (1-\beta_e)(1-\nu_A) \) or \( (1-\beta_e)(2\nu_A - 1) \geq \beta_e c_c \) so that \( \gamma_3 = 0 \) and \( \gamma_4 = (1-\beta_e)(2\nu_A - 1) \).

Case 2 (where \( e = 1 \)) is completely analogous, except that \( \gamma_4 = 2\nu_A - 1 \).

Consider now case 3 (where \( e = 1 \) iff \( D_A = Z_A \)). The principal has the following choices:

- a. \( D_A = D_P = Z_P \), but \( e = 0 \) when \( Z_A \neq Z_P \): \( U_P = (1-\alpha)(2 - \frac{\beta_e}{2}) \nu_P \)
- b. \( D_P = Z_P, D_A = Z_A \), and \( e = 1 \): \( U_P = (1-\alpha)(\nu_P + \frac{\nu_P + (1-\nu_P)(1-\beta_e)}{2}) = (1-\alpha)(\nu_P + \frac{1-\gamma_c}{2}) \).

Note that case 3a dominates case 3b if and only if \( (2 - \frac{\beta_e}{2}) \nu_P \geq (\nu_P + \frac{1-\gamma_c}{2}) \) or \( \gamma_c \geq 1 - (2 - \beta_e) \nu_P = \beta_e \nu_P - (2\nu_P - 1) = \gamma \). With respect to enforcement within cases 3a and 3b, note that in both cases \( A \) prefers \( Z_A \) iff

\[
\alpha((1-\nu_A) + \nu_A - \gamma_c) - \beta_e e_c^2/2 \geq \alpha((1-\nu_A) + (1-\beta_e)(1-\nu_A))
\]

\[14\text{Remember that beliefs are private information. As a consequence, } \hat{J}_A = P \text{ even when the agent is willing to obey the principal without any enforcement.}\]
or \( \gamma_c \leq \hat{\gamma} = 2\nu_A - 1 + \beta_e (1 - \nu_A) - \frac{\beta_e e^2}{\alpha} \) so that enforcement is necessary in case 3a only if \( \gamma_c \leq \hat{\gamma} \) and in
case 3b only if \( \gamma_c \geq \hat{\gamma} \).

I now finish the proof for case 3. If \( \beta_e \leq (2\nu_P - 1)\nu_P \), then \( \tilde{\gamma} \leq 0 \) and 3a always dominates 3b, so that
\( \gamma_1 = \gamma_2 = 0 \). Moreover, \( \gamma_3 = 0 \) and \( \gamma_4 = \hat{\gamma} \). If \( (2\nu_P - 1)\nu_P \leq \beta_e \), then 3a dominates 3b iff \( \gamma_c \geq \hat{\gamma} \geq 0 \), so
\( \gamma_1 = \gamma_2 = \hat{\gamma} \). Moreover, enforcement is needed iff \( \gamma_c \in [\min(\tilde{\gamma}, \hat{\gamma}), \max(\tilde{\gamma}, \hat{\gamma})] \). This proves the proposition.

While this result says that no enforcement of authority will be necessary when coordination is
very important (since the players will self-coordinate), there are a few important caveats to this result.
First of all, it does assume and require that the players all care about the overall project outcome.
Second, the players have to find a way to coordinate on the same action, which is non-trivial since
there are typically multiple equilibria. In the model, the latter issue was absent since the principal
chose first. The absence of such sequencing would make coordination more difficult. Finally, when
coordination does happen, the principal will want to make sure that they coordinate on the action
that she believes is best. If she cannot impose this through choosing first, then she has even more
reasons to enforce her decisions. This requires further research.

5 Putting it all together: Coordination versus Motivation

From an organization design perspective, one of the key implications of the preceding analysis
is that the need to allocate authority induces a trade-off between motivation and coordination.
In particular, in the typical case that effort and decisions are complements, centralized decision-
making gives strong coordination but weak motivation, while decentralized decision-making gives
weak coordination but strong motivation. Assigning decision rights thus forces a choice between
motivation and coordination.

One way to think about this trade-off is in terms of a motivation-coordination ‘possibility
frontier’ (Roberts 2004). Such possibility frontier shows the maximum degree of coordination as a
function of the desired level of motivation for a given amount of resources spent. A down-sloping
possibility frontier indicates a trade-off between motivation and coordination.

For the model of section 2, the possibility frontier can be derived directly from the analysis
of the preceding sections. In particular, in the context of that model, the frontier captures the
maximum probability of coordination as a function of the desired probability of agent-effort, for a
given level of agent-incentives \( \alpha \). One such frontier for the model is represented in figure 2. Note
that, since the frontier just represents possibilities without reference to their relative benefits, this
graph is independent of the importance of effort or coordination. The relationship of this frontier
to the equilibrium outcome is as follows. For a given frontier, i.e., for a given \( \alpha \), the principal
essentially picks a motivation-coordination point on the frontier (by his choice of delegation). The
choice of \( \alpha \) in the first stage determines from which frontier the principal can choose. Note also
that I define the ‘probability of coordination’ here to be the probability that the principal’s actions
are such that there will always be coordination.15

The fact that the possibility frontier is downward sloping can be derived formally. Let the
function \( P_c(P_e) \) denote the maximum probability of coordination if the desired probability of effort

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15When the principal delegates, the parties will obviously also happen to coordinate from time to time, but this
is pure coincidence rather than on purpose. Using the wider definition of ‘probability of coordination’ to be the
probability that there happens to be ex-post coordination, simply requires a transformation of variable that preserves
all results and graphs (up to the rescaling).
is $P_e$. The following proposition essentially combines the earlier delegation and coordination results.

**Proposition 5** For any $(\nu_A, \nu_P, \alpha, w)$, $P_c(P_e)$ decreases in $P_e$.

**Proof**: Remember that

1. If $c_e \leq \sqrt{2\alpha(1 - \nu_A)}$ then $A$ will always exert effort, and $P$ can always ensure coordination.
2. If $c_e \geq \sqrt{2\alpha \nu_A}$ then $A$ will never exert effort, so $P$ can again always ensure coordination without affecting effort.
3. If $\sqrt{2\alpha(1 - \nu_A)} \leq c_e \leq \sqrt{2\alpha \nu_A}$ then $A$ will exert effort if and only if $D_A = Z_A$. By randomizing between $Z_A$ and $Z_P$, $P$ can choose any probability of coordination $P_c$. But the probability of effort will necessarily be $P_e = 1 - P_c$.

Consider first the case that $\sqrt{2\alpha(1 - \nu_A)} < 1$. For $P_e \leq \sqrt{2\alpha(1 - \nu_A)}$, we then have $P_c = 1$. For $\sqrt{2\alpha(1 - \nu_A)} \leq P_e \leq \min(\sqrt{2\alpha \nu_A}, 1)$, $P_c$ will be a strictly decreasing function with slope $-1$. For $P_e > \sqrt{2\alpha \nu_A}$, $P_c$ drops to zero, since these values of $P_e$ are impossible. In the case that $\sqrt{2\alpha(1 - \nu_A)} \geq 1$, the $P_c = 1$ for all values of $P_e$. This concludes the proposition.

This perspective on the motivation-coordination trade-off focuses on within-firm comparisons. A different way to think about the trade-off is to look at a population of firms and see whether motivation and coordination are negatively correlated across firms. The following proposition does that, and more. It shows that in firms where effort is more important and/or coordination is less important, delegation will be high, effort will be high, and coordination will be low, and vice versa. It also shows that, as a consequence, there will be a negative tradeoff between effort and coordination.
in the population. Let \( P_d, P_c \) and \( P_e \) denote respectively the equilibrium probability of delegation, coordination, and effort.

**Proposition 6** For any \( \nu_A, \nu_P \),

- \( P_d \) increases in \( \beta_e \) and decreases in \( \beta_c \).
- \( P_c \) decreases in \( \beta_e \) and increases in \( \beta_c \).
- \( P_e \) decreases in \( \beta_c \) and increases in \( \beta_e \).

For a given \( \beta_e \) and for \( \beta_c \sim F \) for any \( F \) with \( \text{supp} F \subset [0, 1 - \beta_c] \), \( P_c \) decreases in \( P_e \).

For a given \( \beta_c \) and for \( \beta_e \sim F \) for any \( F \) with \( \text{supp} F \subset [0, 1 - \beta_e] \), \( P_e \) decreases in \( P_c \).

For \( \beta_e = k - \beta_c \), with \( k \in [0, 1] \), and \( \beta_c \sim F \), with \( \text{supp} F \subset [0, k] \), \( P_c \) decreases in \( P_e \).

**Proof**: The proof is in appendix.

Figure 3 represents this graphically. In particular, it depicts the probabilities of effort and coordination for 20,000 ‘firms’ for which \( (\beta_e, \beta_c) \) were randomly drawn from the \([ (0,0), (1,0), (0,1) ] \) triangle. Note that this is now not a possibility frontier any more, but an equilibrium outcome. It is clear that there is a strong trade-off between motivation and coordination across firms.\(^{16}\)

### 6 Discussion

#### 6.1 Additional Effects of Differing Priors on Motivation and Coordination

An important simplifying assumption in this paper is that the principal can simply choose whether to centralize or decentralize the decision \( D_A \), at no cost. However, nearly any decision must get executed by an agent, who can, at least in principle, choose not to follow the (centralized) decision. In some cases, this issue is of little concern since the agents have no reason to deviate from the centralized decision and since the principal has simple means for enforcing her decision. When, for example, a dean raises a faculty’s salary, the school’s administrative staff is unlikely to refuse to implement that decision. If so, we can simply assume that decision rights get allocated by contract or by fiat. In important other cases, however, an agent may have reasons to disobey the principal and enforcing obedience may then be more problematic. When the same dean decides how his faculty should teach their classes, he may have a much more difficult time enforcing obedience. In that case, ensuring centralization may be costly and may have important implications in and of itself.

Van den Steen (2005c) shows how this issue of compliance may introduce an additional effect to motivation-coordination trade-off. In particular, strong incentives may give the agent more reason to disobey his principal’s orders when the two of them disagree on the right course of action. This strengthens obviously the trade-off between motivation and coordination: to get the agent to exert more effort, the principal needs to give more incentives, but this reduces his control over the agent and thus reduces the coordination that is possible.

There is one further effect of differing priors that indirectly affects the trade-off between motivation and coordination. Van den Steen (2006) shows that shifting the residual income to one

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\(^{16}\)This can potentially also be interpreted as within-firm comparisons: we could imagine that a firm is faced with 20,000 projects that each have a different weight on motivation and coordination (i.e., different \( \beta_e \) and \( \beta_c \)). The data then represent the motivation/coordination equilibrium outcomes for each of these project. Moreover, the ‘across-firm’ interpretation seems to fit better.
person makes it efficient to also allocate more control rights to that person, and vice versa. This is due to a combination of two effects. On the one hand, shifting control rights to a person makes that person value the income rights higher, by revealed preference. On the other hand, shifting income rights to a person makes that person value the control rights higher, since they affect his utility more. This co-location of authority and income rights implies that giving a person incentives (to increase effort) will make it more attractive to also delegate that person more decision rights, but that will lead to less coordination. Although the effect is indirect, it is another force in the motivation-coordination tradeoff. The assumption of limited liability for the agent essentially eliminated this effect from the analysis.

6.2 Is the trade-off unavoidable?

Given the importance of this trade-off, does the theory suggest any way to get around it? And if the theory does suggest such a way, why don’t all firms use it, and so why would we still observe the tradeoff?

The theory actually does suggest a way to eliminate, or at least mitigate, the trade-off: hire

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16As Van den Steen (2006) shows, this intuitive mechanism requires differing priors and does not hold in an analogous model with common priors but private benefits. First, with common priors all players value an income stream identically, which eliminates the first effect. Second, private benefits and residual income from a project may require conflicting decisions, in which case a player may value control less when his private benefits become more important.
agents who agree with the principal on the right course of action. Increasing the degree of agreement between principal and agent has a double effect. On the one hand, the agent will be more motivated when decisions are centralized since he often agrees with the principal’s decision and thus expects a high return on his effort. On the other hand, delegation leads to fewer coordination problems since the agent will more often choose the same course of action as the principal.

The idea that a high degree of homogeneity allows to combine high coordination with strong motivation is in line with some of the ideas in the management literature. In particular, ‘corporate culture’ has often been interpreted as shared beliefs or shared values (Schein 1985, Van den Steen 2005b) and the ability to motivate people in a coordinated way has been mentioned as one of its important advantages (Kotter and Heskett 1992).

So why wouldn’t all firms do this? The answer to this question is two-sided. On the one hand, firms definitely do this, to some degree. In particular, firms sort explicitly in their hiring process for employees who ‘fit’, and fit is in part about the employees’ beliefs and values. Employees also self-sort: employees who get forced to follow a course of action that they believe will lead to failure may simply quit when they care about the outcome. Both sorting and self-sorting, however, are difficult and expensive. Self-sorting is in essence turnover, which causes an immediate destruction of firm specific human capital and of organizational capital. Sorting by the firm is hindered by the fact that many beliefs are implicit and moreover easy to misrepresent. Finally, shared beliefs and values also have negative effects, e.g. by reducing the incentives to collect information and to experiment.

Overall, only firms who really need simultaneously high levels of coordination and high levels of motivation, and who can live with the downsides of a high degree of homogeneity, should follow this path. As a consequence, the trade-off will remain even though solutions are available.

7 Comparison to other papers on the motivation-coordination trade-off

As mentioned in the introduction, there are two other papers that deal (directly or indirectly) with the motivation-coordination trade-off.

To my knowledge, the first formal economics paper on the trade-off between motivation and coordination is Athey and Roberts (2001), who study the conflict between effort and correct decisions in the presence of externalities, which includes coordination as a special case. Their argument is as follows. Imagine a situation where an agent has to spend effort that increases his own output, but the agent also has to make a decision that affects both his own output and that of others. If the firm wants to raise the agent’s effort, it needs to increase the pay-for-performance on the agent’s own output. However, in order to get optimal decisions in the presence of externalities, equal weight should be put on all the output-components that are affected by that decision, i.e., incentives should be balanced. Ideally the firm would thus also want to raise the agent’s pay-for-performance on the others’ output. But doing so is costly since it exposes the agent to more risk. As a consequence, increasing effort will in equilibrium lead to more distorted decisions.

Dessein, Garicano, and Gertner (2005) study how organizing a firm along functional or product lines affects the implementation of synergies, which again includes coordination as a special case. The central result (from the perspective of the current paper) is again that coordination requires balanced incentives, and thus reduces effort, with the cost of giving incentives now coming from the budget balance constraint. In their paper, however, there are two mechanisms that drive the need for balanced incentives. While the first mechanism is similar to that in Athey and Roberts
(2001), they also have the interesting new result that raising pay-for-performance on the agent’s own output will reduce communication about potential externalities. This communication effect thus introduces a second important trade-off. Finally, their analysis also shows that changing decision structures without simultaneously changing incentives may be futile, and illustrate that point with applications.

Both these papers are very different from the current one. One key distinction is that in both Athey and Roberts (2001) and Dessein, Garicano, and Gertner (2005), the allocation of control has no direct effect (other than through the intensity of incentives) on the agent’s effort or motivation. In other words, after controlling for incentives, delegation does not play a role in the agent’s motivation and the trade-off disappears. This distinguishes these two models from this paper’s both in terms of mechanisms and in terms of empirical implications. With respect to coordination, both papers rely to a large extent on the externality-internalizing effects of residual income, which I show explicitly to be completely ineffective in this paper. Furthermore, there are also obvious differences in the underlying mechanisms such as the role of private information versus differing priors.

8 Conclusion

This paper studied how open disagreement affects the delegation/centralization decision when the firm cares about both motivation and coordination. I first derived a new rationale for delegation: delegation increases motivation when effort and correct decisions are complements since the agent thinks that his own decisions are better than those of the principal. A need for implementation effort will thus lead to more decentralization. The opposite is true when effort and decisions are substitutes.

I then turned to coordination and showed that coordination problems caused by differing priors require more reliance on authority (as opposed to incentives) than coordination problems caused by private benefits. The reason here is that while incentives make the agent care more about coordination, that effect gets counter-acted by the fact that incentives give the agent more reasons to follow his own beliefs. In this paper, these two effects exactly cancelled each other out. I also showed that the principal will (need to) enforce her decisions only at intermediate levels of the need for coordination.

The combination of these results implied a trade-off between motivation and coordination. This trade-off is one of the key challenges in organization design.
A Proofs

Proof of Proposition 6: Remember the cases 1, 2, 3a, and 3b of the proof of proposition 4. Let \( \tilde{\gamma} \) again be such that 3a dominates 3b iff \( \gamma_c \geq \tilde{\gamma} \), let \( \tilde{c} = \frac{c}{\beta_c} \) or

\[
\tilde{c} = \frac{1 - (2 - \beta_c)\nu_P}{\beta_c} = \frac{1 - 2\nu_P + \beta_c\nu_P}{\beta_c}
\]

and let \( \tilde{c} \) be its restriction to \([0, 1]\), i.e., \( \tilde{c} = \max(0, \min(1, \tilde{c})) \). We then have that

\[
P_d = \left( \sqrt{2\alpha\nu_A} - \sqrt{2\alpha(1 - \nu_A)} \right) \tilde{c} = \sqrt{2\alpha} \left[ \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right] \tilde{c}
\]

\[
P_c = 1 - P_d
\]

\[
P_c = \sqrt{2\alpha(1 - \nu_A)} + \left( \sqrt{2\alpha\nu_A} - \sqrt{2\alpha(1 - \nu_A)} \right) \tilde{c} = \sqrt{2\alpha} \left[ \sqrt{(1 - \nu_A)} + \left( \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right) \tilde{c} \right]
\]

For the first 3 parts of the proposition, it thus suffices to show that \( \alpha \) and \( \tilde{c} \) both increase in \( \beta_c \) and decrease in \( \beta_c \). For \( \tilde{c} \), this is trivial. For \( \alpha \), define

\[
Y = \int_0^{\tilde{c}} (\nu_P + 1 - \frac{\beta_c}{2}) d\nu + \int_{\tilde{c}}^1 (2 - \frac{\beta_c}{2}) \nu_P d\nu
\]

so that

\[
U_P = (1 - \alpha) \left\{ \sqrt{2\alpha(1 - \nu_A)}2\nu_P + (1 - \sqrt{2\alpha\nu_A}(2 - \beta_c)\nu_P + \left( \sqrt{2\alpha\nu_A} - \sqrt{2\alpha(1 - \nu_A)} \right) \nu \right\}
\]

\[
= (1 - \alpha)(2 - \beta_c)\nu_P + (1 - \alpha)\sqrt{2\alpha} \left( \sqrt{(1 - \nu_A)}2\nu_P - \sqrt{\nu_A}2\nu_P + \left( \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right) \nu \right)
\]

Note that \( \frac{dY}{d\alpha} = -\frac{\nu_P}{4} (1 - \tilde{c}) \) and \( \frac{dY}{d\beta_c} = -\frac{\tilde{c}^2}{4} \). Note further that

\[
\frac{dU_P}{d\alpha} = -(2 - \beta_c)\nu_P + \frac{1 - 3\alpha}{\sqrt{2\alpha}} \left( \sqrt{(1 - \nu_A)}2\nu_P - \sqrt{\nu_A}2\nu_P + \left( \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right) \nu \right)
\]

so that at the optimum \( \alpha < \frac{1}{3} \) (where I use the fact that \( 2\nu_P \geq Y \geq (2 - \beta_c)\nu_P \) to sign the last factor of the derivative above).

It also follows that

\[
\frac{\partial^2 U_P}{\partial \alpha \partial \beta_c} = \nu_P + \frac{1 - 3\alpha}{\sqrt{2\alpha}} \left( \sqrt{\nu_A}2\nu_P + \left( \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right) \left( \frac{\nu_P}{2} (1 - \tilde{c}) \right) \right)
\]

or

\[
\frac{\partial^2 U_P}{\partial \alpha \partial \beta_c} = \nu_P + \frac{1 - 3\alpha}{\sqrt{2\alpha}} \left( \sqrt{\nu_A} \left( \nu_P - \frac{\nu_P}{2} (1 - \tilde{c}) \right) + \sqrt{(1 - \nu_A)} \frac{\nu_P}{2} (1 - \tilde{c}) \right) > 0
\]

and further

\[
\frac{\partial^2 U_P}{\partial \alpha \partial \beta_c} = \frac{1 - 3\alpha}{\sqrt{2\alpha}} \left( \sqrt{\nu_A} - \sqrt{(1 - \nu_A)} \right) \left( -\frac{\tilde{c}^2}{4} \right) < 0
\]

The last part of the proof follows directly.
References