

LEADERSHIP, COORDINATION AND MISSION-DRIVEN MANAGEMENT: APPENDIX (NOT FOR PUBLICATION)

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1 Foundations for Preferences

This appendix provides a set of foundations that explain why leaders and followers might have objective functions posited in the main text. Specifically, it attempts to explain why followers would want to choose actions that are well-aligned with the leader's action as a way to maximize the value of their human capital and why firms cannot write contracts with followers that induce them to coordinate optimally. The contracting friction is that firms can commit to current, but not future pay schedules. In other words, contracts must be renegotiation-proof. This is the same friction that the main paper considers in the relationship between a leader and a board in section

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3.

A model of product development and production with learning-by-doing.

There are two stages in the process of bringing a new good (or service) to market: a development stage and a production stage. It is during the development stage that leaders and followers are uncertain about the nature of the product that will ultimately be sold. Two things are important to the firm's success in this first stage: strategy and execution. The strategic challenge is to develop the right good, the one that will attract the highest consumer demand at the time it is sold. This is challenging because the market and consumer tastes are constantly changing, so new information about the optimal product is arriving during product development. The leader's choice of action a_L represents this choice of what good to develop. The ideal good is not likely to be an extreme good in any dimension, but typically balances some trade-offs. In other words, the leader is searching for an interior optimum, or bliss point. Payoffs with such a bliss point are typically represented as quadratic loss functions where the loss depends on the squared distance between the good chosen and the optimal good. (See e.g. Wilson (1975).) In our model, θ represents this optimal good. Thus, the strategic component of the firm's payoff is $-(a_L - \theta)^2$.

The second challenge in the development stage is to execute the design well. The firm may choose to make exactly the product that the market now demands, but if the product is poorly designed, it may still fail. A good product design must seamlessly integrate many product features. Since no one worker can develop and refine every feature, workers must cooperate in teams to achieve a coherent design. (A large management literature on operation systems considers such problems. Seminal papers include Marschak and Radner (1972) and Radner and Zandt (2001).) A typical way to represent such coordination problems is with a quadratic loss for deviating from the average action: $-\int (a_i - \bar{a})^2 di$ (see e.g., Morris and Shin 2002).

In production (stage 2), workers' efficiency depends on the skill that they have

acquired in the product development stage. If the worker spent his time developing exactly the product that was eventually produced, his skill set is ideal. He knows exactly the ins and outs of the product and can produce it with maximum efficiency. If he instead worked on a related technology that is similar to, but not identical to the one actually implemented, then his skills are moderately relevant and he can produce with medium efficiency. In other words, worker's marginal product diminishes as the distance between the action they took a_i and the leader's eventual choice of strategic direction for the firm a_L grows. An example of such a marginal product is

$$MP_i = m - (a_i - a_L)^2$$

This is an example of workers who are learning-by-doing in the first stage. The convention of using quadratic loss production functions appears in well-known papers on learning-by-doing such as Jovanovic and Nyarko (1996). While the worker's payoff depends on his own marginal product, firm efficiency depends on the average marginal product, $m - \int (a_i - a_L)^2 di$.

Putting these three payoffs together yields an objective function for the firm that is $-(a_L - \theta)^2 - \int (a_i - \bar{a})^2 di - \int (a_i - a_L)^2 di$, plus a constant. Maximizing this function is equivalent to maximizing the firm's objective function in the paper's main text.

Wage bargaining. Followers are paid at the beginning of the first stage. Then, after product development takes place, the firm can observe the actions of each follower and pay them again at the start of the second stage. One might wonder why firms cannot simply write contracts that induce followers to coordinate optimally. Since coordination yields firm-specific benefits, it is like acquiring firm-specific capital. F& H shows that wage bargaining in such a situation can achieve efficient outcomes. The difference is that our firm suffers from a commitment problem. It can promise high future wages and then fire workers who have coordinated well but are unproductive. In such a setting,

the efficient contract is not renegotiation-proof.

At the start of the first stage, the firm does not observe the workers' private signals. Since all workers appear identical, they are paid a fixed amount. At the start of stage 2, the firm does observe each worker's marginal productivity. The lack of commitment means that each period, the firm writes a contract that maximizes future expected profit. Profit is maximized by hiring all workers that have a marginal product greater than or equal to their wage. The wage is determined by Nash Bargaining. The outside option for the firm is not hiring the worker and getting 0 marginal product. The outside option for the worker is not working and getting 0 payoff as well. Thus the match with worker i produces surplus MP_i . The Nash bargaining solution is that if all workers have the same, non-zero bargaining weight vis-a-vis the firm, then each worker gets paid a fixed positive fraction of their marginal product: $w_i = \alpha MP_i$.

If each worker chooses actions in stage one to maximize their total wage, they will want to maximize the expected value of a constant minus $\alpha(a_i - a_L)^2$, for $\alpha > 0$. Maximizing this expected wage is equivalent to maximizing the first stage objective function in the model of the main text because the only term in the objective that workers have any influence over is the $(a_i - a_L)^2$ term.

The friction undermining optimal contracting does not have to be a lack of commitment. Another way one might justify the inability of firms to punish non-cooperative workers is to write down a competitive market with multiple firms who produce similar products in the second stage. If other firms can hire away productive workers, then workers will still have an incentive to align a_i with a_L in order to maximize their productivity and obtain a high outside wage offer from a competing firm. Even if their own firm threatens to diminish their future wage for lack of cooperation, they cannot implement that punishment if the follower leaves to work for another employer.

Timing assumptions The assumption that followers have to choose their actions a_i before the leader sees his signal and chooses the final direction for the firm a_L can be

relaxed. For example, the second-stage marginal product of the follower might depend on all the actions he has taken between time 0 and time 1: $\int_0^2 -(a_i(t) - a_L)^2 dt$. Even if the follower can adjust his action at every moment in time, he will still want to anticipate what the optimal action will turn out to be so that he can spend as much time as possible developing that optimal skill.

The first order condition of this objective will be $a_i(t)^* = E_i[a_L]$ where $E_i[a_L]$ depends in part on private information. Thus, even when followers can continuously adjust their actions, heterogeneous private information still undermines coordination.

References

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